EVALUATION OF A SOCIAL COGNITIVE THEORY-BASED ADOLESCENT PHYSICAL ACTIVITY INTERVENTION: PLAN FOR EXERCISE, PLAN FOR HEALTH

DISSERTATION

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By

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ABSTRACT

Regular physical activity plays an influential role on morbidity and mortality, particularly within the areas of obesity and cardiovascular disease prevention. The development of programs to increase physical activity levels has the potential to attenuate the health and economic burden that physical inactivity places on our nation. The purpose of the study was to conduct an impact evaluation of the *Plan for Exercise, Plan for Health* intervention. The physical education, health, and/or life-skills teachers from three high schools within the Appalachian region of Ohio implemented the 9-week physical activity curriculum as an integrated unit within their classes; a fourth school served as a comparison school. Multiple regression models were developed to determine whether the intervention could predict changes in the frequency of adolescent physical activity behavior, whether changes in the targeted SCT constructs contributed to the models, and whether changes in the constructs mediated changes in behavior. The intervention explained a greater portion of the variance in changes in moderate physical activity at two of the intervention schools ($R^2 = 0.353$; $R^2 = 0.40$) than the comparison school ($R^2 = 0.287$) but a non-significant portion of the variance at the third intervention school ($R^2 = 0.136$). Subgroup analysis indicated that the intervention was particularly effective at impacting moderate physical activity among previously inactive adolescents; descriptive statistics indicate an increase in the frequency of moderate physical activity and an increase in the SCT construct scores among intervention students. Regression models were able to explain 24 – 78% of the variance in changes in moderate physical activity within intervention schools. Self-regulation and social support contributed to the models and were found to mediate changes in moderate physical activity. There were no changes in the frequency of vigorous physical activity over the course of the study. Results support the efficacy of the *Plan for Exercise, Plan for Health* intervention at changing adolescent moderate physical activity, particularly among previously inactive students.

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1. Suminski, R.R., Poston, W., Petosa, R., Stevens, E, Katzenmoyer, L. (2005). Features of the Neighborhood Environment and Walking by US Adults. *American Journal of Preventive Medicine*, 28(2): 149-155.

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INTRODUCTION

Physical Activity and Health

Regular physical activity plays an influential role on morbidity and mortality, particularly within the areas of obesity and cardiovascular disease prevention. Physical inactivity has a dose-response, temporally consistent, and biologically plausible relationship to the same physiological health outcomes of obesity (Blair & Church, 2004). The potential health benefits associated with reducing overweight and obesity are of considerable public health importance, as overweight and obesity have become a wide-spread epidemic in the United States. The National Health and Nutrition Examination Survey (NHANES), surveying a nationally representative sample of the US population, revealed increases in overweight and obesity among both men and women, in all age groups, and in all racial ethnic groups studied; between the 1988-1994 NHANES III and the 1999-2000 NHANES surveys, the prevalence of overweight increased from 55.9% to 64.5% and the prevalence of obesity (BMI $\geq$ 30) increased from 22.9% - 30.5% (Flegal, Carroll, Ogden, & Johnson, 2002). The number of deaths attributable to overweight and obesity has been increasing at an alarming level; in 2000, an estimated 494,921 people died of causes related to overweight and obesity (Mokdad, Marks, Stroup, & Gerberding, 2004). Between 1990 and 2000, the number of adult deaths attributable to poor diet and physical inactivity had the largest increase among all actual causes of death (Mokdad et al, 2004). The population attributable risk (PAR) for physical inactivity for cardiovascular disease mortality is 35%; this means that 35% of the deaths caused by cardiovascular disease could theoretically be prevented if physical activity levels were sufficient (Twisk, Kemper, & Van Mechelen, 2002).

Overweight and obesity place a burden on both the health and the economic status of our country. Overweight and obesity is related to several health problems, including: diabetes, hypertension, hypercholesterolemia, stroke, heart disease, certain cancers, arthritis, and fair or poor health status (Mokdad, Ford. Bowman, Dietz, Vinicor, Bales et al, 2003). The health care costs directly associated with obesity were estimated to be $70 billion in 1995; the direct costs associated with physical inactivity alone were $24 billion, or 2.4% of US health care expenditures (Colditz, 1999; Grundy, Blackburn, Higgins, Lauer, Perri, & Ryan, 1999). In 1998, medical costs associated with overweight and obesity increased to $78.5 billion (Finkelstein, Fiebelkorn, & Wang, 2003).

The development of programs to increase physical activity levels has potential to attenuate the health and economic impact that inactivity places on our nation. A meta-analysis conducted by Jesse A. Berlin and Graham A. Colditz (1990) revealed an association between a lack of physical activity and increased risk of coronary heart disease; this association was stronger when comparing highly active groups with sedentary groups than when comparing moderately active groups with sedentary groups. The study supported a dose-response relationship between physical activity and protection from coronary heart disease. The adoption and maintenance of regular physical activity is modifiable and provides protection from chronic disease, is used in the treatment of overweight and obesity, helps to maintain a positive health status among all populations, and could help to attenuate the direct medical costs associated with obesity and physical inactivity.

While the health and economic burden that inactivity places on our nation is well documented particularly among adults, overweight and obesity is also a growing problem among youth in our country. Evidence exists to support the use of physical activity programs to promote health and fitness and to reduce overweight and obesity among youth, as well as to prevent the development of obesity and cardiovascular disease risk as youth transition into adulthood. In 1999-2000, 15% of children and adolescents (ages 6-19) were overweight; this value is triple what the proportion was in 1980 (CDC, *Health Topics: Physical Activity*, 2004). The most recent Youth Risk Behavioral Surveillance results, reported in 2005, revealed that between 1999 and 2005 a significant linear increase occurred in the percent of high school students who were at risk for becoming overweight (14.4% - 15.7%) and who were overweight (10.7% - 13.1%)

(CDC, *YRBS*, 2006). Obese children and adolescents are more likely to become obese adults, and improvements in physical activity have been effective at preventing and treating overweight and obesity. Reviews conducted by Steven N. Blair and Suzanne Brodney (1999) and by Leonard H. Epstein and Gary S. Goldfield (1999) reveal that physical activity alone provides protection against several chronic diseases and is an effective treatment for overweight and obesity among youth.

Promoting physical activity among children and adolescents will not only help to prevent health problems; it will also help to promote health maintenance. The Center for Disease Control's *Promoting Better Health; A Report of the President* (2003) reports that physical activity among adolescents and young adults helps build and maintain healthy bones, muscles, and joints. It helps control weight, build lean muscle, and reduce fat. It prevents or delays the development of high blood pressure, it helps to reduce blood pressure in some adolescents with hypertension, and it reduces feelings of depression and anxiety.

The promotion of physical activity has been identified as one of the nation's 10 leading health indicators in *Healthy People, 2010*, the national health objectives for the nation. *Healthy People, 2010* provides a framework for prevention for the nation; it is a statement of national health objectives designed to identify the most significant preventable threats to health and to establish national goals to reduce these threats during this decade (Department of Health and Human Services, 2005). The overall reaching goals of *Healthy People 2010* are to increase quality and years of healthy life and to eliminate health disparities. Among the many objectives identified in *Healthy People, 2010*, several of them target increases in physical activity and physical fitness among children and adolescents. The following provides a list of the *Healthy People 2010* objectives relevant to increasing physical activity among children and adolescents (US Department of Health and Human Services, 2000):

- Increase the proportion of adolescents who engage in moderate physical activity for at least 30 minutes on 5 or more of the previous 7 days.
- Increase the proportion of adolescents who engage in vigorous physical activity that promotes cardio respiratory fitness 3 or more days per week for 20 or more minutes per occasion.
- Increase the proportion of trips made by walking.
- Increase the proportion of trips made by bicycling.
- Increase the proportion of the Nation's public and private schools that require daily physical education for all students.
- Increase the proportion of adolescents who participate in daily physical education.
- Increase the proportion of adolescents who spend 50% of school physical education class time being physically active.

- Increase the proportion of the Nation's public and private schools that provide access to their physical activity spaces and facilities for all persons outside of normal school hours.
- Increase the proportion of middle school, junior high, and senior high schools that provide comprehensive school health education to prevent health problems in the following areas: unintentional injury; violence; suicide; tobacco use and addiction; alcohol or other drug use; unintended pregnancy, HIV/AIDS, and STD infection; unhealthy dietary patterns; inadequate physical activity; and environmental health.

The link between physical activity and health is clear, and evidence from the literature supports the use of physical activity for health maintenance and disease prevention. If our sedentary society is to change to one that is more physically active, health organizations and educational institutions must communicate to the public the amount and types of physical activity that are needed to prevent diseases and to promote health (Pate, Pratt, Blair, Haskell, Macera, Bouchard, et al, 1995). Health educators must continue to develop, implement, and evaluate strategies to promote physical activity within schools and communities. Physical education curricula should provide youth with enjoyable experiences that build exercise self-efficacy, provide significant amounts of physical activity, and promote cognitive learning related to lifelong participation in physical activity (Pate et al, 1995). Only through the development of such strategies will the health objectives of the nation be met.

<u>Adolescent Rates of Physical Activity and Recommendations</u>

The Center for Disease Control and the American College of Sports Medicine developed physical activity recommendations for disease prevention and health promotion for both youth and adults. Based on the evidence linking physical activity to improvements in health and fitness, every US adult should accumulate 30 minutes or more of moderate-intensity physical activity on most, preferable all, days of the week (Pate et al, 1995). Adolescents and young adults should be physically active daily, or nearly every day, as part of play, games, sports, work, transportation, recreation, physical education, or planned exercise, in the context of family, school, and community activities. Further, adolescents should be physically active doing any kind of physical activity that increases their heart rate and makes them breathe hard some of the time for a total of at least 60 minutes per day on five or more days per week. (CDC, *YRBS*, 2006)

Too few adolescents are meeting the levels of physical activity recommended by health agencies for health maintenance and disease prevention. The Center for Disease Control (CDC) and Prevention's

Youth Risk Behavior Surveillance System (YRBSS) shows no change in adolescent physical activity levels among adolescents in grades 9-12 since 1993. Based on the YRBSS, a national school-based survey conducted by CDC, 68.7% of students nationwide had met previous physical activity guidelines of participating in at least 20 minutes of vigorous physical activity (physical activity that made them sweat and breathe hard) on 3 or more days of the previous week, or at least 30 minutes of moderate physical activity (physical activity that did not make them sweat or breathe hard) on five or more days during the 7 days preceding the 2005 survey (CDC, *YRBS*, 2006). 9.6% of students nationwide reported participating in no vigorous or moderate physical activity in the 7 days preceding the 2005 YRBS survey (CDC, *YRBS*, 2006). In 2003, 28.4% of students reported participating on physical education daily, a decrease from 41.6% in 1991 (CDC, YRBS, 2004). In 2005, 54.2% of high school students reported going to physical education classes on one or more days in an average week when they were in school; among those students, 84.0% actually exercised or played sports for 20 or more minutes during an average physical education class (CDC, *YRBS*, 2006). Boys consistently report participating in vigorous physical activity substantially more than girls, and vigorous physical activity declines progressively and significantly with advancing age and grade (Pratt, Macera, & Blanton, 1999).

Studies using both self-repot and objective measures have identified a decline in physical activity that occurs with age and particularly during adolescence (Sallis, 2000 & CDC, *YRBS*, 2004). The National College Health Assessment Survey, a survey organized by the American College Health Association, collects information on college students' habits, perceptions, and behaviors about the most recent health topics. Data from the 2005 survey indicate a substantial reduction in physical activity levels by the time students reach college; 32.6% of all students (35.0% of males and 31.5% of females) reported participating in 20 or more minutes of vigorous physical activity or 30 or more minutes of moderate physical activity on 3-5 days in the week preceding the survey (ACHA, 2005). 8.6% of all students (11.9% of males and 6.7% of females) reported participating in six or more days of vigorous or moderate physical activity in the week preceding the survey; 28.0% of all students (22.3% of males and 30.9% of females) report participating in no physical activity in the 7 days preceding the survey (ACHA, 2005). These statistics indicate almost a 50% (68.7% - 32.6%) reduction in the number of students engaging in sufficient physical activity (vigorous physical activity for 20+ minutes on 3+ days per week or 30+ minutes of moderate physical activity on 5+ days per week) in a given week. Clearly, interventions should target students during the adolescent years to both increase the number of adolescents who are physically active and to attenuate the declining trend in physical activity that occurs with age.

Rural Physical Activity and Health

While physical activity promotion is important for all populations, it is of particular importance within minority, including rural, populations. According to the US Department of Agriculture (2005), rural areas consist of all territory located outside of urbanized areas and urbanized clusters; in 2000, 59 million Americans lived in rural areas, or 21% of the nation's population. In 2002, the government released The Rural Healthy People 2010 campaign to address health priorities for rural communities; similar to the national health objectives, a priority to decrease premature death and morbidities due to physical inactivity was addressed in these rural objectives (Gamm, Hutchison, Bellamy, & Dabney, 2002). Rural Healthy People 2010 noted several rural-urban disparities for preventable and chronic diseases and, particularly, an excessive prevalence of Type II diabetes in rural America. Both overweight and obesity are significantly associated with diabetes (Mokdad et al, 2003). As addressed earlier, the promotion of physical activity is an effective method of treating and preventing overweight and obesity.

Physical activity levels among rural populations tend to be lower than either urban or suburban populations; reports have shown that more than one third of the rural population is physically inactive during their leisure-time. Further, rural adults who are from the Midwestern states are more likely to be inactive compared to adults from other areas around the country (Patterson, Moore, Probst, & Shinogle, 2004). An unpublished study conducted by Holden (2004) revealed alarmingly low levels of vigorous physical activity among rural Ohio high school students when compared to national data. A total of 1,024 high school students within 11 high schools in Appalachia Ohio were given surveys to assess a 7-day recall of their physical activity behavior. According to this descriptive study, 37.4% of all participating students reported engaging in at least 5 days of moderate physical activity within the previous week and 13.9% of students reported engaging in vigorous exercise on three or more days in the previous week. The results of this study support the priority to develop strategies to promote physical activity, and particularly vigorous physical activity, among rural Ohio high school students.

Stages of Research in Health Education

There are two types of intervention evaluations proposed by health promotion specialists and a natural progression in research among these two types of evaluations; the first type of evaluation are efficacy trials and the second are effectiveness trials (Flay, 1986). An efficacy trial provides a test of whether a technology, treatment, procedure, or program does more good than harm when delivered under optimum conditions. An effectiveness trial provides a test of whether a technology, treatment, procedure, intervention, or program does more good than harm when delivered under real-world conditions (Flay, 1986). A natural progression of research when evaluating interventions in health education and health promotion would be to conduct efficacy trials first, to determine that the curriculum or intervention is effective under controlled, ideal circumstances, and then to test the intervention under less controlled and more "real world" circumstances. While an intervention may be deemed effective in ideal and controlled circumstances, the appropriateness or feasibility of implementing the intervention may not be ideal for "real world" circumstances; therefore, efficacy is necessary to, but not sufficient for, effectiveness (Flay, 1986).

Within health promotion, an efficacy trial provides a test of whether a program leads to positive, or reduces negative, changes in knowledge, attitudes, behavioral skills, behavior, morbidity, and/or mortality when delivered under optimal conditions (Flay, 1986). The program is delivered under ideal circumstances in that the program curriculum is standardized and well-specified, implemented uniformly and by a program specialist, and delivered in a standardized setting to a specific audience (an audience that is highly motivated to participate or "captive", as in a classroom setting) that adheres to the program completely. Alternative curricula or treatments are often used in comparison groups rather than placebos, and the innovative curriculum being tested is often compared to an alternative or more traditional curriculum to determine whether it does more good and/or less harm. Tests of efficacy are necessary because it is not worthwhile to evaluate the effectiveness of an intervention delivered in real-world settings if the intervention has not been shown to cause desirable effects under optimum conditions. Evaluators may argue that these types of studies lack external validity due to the ideal circumstances under which they are implemented, but generalizability is improved with multiple replications of efficacy trials and later, when effectiveness trials are completed (Flay, 1986).

Effectiveness trials are concerned with testing whether an efficacious treatment or intervention does more harm than good when delivered via a real-world program; a program will be effective only if an efficacious treatment is implemented in such a way as to be made available to an appropriate target audience in a manner that is acceptable to them (Flay, 1986). The effectiveness of a program is based on: the efficacy of the program, the availability of the program to a target audience (the fidelity of implementation), and the level of program acceptance (adherence or compliance to the program). Effectiveness trials are often conducted in one of two ways: 1) an efficacious program is uniformly implemented to a target audience to determine acceptability or compliance and for whom the intervention is effective, or 2) program delivery or implementation varies (as in teacher training) to determine program availability in real-world settings; often times, changing the program delivery changes the acceptance or compliance, however. Within health program evaluation, the effectiveness trial is most consistent with the impact evaluation (Flay, 1986).

Brian Flay (1986) suggests a progression of research stages in the development of a health promotion program, ranging from basic research to demonstration studies. The first two stages of research involve basic research and hypothesis development to assure a strong theoretical and empirical basis for innovative programs. Basic research is disciplinary-based research on the basic mechanisms defined by a discipline or field (Flay, 1986). Hypothesis development, stage 2, involves the development of hypotheses about new approaches to health promotion for a specific health problem (Flay, 1986). It is considered exploratory research, and it is based on the findings from basic research. Hypothesis development would involve testing specific components of an intervention being developed under a theory. Measurement in this stage would involve only those variables that should directly be impacted by the intervention.

The third stage of research is pilot applied research and it consists of conducting pilot tests on earlier versions of the program or intervention to lead to further development and refinement of the program (Flay, 1986). Pilot studies evaluate the feasibility and acceptability of materials and protocols developed in the first two stages of research. Research on this level is pre-experimental or quasi-experimental, examining the immediate effects of the program related to specific program goals, often using only one classroom or school per experimental condition. Measurement is usually only conducted on those variables thought to be directly affected by the intervention.

The fourth stage of research involves prototype studies; small-scale tests of refined programs using components of the program or intervention that were shown to be efficacious in the stage 3 pilot studies (Flay, 1986). Prototype studies provide preliminary testing of those materials and protocols as they would be used in later efficacy trials to provide a preliminary estimate of the magnitude of the intervention effect. Research on this level is usually experimental or quasi-experimental (either classrooms or schools are assigned to control/comparison or experimental conditions), and complete programs are tested in a small number of units (1-2 classrooms or schools per condition). Measurement at this level of research involves both educational outcomes of the targeted constructs thought to be directly affected by the program and behavioral outcomes.

The fifth stage reaches the level of efficacy trials, to determine the effectiveness of programs suggested to be effective by earlier stages in ideal conditions, as discussed earlier (Flay, 1986). Research in this stage ideally involves pure experimental trials with random assignment to intervention and control/comparison experimental conditions, and it uses a large enough number of subjects (classrooms or schools) to have adequate power to detect practical, significant, and behavioral effects.

After stage 5, the efficacy of the intervention should be known and effectiveness trials begin; stage 6 research involves treatment effectiveness trials to determine the effectiveness of an efficacious and acceptable program under real-world conditions of delivery or implementation (Flay, 1986). Research in stage 6 evaluations involves large-scale experimental or quasi-experimental trials in real-world settings, with implementation or delivery standardized and carefully assessed; often-times a program specialist will deliver the intervention in a naturally-set classroom(s). This way, only program acceptance, or compliance, is tested as levels of participation by students and families. Measurement in stage 6 research often involves the addition of morbidity/mortality assessment for the evaluation of health status goals.

During stage 7, more variation is added to the program evaluation as the level or mode of implementation is either directly manipulated or allowed to naturally vary. Implementation effectiveness trials are conducted within this stage to determine the effectiveness of the efficacious and acceptable program under real-world conditions of implementation (Flay, 1986). The curriculum delivered does not vary but experimental tests are conducted to determine program effectiveness under changing personnel, training, setting, and adding of supplementary activities. An example of such a trial would be to train multiple teachers to deliver a program in their own classrooms and testing the fidelity of implementation, rather than having the program specialist implement the intervention as designed. Research in this stage involves experimental or quasi-experimental trials in real-world settings, with implementation or delivery deliberately or naturally varying to conduct planned comparisons, and careful assessment of implementation fidelity. Measurement can involve measures of morbidity and mortality.

The final stage of research that Flay proposes involves demonstration studies to determine the effects of an efficacious program on public health when implemented in whole systems (i.e. schools, cities, states, and nations) (Flay, 1986). Research in this stage involves "naturalistic" quasi-experimental program evaluation, with natural variations in delivery and implementation and assessments of morbidity and mortality. Diffusion patterns may also be studied at this stage.

Need for the Study

As discussed in the above sections, a priority exists within health education research to develop and evaluate strategies to increase physical activity among all populations, with a priority to promote physical activity for health promotion and disease prevention among minority, including rural, populations. Educational theories should be used to guide the development of health education interventions and to plan evaluations. Educational theories provide the empirical basis for the development of effective behavioral interventions; following Flay's progression in research, support for the use of educational theories in the development of behavior change strategies would arise from the first two stages of research. Theories of health behavior identify the targets for change (usually psychological or educational constructs) and the methods for accomplishing changes. They inform the evaluation of change efforts by helping to identify the outcomes to be measured, the timing, and the methods of study to be used (Glanz, Rimer, & Lewis, 2002). Once a group of investigators has demonstrated that a theoretical model predicts behavior at some acceptable level, they should demonstrate that their intervention effects change in the mediating variables within the theory at an acceptable level (Baranowski, Anderson, & Carmack, 1998).

A line of programming has been established at The Ohio State University to develop an effective Social Cognitive Theory-based intervention to increase physical activity among Ohio adolescents (Winters, 2001; Hortz, 2005). The use of Social Cognitive Theory (SCT) in the development of adolescent physical activity interventions is supported within the literature; descriptive models containing SCT constructs have been able to explain 5-59% of the variance in adolescent physical activity (Petosa et al, 2005; Petosa et al, 2003; Winters et al, 2003; Motl et al, 2002; Sallis et al, 1999; Trost et al, 1997; Biddle et al, 1996; Zakarian et al, 1994; Reynolds et al, 1990). The largest proportion of the variance in adolescent physical activity levels (43.3% for boys and 58.6% for girls) can be captured by examining constructs from multiple SCT domains (Sallis, Prochaska, & Taylor, 1999).

Eric Winters (2001) laid the foundation for a SCT-based, adolescent physical activity intervention by developing and conducting a pilot study to evaluate the efficacy of the intervention in one Central Ohio high school. Following Flay's description of pilot research, the physical activity intervention was developed based on the literature from the descriptive research documenting the first two stages of research supporting the use of SCT to promote adolescent physical activity. Winters used a quasi-experimental design with one school receiving the intervention and one school serving as a comparison. While the intervention was delivered within "real world" conditions, within naturally occurring classrooms, it was implemented under "ideal" conditions, with a health education specialist serving as the program implementer. The efficacy of the intervention was supported by an increase in the frequency of moderate exercise among students enrolled in the program ($p<0.01$) and by a decrease in the number of students in the intervention school categorized as sedentary at post-test when compared to pretest (Winters, 2001).

Brian Hortz (2005) continued the line of efficacy evaluation by conducting a prototype study, the fourth stage of research in Flay's model. Following Flay's line of research, Hortz took information from the Winters' intervention that were shown to be efficacious in the stage 3 pilot study. Four SCT constructs were identified as potential targets for change in an adolescent population (self-efficacy, social situation, outcome-expectancy value, and self-regulation) and strategies to mediate changes in physical activity through changes in the constructs were refined. This prototype evaluation used a quasi-experimental design, with all of the physical education classes from one Ohio Appalachian high school receiving the intervention and all of the classes from another school serving as a comparison school. The intervention was delivered in natural classroom settings, with a health education specialist serving as an “ideal” implementer. The program was found to be effective at increasing the frequency of moderate physical activity among students, and particularly among previously sedentary students. The results of the evaluation further supported the efficacy of the program at changing the SCT constructs self-regulation and social situation (Hortz, 2005).

The next subsequent line of research is needed to continue the development and evaluation of the efficacy of this adolescent physical activity intervention. This fifth stage will complete the efficacy trials and should provide support for the dissemination of the program and an evaluation of the effectiveness of the intervention. Ideally, the next line of evaluation should involve a pure experimental design with random assignment to intervention and control/comparison experimental conditions; however, using pure experimental designs within school settings is problematic. While the current study will use an ex post facto design to evaluate the efficacy of the Social Cognitive Theory-based adolescent physical activity intervention, it will use a large enough number of subjects to have adequate power to detect practical, significant, and behavioral effects. The program will further be evaluated under more “real world” conditions, using both naturally occurring classroom settings and naturally occurring implementation. Physical education, health, and life-skills classroom teachers will be trained to deliver the program components within their current high school classes.

Curricular Models of Physical Education

The line of research in the development and evaluation of the SCT-based adolescent physical activity intervention at The Ohio State University, described above, has used physical education as the sole context for implementation. As will be outlined in the Literature Review, the primary setting for the evaluation of most school-based physical activity interventions is physical education. The evaluation of the *Plan for Exercise, Plan for Health* intervention, developed for the current study, was developed for implementing primarily within physical education settings; the intervention was also implemented within two health classes and five life skills classes, however. Because the intervention was developed for and primarily delivered within physical education settings, a review of the current curricular models of physical education as well as where *The Plan for Exercise, Plan for Health* intervention fits within those models is warranted.

Ten curricular models for physical education were identified through a review of the literature. These models include movement education, fitness education, developmental education, activity-based education, humanistic and social development education, sport education, wilderness sports and adventure education, conceptually based education, personally meaningful education, and the eclectic model (Kelly & Melograno, 2004). Movement education places an emphasis on exploring various movement skills in areas such as dance, games, and gymnastics. Fitness education places an emphasis on the development of a healthy lifestyle, including lifestyle management through the design and use of a personal fitness program. Developmental education emphasizes the use of developmentally appropriate lessons; through this model, basic skills are taught at the elementary level, followed by varied activity or themed units and lifetime sports at the secondary level. Activity-based education involves exposing students to various activities within specific units (such as team sports, individual and dual activities, outdoor activities, rhythm and dance, and popular or local activities) to enhance self-testing, exploration, and new interests. The humanistic and social development model emphasizes self-awareness and choice as a basis for personal growth; within this model, the teacher facilitates the development of self-discipline through a self-directed progression through activities resulting in the development and implementation of personal physical activity programs. Within sport education, the emphasis is placed on skills, rules, and strategies in sports, an appreciation for play in society, and ethical principles that define “good” sport. Within wilderness and adventure education, the emphasis is placed on experiential learning in relation to natural phenomena with activities such as camping, backpacking, canoeing, hiking, and orienteering. In conceptually based education, the emphasis is placed on knowledge and understanding; subject matter is organized around key concepts or principles and concepts are applied to appropriate sport and movement skills. Educators using personally meaningful education base their curriculum around individual development (physiological efficiency, group interaction, cultural involvement), emphasizing personal involvement with sports, self-directed learning, and individual goals associated with finding personal meaning through movement activities. Finally, the eclectic model uses a combination of the previous models, most often breaking them into units such as individual sports, team sports, outdoor pursuits, and social developmental units.

The *Plan for Exercise, Plan for Health* intervention fits within the fitness education and the humanistic and social developmental models of physical education. The nine-week intervention was developed to teach high school students self-regulatory skills to develop their own personal exercise program, a program participated in on their own, outside of school. Because the intervention was designed to teach students skills to develop a personal exercise program outside of school, it focuses on teaching students how to adopt a healthy lifestyle, as suggested in the fitness education model. Focusing on strategies such as tracking physical activity, identifying strategies to overcome barriers to physical activity, goal setting for physical activity, and adopting social support teaches students how to adopt their exercise program as part of a healthy lifestyle. Throughout the program, the students created their own goals, chose the exercise activities that they participated in, and progressed in their exercise program based on the accomplishment of their personal exercise goals. The intervention fostered student self-awareness and self-discipline through a self-directed progression in an exercise program; in this way, the intervention also fits within the humanistic and social developmental model of physical education.

Purpose of the Study

The purpose of the current study was to conduct an impact evaluation of the *Plan for Exercise, Plan for Health* intervention. The primary purpose was to evaluate the efficacy of the *Plan for Exercise, Plan for Health* intervention at changing the frequency of adolescent moderate and vigorous physical activity. There were two secondary purposes to this study. First, the study sought to examine whether changes in following four Social Cognitive Theory (SCT) constructs were able to predict changes in the frequency of adolescent moderate and vigorous physical activity: self-efficacy for overcoming barriers to physical activity, self-regulation of physical activity, social support from family and friends for physical activity, and outcome expectancy-values for physical activity. Second, the study sought to test whether changes in the targeted SCT constructs mediated changes in adolescent moderate and vigorous physical activity, thereby testing the utility of the theory in the development of physical activity interventions.

Research Questions

The following research questions were developed to guide the evaluation of the efficacy of *the Plan for Exercise, Plan for Health* intervention:

1. Did the *Plan for Exercise, Plan for Health* intervention account for a significant portion of the variance in changes in the frequency of adolescent moderate physical activity?
2. Did the *Plan for Exercise, Plan for Health* intervention account for a significant portion of the variance in changes in the frequency of adolescent vigorous physical activity?
3. Did changes in student social support scores independently predict changes in the frequency of adolescent moderate physical activity?
4. Did changes in student social support scores independently predict changes in the frequency of adolescent vigorous physical activity?
5. Did changes in student outcome expectancy-value scores independently predict changes in the frequency of adolescent moderate physical activity?
6. Did changes in student outcome expectancy-value scores independently predict changes in the frequency of adolescent vigorous physical activity?
7. Did changes in student self-efficacy scores independently predict changes in the frequency of adolescent moderate physical activity?
8. Did changes in student self-efficacy scores independently predict changes in the frequency of adolescent vigorous physical activity?
9. Did changes in student self-regulation scores independently predict changes in the frequency of adolescent moderate physical activity?
10. Did changes in student self-regulation scores independently predict changes in the frequency of adolescent vigorous physical activity?
11. Among those SCT constructs that significantly predicted changes in adolescent physical activity behavior, did changes in the Social Cognitive Theory constructs targeted through the intervention mediate changes in the frequency of adolescent leisure-time physical activity?

Operational Definitions

The following terms were used to guide the current research:

Adolescent

Adolescence can be defined as a time of life marked by puberty and the transition from childhood to adulthood.

Operational Definition: For the purpose of this study, an adolescent was defined as any person attending high school between the ages of 13-19.

Appalachia Ohio

According to the Appalachian Regional Commission (2005) Appalachia is a 200,000-square-mile region that follows the spine of the Appalachian Mountains from southern New York to northern Mississippi. It includes all of West Virginia and parts of 12 other states: Alabama, Georgia, Kentucky, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, and Virginia.

Operational Definition: The current study worked within Ohio Appalachian counties. Appalachia Ohio was defined as any state county that fell within Appalachian boundaries, including the following: Adams, Athens, Belmont, Brown, Carroll, Clermont, Columbiana, Coshocton, Gallia, Guernsey, Harrison, Highland, Hocking, Holmes, Jackson, Jefferson, Lawrence, Meigs, Monroe, Morgan, Muskingum, Noble, Perry, Pike, Ross, Scioto, Tuscarawas, Vinton, and Washington.

Leisure-Time Physical Activity

Physical activity can be defined as any bodily movement produced by skeletal muscles that results in energy expenditure (CDC, 2005, *Physical Activity for Everyone: Physical Activity Terms*).

Operational Definition: Leisure-time physical activity was defined as any bodily movement produced by skeletal muscle that results in energy expenditure, which is conducted in the leisure-time. Leisure-time included any time in which a student had discretion over his/her behavior; outside of school hours and organized school sports.

Exercise

Operational Definition: Exercise was defined as physical activity that was planned, structured, and involved repetitive bodily movement conducted to improve or maintain one or more of the components of physical fitness, including: cardiovascular endurance, muscular endurance, muscular strength, flexibility, and body composition (CDC, 2005, *Physical Activity for Everyone: Physical Activity Terms*).

Leisure-Time Moderate Exercise

Operational Definition: Leisure-time moderate exercise was defined as planned or structured physical activity, conducted in the leisure-time, to improve or maintain one or more of the components of physical fitness, which resulted in increases in breathing and heart rate and was conducted at 40-60% of the maximum heart rate.

Leisure-Time Vigorous Exercise

Operational Definition: Leisure-Time vigorous exercise was defined as planned or structured physical activity, conducted in the leisure-time, for the purpose of increasing one or more of the components of physical fitness, which resulted in substantial increases in breathing and heart rate and was conducted at 60-80% of the maximum heart rate.

Social Cognitive Theory

Social Cognitive Theory is a theory of human behavior which explains psychosocial functioning in terms of a triadic reciprocal causation (Bandura, 1986). Within this model, internal personal factors in the form of cognitive, affective, and biologic events, behavioral patterns, and environmental influences all operate as interacting determinants that influence one another bi-directionally (Bandura, 2001).

Operational Definition: For the current study, Social Cognitive Theory was examined through four underlying theoretical constructs: self-efficacy, social support, self-regulation, and outcome-expectancy values.

Self-Efficacy

Self-efficacy is the belief a person has in his or her ability to perform a behavior in a given situation. This focal belief is the foundation of human motivation and action (Bandura, 2004). Stated another way, self-efficacy is the confidence a person feels about performing a behavior, including confidence in the ability to overcome barriers to performing the behavior (Baranowski, Perry, & Parcel, 2004).

Operational Definition: Self-efficacy was defined as a student's perception of his or her ability to overcome barriers to physical activity. Self-efficacy was evaluated by a 7-item instrument developed by

Saunder's et al (1997) and altered and re-evaluated by Winters (2001). The instrument asked students to rate, on a 6-point Likert-type scale, how often they felt they could exercise under specific challenging conditions, such as when it was hot out, when they had a lot of homework, or when they were tired. Each student was given a self-efficacy for overcoming barriers to physical activity score, calculated as the sum of 7-item instrument

Self-Regulation

In the exercise of self-directedness, people adopt certain standards of behavior that serve as guides and motivators and regulate their actions anticipatorily through self-reactive influence; in this way, human behavior is self-regulated (Bandura, 1991). Self-regulation allows people to set goals, to track their progress towards goals, and to evaluate their capabilities to perform behaviors in given situations. Self-regulation, as outlined by Bandura, has three sub-functions: self-monitoring, judgmental, and self-reactive influence (Bandura, 1991).

Operational Definition: Self-regulation was defined as the strategies students used to direct and regulate physical activity behavior. Self-regulation was examined using an instrument developed by Petosa (1993) and altered to be appropriate for an adolescent population by Winters (2001, 2003). This 25-item instrument examined four subscales of self-regulation which assessed the following properties of the construct: goal setting, self-monitoring, enlisting social support, planning to overcome barriers to physical activity, and securing positive reinforcements. The questionnaire asked students to answer questions regarding the frequency of using self-regulatory skills in their exercise behavior over the previous 4 weeks. Students were asked to respond to each item using a 6-point Likert-type scale. Each student was given a self-regulation score, calculated as the sum of the 25-item instrument.

Social Support

People need to learn how to enlist social support to sustain their behavioral efforts (Bandura, 2004). Social support comes in the form of verbal or behavioral actions that help an individual adopt and maintain a given behavior.

Operational Definition: Social support was defined as students' perceptions of the verbal and behavioral actions provided to them by family and friends to help them adopt and maintain a physical activity program. It was examined through an 8-item instrument developed by Saunders et al (1997) and altered by Winters (2001) for use in adolescent populations. The questionnaire asked students to respond to 4 questions regarding specific supports that their family may have provided them for physical activity in the previous two weeks. Students then responded to 4 questions regarding specific supports that their friends may have provided them for physical activity in the previous two weeks. Students were asked to respond to each support statement on a 6-point Likert-type scale. Each student was given a social support from family and friends score computed as the sum of the friends and family subscales.

Outcome Expectancy Values

Outcome expectations are defined as judgments of the likely consequences a behavior will produce (Bandura, 1986). Outcome expectancies are the values that a person places on a particular outcome (or outcome expectation); expectancies influence behavior according to the hedonic principle: if all other things are equal, a person will choose to perform an activity that maximizes a positive outcome or minimizes a negative outcome (Baranowski, Perry, & Parcel, 2004). The influence that outcome expectations have on behavior depends on the outcome expectancies. According to expectancy-value theories, performance level is a multiplicative function of expectancy that behaving in a particular way will lead to a given outcome and the value of that outcome (Bandura, 1986).

Operational Definition: Outcome expectancy-values was examined in two dimensions; as outcome expectation (a person's beliefs about the outcomes that occur as a result of physical activity) and as outcome expectancies (the value a person places on the perceived outcomes of physical activities). The dimensions were computed as a multiplicative function, or the product of the outcome expectation and the coinciding outcome expectancy. These two dimensions were examined through a 23-item instrument developed and validated by Winters (2001). The questionnaire asked student to first respond to a statement regarding their beliefs about the outcomes of physical activity, and then to respond to a statement which asked about the value they place on the outcome statement. Students responded to each belief and value statement on a 6-point Likert-type scale. Each student was given an outcome expectancy-value score, calculated as the sum of the belief-value products.

CHAPTER 2

LITERATURE REVIEW

Introduction

A literature review was conducted on five major research topics in support of the current study. The first section of the review details Albert Bandura's Social Cognitive Theory (Bandura, 1986), the theoretical basis for the intervention under study. Social Cognitive Theory (SCT) has commonly been used in the development of interventions designed to target physical activity behavior among adolescents. The second section of the review details the literature pertaining to the SCT determinants of adolescent physical activity behavior. The third section of the review describes the components of evaluation in health education. The fourth reviews SCT-based interventions designed to impact adolescent physical activity behavior. The fifth section details the curricular objectives and goals inherent to physical education. Because the primary implementation site for the current intervention is physical education classes, the intervention must be designed in accordance with the current objectives and standards of physical education.

An article search was conducted for resources related to the preceding topics between March and September of 2005. Research articles published between 1985 and 2006 were identified through the use of Pubmed and Medline databases, through an examination of resources cited in published articles of similar topics, and through a hand search of pertinent health education and health promotion research journals.

<u>Section One: Social Cognitive Theory</u>

Social Cognitive Theory is especially relevant in the study of health behaviors. The theory specifies a core set of determinants, the mechanisms through which they work, and the optimal ways of translating this knowledge into effective health practices (Bandura, 2004). It is one of the most frequently applied theories of health behavior. As Tom Baranowski and his colleagues point out, SCT is particularly relevant to health education and health behavior for three reasons (Baranowski, Perry, & Parcel, 2004). First, it synthesizes previous attempts to understand behavior change. Second, the constructs and processes within the SCT suggest many important avenues for new behavioral research and practice in health education. Third, it was developed based on the insights and understandings used to develop theories within other historically rooted fields, such as psychology, allowing health behavior change strategies to benefit from years of research and theory development (Baranowski et al, 2004). Due to the importance and usefulness of SCT to the field of health education, this section is devoted to an explanation of the theory's foundational model, the underlying capabilities from which behavior is theorized to derive within SCT, and the constructs that comprise the theoretical framework more commonly applied to health behavior programs.

Foundation of Social Cognitive Theory

Social Cognitive Theory explains psychosocial functioning in terms of a triadic reciprocal causation (Bandura, 1986). Within this model, internal personal factors in the form of cognitive, affective, and biologic events, behavioral patterns, and environmental influences all operate as interacting determinants that influence one another bi-directionally (Bandura, 2001). Starting with the person, the way an individual thinks, his or her beliefs, attitudes, and intentions, and personal attributes such as genetics, history, gender, and age influences behavioral choices. The development of behavioral skills and behavioral successes and failures then influences beliefs, attitudes, intentions, etc. Environmental influences (both social and physical) influence the person apart from their behavior, when thoughts and feelings are modified through modeling, tuition, or social persuasion (Bandura, 1986). A person influences the environment in how they interact with their environment, in how they interpret their environment, and in how to behave within their environment. For the final reciprocal link between the environment and behavior, in the transactions of everyday life, behavior alters environmental conditions, and it is, in turn, altered by the very conditions it creates (Bandura, 1986). The ways that we interpret our social and physical environment will influence how we behave within that environment; our behavior will reciprocally influence ways that we interpret our social and physical environment. What part of the potential environment becomes the actual environment thus depends on how people behave (Bandura, 1986). This unique model of Triadic Reciprocality is presented in Figure 2.1; this model contains the three domains (environmental, behavioral, and personal/cognitive) discussed above, providing the foundation for SCT. What people think, believe, and feel affects how they behave. The natural and extrinsic effects of their actions, in turn, partly determine their thought patterns and affective reactions (Bandura, 1986). Under this model, SCT explains behavioral processes as truly dynamic.

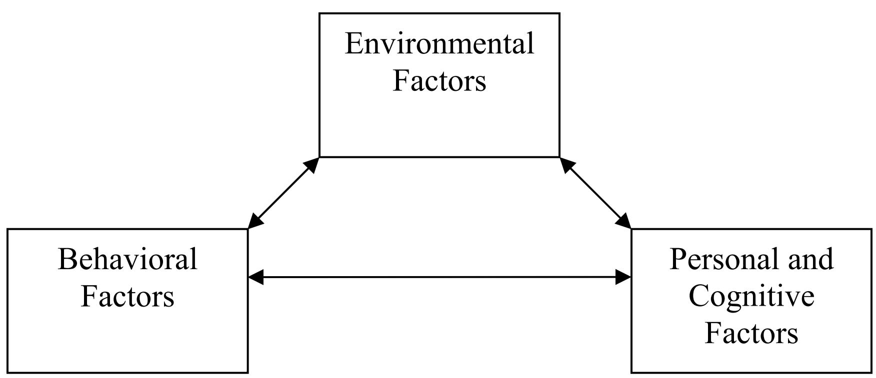

Figure 2.1: Triadic Reciprocality, The Foundation of Social Cognitive Theory

Because of the reciprocal causation within the model, therapeutic efforts to change behavior can be directed at all three domains. Psychosocial functioning is improved by altering faulty thought patterns, by increasing behavioral competencies and skills in dealing with situational demands, and by altering adverse social conditions (Evans, 1989). Behavior is modified and developed by constant interactions and adaptations within the person, the behavior, and the environment in which the person is behaving. The relative influence exerted by the three sets of interacting factors will vary for different activities, different individuals, and different circumstances. For example, when environmental conditions exercise powerful constraints on behavior, they emerge as the overriding determinants; when situational constraints are weak, personal factors serve as the predominant influence in the regulatory system (Bandura, 1986).

Underlying Behavioral Capabilities in Social Cognitive Theory

Within the perspective of the Social Cognitive Theory, the person is defined by five underlying basic capabilities. It is from these basic capabilities that humans are able to adopt and maintain behavior: symbolizing capability, forethought capability, vicarious capability, self-regulatory capability, and self-reflective capability (Bandura, 1986). The preceding sections will outline each of these human capabilities, which provide the underpinnings for the SCT.

Symbolizing Capability

Symbolizing capability allows humans to create abstractions, or symbols, of what is going to happen as a result of actions; it allows us to anticipate likely outcomes before behavior is conducted. Through symbols, people process and transform experiences to serve as guides for future action (Bandura, 1986). By representing their experiences symbolically, people can give meaning and continuity to their lives (Evans, 1989). Symbolizing capability takes the need for stimulus/response and trial and error out of behavioral processes. Over time, through observational learning and experiential learning, humans develop the ability to symbolize what will occur as a result of their own behavior. These anticipated symbols motivate behavior. An example can be seen with adolescents and smoking behavior. Adolescents commonly view smoking as “cool” because they see peers smoking in social situations; the abstraction of “cool” becomes a symbol for the result of smoking behavior. The motivation to initiate smoking behavior therefore becomes this anticipated outcome (“cool”) they have symbolized from watching their peers. The motivation to initiate a behavior does not start with the actual experimentation with behavior or with an environmental stimulus; instead, it starts with the ability to symbolize the valuable outcome of the behavior.

Forethought Capability

People do not simply react to their immediate environment, nor are they steered by implants from their past; most of their behavior, being purposive, is regulated by forethought (Bandura, 1986). Forethought capability allows people to set goals for themselves, anticipate the likely consequences of prospective actions, and select and create courses of action likely to produce desired outcomes and avoid detrimental ones (Bandura, 2001). This capability is clearly linked to symbolizing capability. People develop cognitive representations (symbols) for foreseeable outcomes of their behavior; these foreseeable outcomes become the motivators of behavior. Through the exercise of forethought, people motivate themselves and guide their actions in anticipation of future events (Bandura, 2001). An example of forethought within health education can be seen for physical activity behavior. A common motivator for changing physical activity behavior is weight loss. Forethought capability allows people to look into the future and anticipate that if they change their behavior and become physically active, weight loss and a subsequent change in body form will result. This is not an immediate outcome for physical activity behavior; rather, it takes time for an individual to notice the effects. Their ability to look into the future and anticipate these desired outcomes motivates behavior change. Forethought is translated into action through the aid of self-regulating mechanisms (Bandura, 1986). Anticipated outcomes of a behavior motivate the behavior, and we use self-regulatory processes to track our progress towards those anticipated outcome, providing continual motivation for behavior.

Vicarious Capability

Vicarious capability takes into account that behavior is not learned solely through trial and error. Rather, humans can observe the outcomes of other people's behaviors, which will motivate decisions for their own behavior. As discussed earlier, learning does not occur simply as a result of a stimulus-response mechanism with the environment. "In actuality, virtually all learning phenomena, resulting from direct experience, can occur vicariously by observing other people's behavior and consequences for them. The capacity to learn by observation enables people to acquire rules for generating and regulating behavioral patterns…" (Bandura, 1986). Through vicarious capabilities, people within our social environments become behavioral models. Some behaviors, such as speaking, are developed entirely through modeling. Other behaviors, such as learning how to cook and choose a healthful diet, can be learned by other means but the acquisition process can be considerably shortened through modeling.

Observational learning is one of the core underlying concepts within the SCT. By observing others, individuals form rules for behavior, and on future occasions this coded information serves as a guide for action. The capacity to learn by observation enables people to expand their knowledge and skills on the basis of information exhibited and authored by others (Bandura, 1986). This ability to learn by observing others is linked back to symbolizing and forethought capability. All modeled information must be symbolically represented if it is to be retained as a guide for future action (Bandura, 1986). By observing people within our social environments, we learn specific outcomes associated with specific behaviors under specific conditions. We then form symbols for these outcomes to generalize them to other situations. Our ability to foresee these symbolic outcomes occurring as a result of our own behavior in similar situations becomes the motivating force for our own future behavior.

Self-regulatory Capability

Self-regulatory capability takes into account that behavior is motivated and regulated by internal standards and self-evaluative reactions to personal actions (Bandura, 1986). With self-regulatory capabilities, humans can monitor the outcomes anticipated through symbolizing capabilities, forethought capabilities, and vicarious capabilities. Monitoring one's pattern of behavior and the cognitive and environmental conditions under which it occurs is the first step towards doing something to affect it (Bandura, 2001). Self-regulatory capabilities allow humans to monitor progress towards anticipated outcomes and goals; this provides constant feedback and motivation for continued behavioral adjustment. By arranging facilitative environmental conditions, recruiting cognitive guides, and creating incentives for their own efforts, people make causal contributions to their own motivation and actions (Bandura, 1986). In essence, people create ways, in their environment and through cognitive processes, to monitor and regulate behavior and to set incentives for the outcomes of behavior. An example of self-regulatory capability can be seen within the substance abuse behavioral field, with Alcoholic's Anonymous and drinking cessation. In order to quit drinking, people in AA follow 12 steps clearly outlined by the program. These steps become behavioral goals, and the recovering alcoholic and his or her sponsor monitor progress towards these goals as they monitor progress in their number of sober days. Meeting these behavioral goals and tracking and announcing the number of sober days becomes a motivator for future sober behavior.

Self-reflective Capability

Self-reflective capability allows humans to analyze their behavioral experiences and to think about their own thought processes. People are not only agents of action but self-examiners of their own functioning (Bandura, 2001). They can act on their ideas or predict occurrences from ideas, judge from the results the adequacy of their thoughts, and change them accordingly (Evans, 1989). Self-reflective capability enables us to take what we are doing, monitor our progress towards standards of behavior based on comparisons with others' and our own past performances in similar situations, make judgments about the adequacy of our behavior in meeting those standards, and then make behavioral adjustments accordingly. Albert Bandura stated this regarding self-reflective capability:

> "By reflecting on their varied experiences and on what they know, people derive generic knowledge about themselves and the world around them. In verifying thought through self-reflective means, people monitor their ideas, act on them or predict occurrences from them, judge the adequacy of their thoughts from the results, and change them accordingly." (Bandura, 1986)

In self-reflecting, people judge the correctness of their predictive and operative thinking against the outcomes of their actions, the effects that other people's actions produce, what others believe, deductions from established knowledge and what necessarily follows from it (Bandura, 2001). Through observational learning and past experiences, people develop expected outcomes for behavior and standards to which they feel they should act. As Bandura states, self-reflective capability allows humans to analyze their behavior, the correctness of their predicted outcomes, and their ability to meet the standards needed to achieve the outcomes. This self-reflection leads to a sense of behavioral efficacy: a belief in their ability to act up to a standard in any given circumstance.

As Bandura postulated, these five underlying capabilities are distinctly human. They bring sophistication into earlier theoretical models that presumed behavior is learned by trial and error, or is a result of an automatic stimulus-response reaction between the environment and the person. Rather, behavior is purposive and is motivated by abilities to anticipate outcomes for behavior and symbolize anticipated outcomes of behavior. Behavior is learned both through trial and error and through observing the outcomes of behavior within other human models. Our abilities to self-monitor and reflect on the capabilities of our own behavior in specific circumstances motivate us to continually adjust behavior to achieve desirable outcomes. Through self-regulative and self-reflective capabilities, humans are constantly evaluating their behavior and anticipated outcomes against standards regarding the influences it has on their self and within their social and physical environments.

Social Cognitive Theory Constructs

After outlining the basic underlying human capabilities inherent to the Social Cognitive Theory, theory's core psychological constructs, which fall into the three domains within the foundational model of Triadic Reciprocality, can be discussed: the environmental domain, the personal/cognitive domain, and the behavioral domain. Constructs falling into the environmental domain include the perceived environment (both the physical environment and the social environment) and social support. Constructs falling into the personal/cognitive domain include self-efficacy, self-regulation, and outcome expectations/outcome expectancies. The construct falling into characteristics of the behavior include behavioral capability. Under the model of Triadic Reciprocality, each of these factors functions in a dynamic and reciprocal causal pathway. This makes the theory very difficult to test because it implies that a change in one construct will lead to a subsequent change in every other construct. Despite this dilemma, the constructs within the theory are often targets of change for health promotion programs and the theory is often used to predict behavior.

Self-efficacy

Self-efficacy is the belief a person has in his or her ability to perform a behavior in a given situation. This focal belief is the foundation of human motivation and action (Bandura, 2004). People tend to avoid tasks and situations they believe exceed their capabilities, but they undertake and perform assuredly activities they judge themselves capable of handling (Bandura, 1977). Bandura defines self-efficacy as people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances. It is concerned not with the skills one has but with judgments of what one can do with whatever skills one possesses (Bandura, 1986). Stated another way, self-efficacy is the confidence a person feels about performing a behavior, including confidence in the ability to overcome barriers to performing the behavior (Baranowski et al, 2004).

Self-efficacy is based on four principle sources of information: performance attainment, vicarious experiences of observing the performances of others, verbal persuasion and allied types of social influences, and physiological states from which people partly judge their capableness (Bandura, 1986). Performance attainment is the most influential source of self-efficacy. Through mastery experiences, people learn that they are capable of performing specific behaviors under specific conditions. Successes raise efficacy appraisals; repeated failures lower them, especially if the failures early in the course of events and do not reflect lack of effort or adverse external circumstances (Bandura, 1986). Vicarious experiences of observing the performances of others is a source of efficacy in that people persuade themselves that if others can perform the behavior, they should be able to achieve at least some improvement in performance (Bandura, 1986). As discussed earlier, by watching others, people develop rules for behavior. Armed with these rules, and seeing successful capabilities of others' behavior, people then feel they can behave similarly in similar situations. Verbal persuasion is widely used to try to talk people into believing they possess capabilities that will enable them to achieve what they seek (Bandura, 1986). People who are persuaded that they have the capabilities to perform a behavior are more likely to try harder to perform the behavior and are more likely to persevere in the face of obstacles in performing a behavior, Bandura argues. The final source of self-efficacy is physiological states. People rely partly on information from their physiological state in judging their capabilities (Bandura, 1986). People read their physiological states as either indicators of efficacy or inefficacy; for example, cardiac patients who become tired and out of breath when exercising for cardiac rehabilitation may interpret this response to exercise as signs of cardiac distress, reducing their efficacy for physical activity in rehabilitation.

Self-efficacy is a central construct of the Social Cognitive Theory. As Bandura states, "among the mechanisms of personal agency, none is more central or pervasive than people's beliefs in their capability to exercise some measure of control over their own functioning and over environmental events" (Bandura, 1997). Judgments of efficacy determine how much effort a person will expend and how long they will persevere in the face of difficulty, obstacles, or aversive experiences. The stronger their perceived self-efficacy, the more persistent are their efforts (Bandura, 1986).

Self-regulation

Health habits are not changed by an act of will; they require motivational and self-regulatory skills (Bandura, 2004). In the exercise of self-directedness, people adopt certain standards of behavior that serve as guides and motivators and regulate their actions anticipatorily through self-reactive influence; in this way, human behavior is self-regulated (Bandura, 1991). Self-regulation allows people to set goals, to track their progress towards goals, and to evaluate their capabilities to perform behaviors in given situations. Self-regulation, as outlined by Bandura, has three sub-functions: self-monitoring, judgmental, and self-reactive influence (Bandura, 1991).

Success in self-regulation partly depends on the fidelity, consistency, and temporal proximity of self-monitoring. People cannot influence their own motivation and actions very well if they do not pay adequate attention to their own performances, the conditions under which they occur, and the immediate and distal effects they produce (Bandura, 1991). Self-monitoring occurs through self-observation. By systematically varying things in their daily lives and noting the accompanying personal changes, people can discover what factors influence their psychosocial functioning and sense of well being (Bandura, 1991). Self-observation provides information needed for setting realistic goals and for evaluating one's own progress towards those goals. Goal setting enlists evaluative self-reactions that mobilize efforts towards goal attainment (Bandura, 1991). Being able to set goals and monitor progress towards goals can become a motivating force for behavior. Self-monitoring is most effective in motivating behavior when the goals for the behavior are focused on proximal effects rather than distal effects, when the effect of the behavior is clear and direct rather than ambiguous, when the person is motivated to change behavior, and when the behavioral domain is valued so that the behavior change produces self-satisfactions that raise aspirations (Bandura, 1991).

Whether a given performance is regarded favorably or negatively will depend upon the personal standards against which the person is being evaluated; the judgmental sub-function accounts for the personal standards against which one monitors behavior (Bandura, 1986). Judgment standards are derived from the development of personal standards, through social referential comparisons, through the valuation of activities, and through perceived performance determinants. Personal standards for behavior are developed from information conveyed by three principal modes of influence: through the reactions to one's behavior by people within the social network, through standards one develops based on personal experiences, and through the behavioral responses that members of the social network have given to other members of their social network (Bandura, 1986; Bandura, 1991). People also evaluate their performances in relation to the attainments of others; we make social referential comparisons with members of our social network to judge our own behavior against their behavioral accomplishments. Humans make judgments about behaviors that they value; the more relevant performances are to one's value preferences and sense of personal adequacy, the more likely self-evaluative reactions are to be elicited in that activity (Bandura, 1991). Finally, self-reactions will vary depending on how people perceive the determinants of their behavior; they are more likely to take pride in their accomplishments when they ascribe their successes to their own abilities and efforts (Bandura, 1991).

The third subfunction within self-regulation is the self-reactive influence. Performance judgments set the occasion for self-reactive influence. Self-reactions provide the mechanism by which standards regulate courses of action (Bandura, 1991). People are motivated by behavior that they feel either produces positive tangible outcomes or positive self-reflections: behaviors that provide positive outcomes or make one feel good about oneself. As part of this subfuncion, people who provide themselves with incentives or who reward themselves as a consequence of monitoring their own behavior and meeting goals are more likely to continue the behavior. One of the factors that differentiate people who succeed in regulating their motivation and behavior to achieve what they seek from those who are unsuccessful in their self-regulatory efforts is the effective use of self-incentives (Bandura, 1991).

Outcome Expectations/Outcome Expectancies

Health behavior is affected by the outcomes people expect their actions to produce (Bandura, 2004). Outcome expectations are defined as judgments of the likely consequences a behavior will produce (Bandura, 1986). In regulating behavior by outcome expectations, people adopt courses of action that are likely to produce positive outcomes and generally discard those that bring unrewarding or punishing outcomes (Bandura, 2001). People do things to gain anticipated benefits or to avert future trouble. The anticipation of distal outcomes provides general direction for choosing activities, and it raises the level of involvement in them (Bandura, 1986). Bandura argues that outcome expectations take on three forms: physical outcomes, social outcomes, and self-evaluative outcomes. The physical outcomes include the pleasurable and aversive effects of the behavior and the accompanying material losses and benefits. The social outcomes include the perceived approval and disapproval of the behavior from members of one's social network. The self-evaluative outcomes include the positive and negative self-evaluative reactions to one's health behavior and health status (Bandura, 2004). These self-evaluative reactions are based on personal standards adopted through past experiences and observational learning, which also serve to regulate behavior.

Outcome expectancies are the values that a person places on a particular outcome (or outcome expectation); expectancies influence behavior according to the hedonic principle: if all other things are equal, a person will choose to perform an activity that maximizes a positive outcome or minimizes a negative outcome (Baranowski et al, 2004). The influence that outcome expectations have on behavior depends on the outcome expectancies. According to expectancy-value theories, performance level is a multiplicative function of expectancy that behaving in a particular way will lead to a given outcome and the value of that outcome (Bandura, 1986). Therefore, if a person believes that an outcome will result as a consequence of behavior and if he or she values that outcome, he or she is more likely to change behavior based on the outcome expectation/expectancy than if the person either believed the outcome would occur but didn't care about the outcome or if the person cared about the outcome but did not believe that the outcome would result.

Perceived Environment

The environment refers to those objective factors that can affect a person's behavior but that are physically external to that person (Baranowski et al, 2004). The perceived environment has two components: the perceived physical environment and the perceived social environment. The perceived physical environment refers to the real, distorted, or imagined components of the physical environment in which the behavior is operating. Features of the physical environment include place, time, physical features, and activity (Baranowski et al, 2004). By choosing and shaping their environments, people can have a hand in what they become (Bandura, 2001). Behavior partly determines which of the many potential environmental influences will come into play and what forms they will take; environmental influences, in turn, partly determine which forms of behavior are developed and activated (Bandura, 1986). The ways in which we evaluate our physical environment influence our attitudes, beliefs, fears, and affect about behaving within the environment, subsequently influencing behavior.

The perceived social environment refers to the real, distorted, or imagined components of the social environment in which the behavior is operating. Features of the social environment, also referred to as the social situation, include family members, peers, colleagues, friends, and anyone else in the social network. Within SCT, behavior is a function of a shared environment with other members of the social network and their behavior and personal characteristics, all of which function within a larger environment (Baranowski et al, 2004). The social environment provides an especially wide latitude for creating conditions that can have a reciprocal effect on one's own behavior. People can converse on a number of topics, they can express different interests, and they can pursue a variety of activities (Bandura, 1986). The social environment provides a network of models through which observational learning can occur. Interacting with members of our social network provides evaluative standards by which we can evaluate our own behavior. Reinforcement and appraisal from members of our social network can provide incentive and motivation for behavior. Because most performances are evaluated in terms of social criteria, social comparative information figures prominently in self-efficacy appraisal (Bandura, 1986).

Social Support

People need to learn how to enlist social support to sustain their behavioral efforts (Bandura, 2004). Social support comes in the form of verbal or behavioral actions in support of a given behavior. There are four types of social support that members of the social environment can provide: instrumental social support, informational social support, emotional social support, and appraisal social support. Instrumental social supports are tangible resources that aid in behavioral processes. An example may be a ride to the gym to enable an individual to be physically active. Informational social supports are rules or information which enables the behavioral processes. An example may be a member of the social network teaching a friend how to ride a bicycle for physical activity or informing the friend of the gym's operational hours. Emotional social support is the affective support that a member of the social network provides to enable a behavior. An example may be empathy and encouragement for overcoming obstacles in being physically active. Appraisal social support is reinforcement that members of the social network provide that can motivate behavior. An example would be a father expressing pride in his child for scoring goals in a game or buying him or her ice cream to reward the job well done.

The impact that social support has on behavior will depend on its nature. Bandura argues that while social support is important for behavior, it will not directly impact behavior: "Converging evidence across diverse spheres of functioning reveals that the social support has beneficial effects only if it raises people's beliefs in their efficacy to manage their life circumstances… Effective enablers produce the type of support and guidance that is conducive to self-efficacy enhancement for personal success" (Bandura, 2004). Social support therefore seems to have a mediating, rather than a direct, effect on behavior through self-efficacy enhancement.

Behavioral Capability

Behavioral Capability is the only construct to fall under the behavioral domain within the model of Triadic Reciprocality. Effective functioning requires that people develop competencies and skills (Evans, 1989). Behavioral capability is the knowledge and skills required to perform a specific behavior. The concept behavioral capability maintains that if a person is to perform a particular behavior, he or she must know what the behavior is (knowledge of the behavior) and how to perform it (skill) (Baranowski et al, 2004).

Interrelationships between Constructs

Based on the literature, I have proposed a framework for the Social Cognitive Theory which depicts both the model of Triadic Reciprocality and models that attempt to explain ways in which the constructs within the environmental, behavioral, and personal/cognitive domains interact. As Bandura expressed, complex and dynamic relationships among the constructs within each domain occurs: “It should be noted in passing that reciprocal processes also operate within each of the three constituent factors.” (Bandura, 1986). This final model, representing the Social Cognitive Theory as I have come to interpret it, is depicted in Figure 2.2. While any theorist could argue that multiple constructs could be included in each of the three domains of Triadic Reciprocality, only the primary constructs addressed by Bandura (1986) and Baranowski et al (2004) are addressed here: the environmental domain accounts for the relationships between the perceived physical and social environments and social support; the behavioral domain accounts for the relationship between behavioral skills and knowledge and behavioral capability; the personal/cognitive domain accounts for the relationship between self-efficacy, self-regulation, and outcome expectations/outcome expectancies.

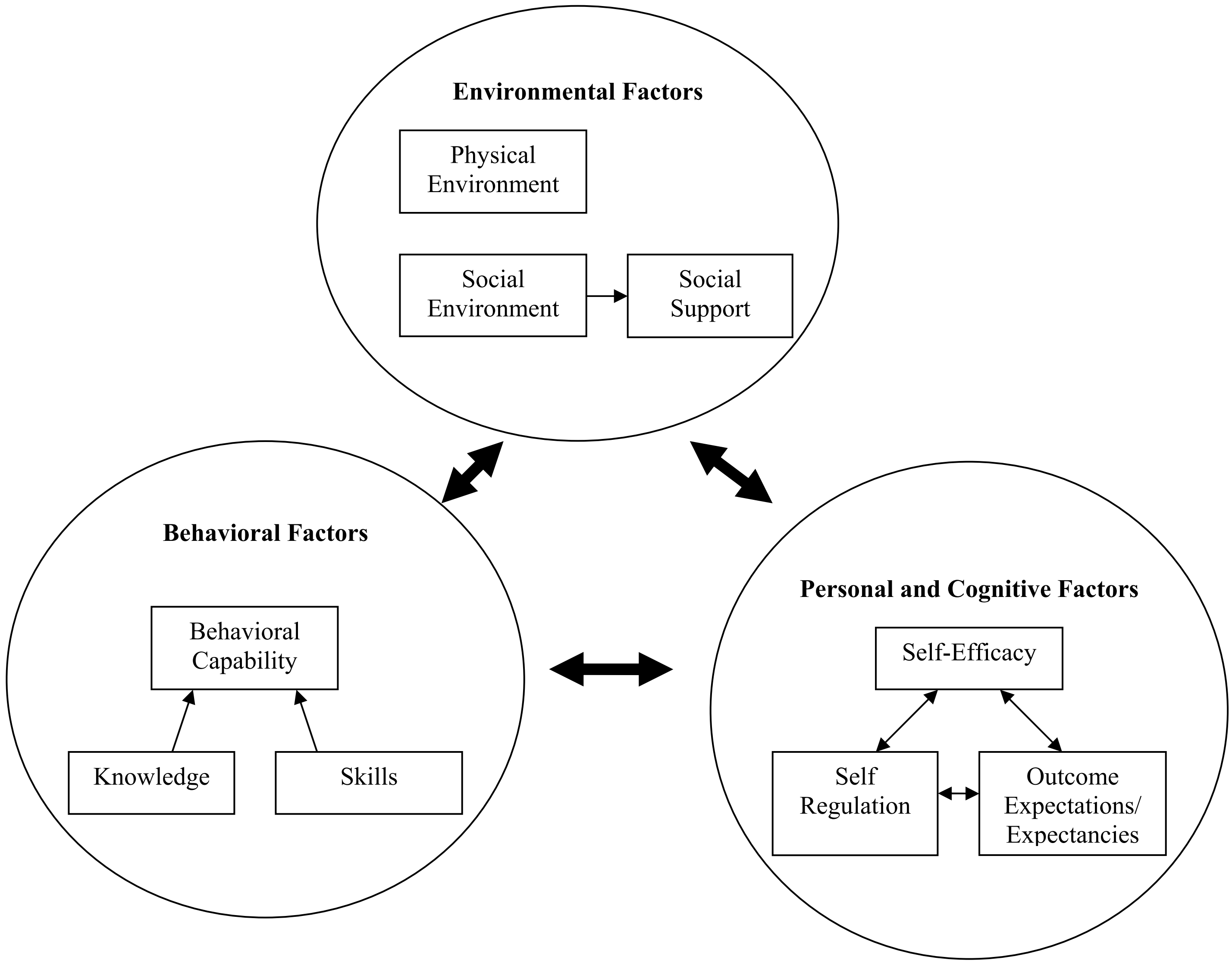

Figure 2.2: Proposed SCT Model

One major construct was identified as contributing to the behavioral domain, and that was behavioral capability. By definition, behavioral capability is the attainment of skills and knowledge necessary to perform a behavior. Therefore, skill and knowledge are placed in this domain to predict behavioral capability. One may argue that this domain covers characteristics of the behavior itself, rather than behavioral skills and knowledge of the person. I would argue, however, that the knowledge and skills required of a behavior are the characteristics of the behavior. An example can be found within physical activity, and more explicitly in the behavior of engaging in a game of soccer. One cannot engage in the behavior of playing soccer unless knowledge of the rules and the skills necessary to play the game have been acquired. The characteristics of the game itself are the rules, dribbling, kicking, tactics, etc. Those specific characteristics must be adopted by the individual in order for the behavior itself to be a possibility. The constructs within the personal/cognitive and environmental domains influence the acquisition of knowledge and skills inherent to behavioral characteristics.

Within the environmental domain are the constructs of perceived physical environment, perceived social environment, and social support. The perceived social environment should predict social support because it is the members of the social environment, or social network, who provide the social support that enables behavior. Bandura states, however, that the social environment is not sufficient to change behavior on its own. This idea is reflected upon in the earlier section addressing social support. The primary influence that the social environment and social support have on behavior occurs through the mediating effect that self-efficacy has on behavior:

> "In SCT, sociostructural factors operate through psychological mechanisms of the self-system to produce behavioral effects. Thus, for example, economic conditions, socioeconomic status, and educational and family structures affect behavior largely through their impact on people's aspirations, sense of efficacy, personal standards, affective states, and other self-regulatory influences, rather than directly." (Bandura, 2001)

Finally, there appears to be a dynamic and reciprocal relationship between the constructs within the personal/cognitive domain: self-efficacy, self-regulation, and outcome expectations/outcome expectancies. It is clear within the literature that self-efficacy should impact both self-regulation and outcome expectations/outcome expectancies. Perceived self-efficacy occupies a pivotal role in the causal structure of SCT because efficacy beliefs affect adaptation and change not only in their own right, but through their impact on other determinants (Bandura, 2001). Looking first at the ability of self-efficacy to influence self-regulation: the stronger the perceived self-efficacy, the higher the goals people set for themselves and the firmer their commitment to reach those goals. Examining the ability of self-efficacy to impact outcome expectations, those of high efficacy expect to realize favorable outcomes; those of low efficacy expect their efforts to bring poor outcomes (Bandura, 2004). In the following statement, Bandura reflects upon the influence that self-efficacy has on both self-regulation and outcome expectations:

> "Efficacy beliefs play a central role in the self-regulation of motivation through goal challenges and outcome expectations. It is partly on the basis of efficacy beliefs that people choose what challenges to undertake, how much effort to expend in the endeavor, how long to persevere in the fact of obstacles and failures, and whether failures are motivating or demoralizing. The likelihood that people will act on the outcomes they expect prospective performances to produce depends on their beliefs about whether or not they can produce those performances." (Bandura, 2001)

Self-regulation and outcome expectations/outcome expectancies should reciprocally influence self-efficacy, accounting for the bi-directional relationships between these constructs and self-efficacy in the personal/cognitive domain. On the self-regulation side, if someone enhances their ability to set proximal goals and self-monitor their progress towards those goals, they should be able to identify the attainment of the goals, providing mastery experiences, which should subsequently improve self-efficacy. Similarly, outcome expectations/expectancies should predict self-efficacy because the amount of effort that a person allocates towards a behavior and his or her perseverance through obstacles depends on the outcome he or she expects to result from the behavior and how much he or she values that outcome. The anticipation of an outcome that one values will motivate one to place more effort in the behavior and persevere through obstacles, leading to mastery experiences and enhanced self-efficacy.

The final arrow within the personal/cognitive domain accounts for the reciprocal relationship between self-regulation and outcome expectations/outcome expectancies. The valued anticipated outcomes become the targets for proximal and distal goals within self-regulation. Through self-monitoring and self-reflection an individual is able to track progress towards proximal and distal goals (anticipated outcomes), which could lead to the setting of subsequent proximal goals to reach anticipated outcomes as part of the distal goals. The more one realizes he can achieve through self-regulatory processes, the higher he may set his sights for future outcomes. This final bi-directional arrow completes the triadic reciprocal relationship that appears to influence self-regulation, self-efficacy, and outcome expectations/expectancies. Similar to the foundational model of Triadic Reciprocality, I would project that if one construct were targeted, the others would be influenced and behavior would change. To optimize the impact that the personal/cognitive domain has on behavior, however, I would suggest targeting all three of the constructs within the personal/cognitive domain.

Summary of Social Cognitive Theory

Social Cognitive Theory provides a very complex and interactive framework between environmental factors, personal and cognitive factors, and behavioral factors to explain or predict behavior. The underlying foundation of SCT is Triadic Reciprocality. Underlying the theory are five distinctly human capabilities: symbolizing capability, forethought capability, vicarious capability, self-regulatory capability, and self-reactive capability. From these five underlying human capabilities stem many constructs, which can be viewed to fall under the domains of the model of Triadic Reciprocality. The most commonly cited constructs, presented here, were perceived environment, social support, behavioral capability, self-efficacy, self-regulation, outcome expectations, and outcome expectancies. By incorporating the environment, the person, and behavior, SCT provides a framework for designing, implementing, and evaluating comprehensive behavioral change programs (Baranowski et al, 2004).

Section Two: Social Cognitive Determinants of Physical Activity

The research process must begin with determining relationships among variables. Researchers in health education use descriptive research to identify the determinants of physical activity and to test the ability of psychosocial theories, such as the Social Cognitive Theory, to predict behavior. Such studies provide insight to the utility of the theory for potentially changing behavior and they help to identify priority mediators to target through intervention. Theory guides intervention, so it is important to identify which of the theoretically based relationships hold up in explaining variation in physical activity (Motl, Dishman, Saunders, Dowda, Felton, Ward, & Pate, 2002). Because the current study uses SCT as a theoretical basis for developing an adolescent physical activity intervention, the literature review pertaining to the determinants of adolescent physical activity was restricted to those SCT constructs identified in section one of this review.

Eight studies were identified which explicitly examined the ability of SCT constructs to predict adolescent physical activity behavior. In each of these studies, Pearson product moment correlations were examined between the SCT determinants and physical activity behavior. Identification of social-cognitive variables that correlate with physical activity represents one approach that can inform interventions designed to increase physical activity (Motl et al, 2002). Six of the studies went beyond simple correlational analysis to examine the ability of multiple regression models containing SCT constructs to explain variance in physical activity behavior.

Many of the SCT constructs have several properties, lending themselves to differing operational definitions between studies. For example, self-efficacy can be defined as the ability to overcome barriers or a person's perceived confidence to engage in the behavior in different situations; self-regulation can be examined in terms of self-monitoring, goal setting, or self-reflection. It is important to therefore assess how the constructs within the domains of Triadic Reciprocality have been operationalized in the associational studies predicting physical activity.

As outlined in the previous section of this review, the personal/cognitive domain considers three inter-related constructs: self-efficacy, self-regulation, and outcome expectation/outcome expectancies. Within the physical activity literature, self efficacy has been operationally defined in three ways. The primary operational definition used is self-efficacy to overcome barriers to physical activity or perceived ability to exercise despite obstacles (Reynolds et al, 1990; Zakarian et al, 1994; Motl et al, 2002; Petosa et al, 2003; Sallis et al, 1999; Winters et al, 2003). Self-efficacy to overcome barriers is one of the most commonly studied correlates of adolescent physical activity (Sallis, Prochaska, & Taylor, 1999). One study measured self-efficacy as perceived sport competence (Biddle & Brodney, 1996). Another study defined self-efficacy through three components: the perceived ability to seek social support for a behavior, the perceived ability to overcome barriers, and as the perceived ability to choose physical activity over competing behavioral options (Trost, Pate, Saunders, Ward, Dowda, & Felton, 1997). In both of the studies assessing self-regulation, it was operationally defined as the personal regulation of goal-directed behavior, and the components of self-regulation measured included goal-setting, self-monitoring, gaining and maintaining social support, planning to overcome barriers, and securing reinforcements (Petosa, Suminski, & Hortz, 2003; Winters, Petosa, & Charlton, 2003). Outcome expectations/outcome expectancies have been measured in three ways. Motl et al (2002) defined outcome expectations as perceived expectations for performing a behavior. Trost et al (1997) defined outcome expectations as beliefs about physical activity outcomes. Both Petosa et al (2003) and Winters et al (2003) measured the combined outcome expectations/outcome expectancies constructs and defined them as the interaction between a person's estimate that a behavior will lead to an outcome and the value placed on the outcome.

The environmental domain contains the constructs perceived physical environment, perceived social environment, and social support. Three studies were identified which assessed variables related to the physical environment. One study was measured it as perceived like or dislike of physical education and access to sporting or fitness equipment at home (Trost et al, 1997). A second study examined the physical environment as access to play space, play rules, supervised programs, and environmental barriers (Sallis, Prochaska, & Taylor, 1999). Zakarian et al (Zakarian, Hovell, Hofstetter, Sallis, & Keating, 1994) operationally defined the physical environment as perceptions of neighborhood safety and access to exercise facilities.

The social environment has been operationalized as adult modeling, exercise role-identity, direct social influence from friends and family, and as a combination of factors. The social environment operationalized as adult modeling is defined as the frequency of participation of parents and teachers in active sports and physical activities (Biddle et al, 1996). Operationalized as exercise role-identity, the social environment is a form of self-definition developed by actions in a social context (Petosa et al, 2003). Operationalized as direct social influence from friends and family, the social environment is modeling and social support from peers and family members (Reynolds, Killen, Bryson, Maron, Taylor, Naccoby, & Farquhar, 1990). Three studies examined the social environment through multiple factors. Trost et al (1997) measured the social environment as perceived physical activity habits of parents and peers, participation in school sports, participation in community sports, and involvement in community physical activity organizations. Sallis et al (1999) examined the social environment as a parent physical activity index, importance of child's physical activity, parent enjoyment of activity, fees paid for child activity, a family support index, social barriers, and a parent body mass index. Zakarian et al (1994) examined family modeling, teacher modeling, coach modeling, and neighborhood modeling as they related to minority adolescent physical activity.

Five studies examined social support. The Biddle et al (1996) study operationalized social support as adult encouragement, defined as the frequency and intensity of encouragement from parents and teachers for participation in sports and physical activities. Trost et al defined social support as social influences, or perceptions of friend or family encouragement for physical activity or participation in physical activity with the individual (Trost, 1997). Winters et al (2003) operationalized social support as social situation, defined as instrumental social support, social encouragement, and social expectations that are provided by friends and family members for physical exercise. Petosa et al (2003) study measured social support as social support for exercise provided by friends and social support for exercise provided by family. Zakarian et al (1994) examined friend support, teachers support, family support, and coach support.

The third domain is the behavioral domain, containing the constructs of behavioral knowledge and behavioral skills. Biddle et al (1996) operationalized knowledge as the knowledge of the health benefits of exercise. This was the only study identified to directly measure either skills or knowledge. Another construct that was identified in the SCT literature that seemed pertinent to the behavioral domain was previous exercise. One study used baseline measures of physical activity behavior to predict behavior at 4 months and at 16 months (Reynolds et al, 1990). Another study measured positive exercise experiences, defined as positive well-being, psychological distress, and fatigue during previous exercise experiences (Petosa et al, 2003).

The results from the literature review, presenting correlations between SCT constructs and physical activity behavior, are presented in Table 2.1. Because of the inconsistencies in the operational definitions for each of the constructs, as outlined above, the core SCT construct as well as the underlying (measured) property under study is presented. The table further presents the Pearson correlation between the construct and whatever type of physical activity was addressed in the study; the studies addressed either moderate or vigorous physical activity, both moderate and vigorous physical activity, or moderate-to-vigorous physical activity. This table should provide a concise synthesis on the association between SCT constructs and adolescent physical activity found within the literature.

SCT Construct	Study	Related Construct	Population	Pearson r Moderate PA	Pearson r Vigorous PA	Pearson r MVPA
Self-efficacy	Zakarian et al (1994)	Self-efficacy to exercise despite obstacles (specific conditions)	Boys and Girls (grade 9,11)	-	Boys 0.29***; Girls 0.29***	-
	Biddle et al (1996)	Perceived Sport Competence	Boys and Girls (13-14 yrs)	-	0.30**	-
	Trost et al (1997)	Support Seeking	Boys and Girls (11-14 yrs)	-	Boys 0.17; Girls 0.11	Boys 0.31*; Girls 0.07
		Overcoming Barriers		-	Boys 0.23*; Girls 0.27*	Boys 0.23*; Girls 0.26*
		Competing Activities		-	Boys 0.01; Girls 0.13	Boys 0.04; Girls 0.09
	Sallis et al (1999)	Time Barriers	Boys and girls (grades 10-12)	-	-	Boys 0.36*** Girls 0.13
		General Barriers		-	-	Boys 0.12; Girls 0.24***
	Motl et al (2002)	Self-efficacy to overcome barriers	Girls (14 yrs)	0.24***	0.31***	-
	Reynolds et al (1990)	Self-efficacy despite obstacles	Boys and Girls (14-16 yrs)	-	-	Boys 0.28; Girls 0.46
	Petosa et al (2003)	Perceived confidence to overcome barriers	Males and Females (21 yrs)	-	0.40**	-
	Winters et al (2003)	Self-efficacy to overcome barriers	Boys and girls (15 yrs)	0.15*	0.34*	-
Self-regulation	Petosa et al (2003)	Self-regulation	Males and Females (21 yrs)	-	0.41***	-

Continued

Table 2.1: Bivariate Correlations between SCT Constructs and Physical Activity Behavior

Table 2.1 Continued

SCT Construct	Study	Related Construct	Population	Pearson r Moderate PA	Pearson r Vigorous PA	Pearson r MVPA
Self-Regulation	Winters et al (2003)	Self-regulation	Boys and girls (15 yrs)	0.26^{*}	0.44^{*}	-
Outcome expectancies/ Outcome expectations	Motl et al (2002)	Expectations for behavior	Girls (14 yrs)	0.22^{***}	0.27^{***}	-
	Trost et al (1997)	Beliefs about outcomes	Boys and Girls (11-14 yrs)	-	Boys 0.22^{*}; Girls 0.09	Boys 0.32^{*}; Girls 0.08
	Petosa et al (2003)	Expectancy-values	Males and Females (21 yrs)	-	0.24^{***}	-
	Winters et al (2003)	Expectancy-values	Boys and girls (15 yrs)	0.27^{*}	0.49^{*}	-
Physical Environment	Zakarian et al (1994)	Neighborhood Saftety	Boys and Girls (grade 9,11)	-	Boys 0.06; Girls -0.01	-
		Access to Facilities		-	Boys 0.17^{***} Girls 0.11^{**}	-
	Sallis et al (1999)	Environmental Barriers	Boys and Girls (grade 10-12)	-	-	Boys 0.004; Girls 0.08
		Supervised Programs		-	-	Boys 0.07; Girls 0.12
		Play Rules		-	-	Girls 0.06
	Trost et al (1997)	Home Equipment	Boys and Girls (11-14 yrs)	-	Boys 0.10; Girls 0.15	Boys 0.17; Girls 0.12
		School Sports		-	Boys 0.10; Girls 0.09	Boys 0.05; Girls 0.11
		Community Sports		-	Boys 0.11; Girls 0.28^{*}	Boys 0.21^{*}; Girls 0.31^{*}

Continued

Table 2.1 Continued

SCT Construct	Study	Related Construct	Population	Pearson r Moderate PA	Pearson r Vigorous PA	Pearson r MVPA
	Trost et al (con’t)	Community organizations		-	Boys 0.02; Girls 0.13	Boys 0.04; Girls 0.16
Social Environment	Zakarian et al (1994)	Family Modeling	Boys and Girls (grade 9,11)	-	Boys 0.15*** Girls 0.16***	-
		Friend Modeling		-	Boys 0.20*** Girls	-
		Teacher Modeling		-	Boys 0.00; Girls 0.01	-
		Neighborhood Modeling		-	Boys 0.13*** Girls 0.09**	-
		Coach Modeling		-	Boys 0.09* Girls 0.12***	-
	Biddle et al (1996)	Adult Modeling	Boys and girls (13-14 yrs)	-	0.04	-
	Trost et al (1997)	Social Influences	Boys and girls (11-14 yrs)	-	Boys 0.23*; Girls 0.14	Boys 0.25*; Girls -0.01
	Sallis et al (1999)	Family support	Boys and girls (grades 10-12)	-	-	Boys 0.15*; Girls 0.38***
		Importance of Child’s PA		-	-	Boys 0.12; Girls 0.27***
		Social Barriers		-	-	Boys 0.05; Girls 0.08
		Parent Paid Fees		-	-	Boys 0.23**; Girls 0.13

Continued

Table 2.1 Continued

SCT Construct	Study	Related Construct	Population	Pearson r Moderate PA	Pearson r Vigorous PA	Pearson r MVPA
	Petosa et al (2003)	Exercise Role-identity	Males and Females (21 yrs)	-	0.47^{***}	-
	Reynolds et al (1990)	Social influence-friends and family behavior	Boys and Girls (14-16 yrs)	-	-	Boys 0.18; Girls 0.44
Social Support	Zakarian et al (1994)	Family Support	Boys and Girls (grade 9,11)	-	Boys 0.19^{***} Girls 0.24^{***}	-
		Friend Support		-	Boys 0.24^{***} Girls 0.14^{***}	-
		Teacher Support		-	Boys 0.04; Girls 0.01	-
		Coach Support		-	Boys 0.12^{**} Girls 0.14^{***}	-
	Biddle et al (1996)	Adult Encouragement	Boys and girls (13-14 yrs)	-	0.38^{***}	-
	Winters et al (2003)	Social Situation	Boys and girls (15 yrs)	0.15^{*}	0.26^{*}	
	Petosa et al (2003)	Social Support from Family	Males and Females (21 yrs)	-	0.16^{***}	-
	Petosa et al (2003)	Social Support From Friends		-	0.28^{***}	-
Behavioral Capability	Biddle et al (1996)	Knowledge	Boys and girls (13-14 yrs)	-	0.25^{**}	-
	Petosa et al (2003)	Previous Exercise	Males and Females (21 yrs)	0.27^{***}	-	-
	Reynolds et al (1990)	Baseline Activity	Boys and Girls (14-16 yrs)	-	-	Boys 0.47; Girls 0.65

*p<0.05, **p<0.01, ***p<0.001

Six of the studies went beyond simple correlation analysis to study the ability of multiple regression models containing SCT variables to explain variance in physical activity behavior. The results of the literature review examining regression models composed of SCT variables to explain physical activity is presented in Table 2.2. According to the results of the literature review, regression models developed containing Social Cognitive variables are able to account for 5-59% of the variance in adolescent physical activity.

Study	SCT Model Variables	Outcome Variable	Model R^2
Petosa et al (2003)	Self-regulation, social support family, social support friends, self-efficacy, outcome expectancy-values, exercise identity, and previous exercise	Days of Vigorous PA (4 weeks)	0.27
Winters et al (2003)	Social situation, strength of self-efficacy, self-regulation, outcome expectation value (controlling for gender)	Vigorous physical exercise	0.29***
	Social situation, strength of self-efficacy, self-regulation, outcome expectation value	Moderate physical exercise	0.11***
Sallis et al (1999)	Demographics, child variables (including time barriers and general barriers), social variables, environmental barriers	Physical activity level (MVPA)	0.43***
	Demographics, child variables, social variables, environmental barriers	Physical activity level (MVPA)	0.59***
Trost et al (1997)	Community sports, self-efficacy (barriers), liking physical education, race/ethnicity	Vigorous physical activity- Girls	0.26*
	Self-efficacy (barriers)	Vigorous physical activity- Boys	0.05*
	Community sports, self-efficacy (barriers)	MVPA- Girls	0.17**
	Beliefs of outcomes, community sports	MVPA- Boys	0.17**
Zakarian et al (1994)	Year in school, self-efficacy, friend support, perceived benefits, cigarette smoking, perceived barriers, and body image	Vigorous PA outside of school; Boys	0.16***
	Self-efficacy, perceived barriers, family support, year in school, unfavorable attitude towards PE, BMI, perceived benefits	Vigorous PA outside of school; Girls	0.17***
Reynolds et al (1990)	Self-efficacy, intention, stress, social influence, BMI, base-line activity	4-month post-baseline PA score	Males: 0.24*** Females: 0.45***
	Self-efficacy, intention, stress, social influence, BMI, base-line activity	16-month post-baseline PA score	Males: 0.24*** Females: 0.28***

*p<0.05, **p<0.01, ***p<0.001

Table 2.2: Multiple Regression Coefficients Showing the Ability of SCT Models to Explain Variance in Physical Activity Behavior

Several findings within this literature review are important to present. First, the ability of SCT constructs to predict moderate versus vigorous physical activity differs. In examining Table 2.1, the correlations between the constructs and the different forms of physical activity varies. This finding is supported in the results presented in Table 2.2. Winters et al (2003) tested the ability of the SCT-based regression model to explain variance in moderate and vigorous physical activity separately; results indicated that the model could explain more variation in vigorous physical activity than moderate physical activity. Similarly, Trost et al (1997) found that different variables significantly contributed the models to explain variation in vigorous physical activity versus moderate-to-vigorous physical activity among both boys and girls, and the models designed to predict vigorous physical activity were able to account for a greater amount of the variation in behavior. These findings suggests that the determinants for moderate physical activity may not be the same as the determinants for vigorous physical activity; therefore, interventions designed to change each might need to target different SCT constructs (Motl et al, 2002 & Winters et al, 2003). Future research should distinguish between moderate and vigorous physical activity rather than compiling them as MVPA.

Second, the ability to predict physical activity with SCT constructs differs for males and females. Examining Table 2.1, the correlations between the constructs and the physical activity variables are different for males and females. Further, in a study designed to determine those predictors of physical activity which explained the differences in behavior among male and female adolescents, Trost et al (1996) found that self-efficacy to overcome barriers was significantly higher among males than females and was a significant covariate for vigorous physical activity and for moderate-to-vigorous physical activity; gender differences in behavior could be minimized to 5-7% when controlling for self-efficacy to overcome barriers in this study.

Examining Table 2.2, the variables that significantly contribute to the regression equations differs between genders. It also appears that these models are able to account for more of the variation in female behavior than male behavior. Examining specifics, the Reynolds et al (1990) study indicated that for males, self-efficacy and baseline activity were the only variables to contribute significantly to the regression model explaining variance in 4-month physical activity; for females, baseline activity, intentions, stress, and social influence contributed to the model. In the regression models explaining variance in 16-month physical activity, baseline activity and intention contributed to males' behavior, while baseline activity, intention, and stress contributed to females' behavior. Trost et al (1997) demonstrated that different variables contribute to models explaining variance in behavior between genders; the study also found varying results for the ability to explain variance in activity levels among boys and girls. The models explaining behavior among females were able to account for 17-26% of the variance in behavior, while the models explaining behavior among males were able to account for 5-17% of the variation. The model developed by Sallis et al (1999), predicting high school male behavior, was able to account for 43% of the variance in physical activity levels; neither demographics nor environmental variables contributed to the model, child variables (including measures of self-efficacy) predicted 35.4% of the variance, and social variables predicted 6.5% of the variance in physical activity levels. The model predicting female behavior was able to account for 58.6% of the variance in physical activity levels; once again, neither demographics nor environmental variables contributed to the prediction of behavior, but child variables accounted for 42.4% of the variance and social variables accounted for 17.2% of the variance in physical activity levels. These findings suggest that the determinants of physical activity differs between males and females; therefore, interventions targeted to change behavior may be more effective if they are developed separately for males and females, targeting those constructs which are most predictive of the behavior for the specific gender.

Summary of Determinants

The findings from this review suggest a several key points. First, the constructs within the SCT that are used to predict physical activity behavior have been used with widely ranging operational definitions. This makes if very difficult to compare studies and to assess the utility of the theory in predicting or explaining behavior. One of the primary objectives of using theory in the study of health education and health behavior is to be able to generalize findings; in order to enhance our ability to generalize findings, more standardized operational definitions for the constructs must be developed. This could also enhance our ability to develop standardized, valid and reliable measures of the constructs to reduce the errors in measurement, leading to the ability to explain more variation in behavior.

Second, the SCT is able to predict adolescent physical activity behavior, but the ability of the theory to predict behavior varies by gender and according to the operational definition of physical activity. Based on the results of the multiple regression analyses, the SCT can explain 11% of the variance in moderate physical activity (MPA), 5-29% of the variance in vigorous physical activity (VPA), and 17-59% of the variance in moderate-to-vigorous physical activity (MVPA). The theory can explain 5-43% of the variance in behavior among adolescent males and 17-59% of the behavior among females. The largest proportion of the variance in adolescent physical activity levels (43.3% for boys and 58.6% for girls) can be captured by examining constructs from multiple domains (Sallis et al, 1999). This illustrates the complexity of adolescent physical activity and suggests, as has been outlined by the SCT literature, that determinants from multiple domains must be targeted to impact behavior.

Third, the ability of the individual constructs to predict behavior varies. Based on the results of the correlations presented in Table 1, no SCT is better at predicting MPA than VPA. Several constructs are better at explaining VPA than either MPA or MVPA, including: self-efficacy, self-regulation, outcome expectations/expectancies, and social support. Two constructs appear to predict male behavior better than female behavior: outcome expectancies/expectations and the social environment. Two constructs appear to predict female behavior better than male behavior: self-efficacy and knowledge. Trost et al (1996) found that self-efficacy to overcome barriers was higher among adolescent boys than girls and that the construct explained differences in behaviors among genders (Trost, Pate, Dowda, Suanders, Ward, & Felton, 1996); this finding further illustrates the inconsistencies within the literature.

The results of this review will help to direct the targets for an adolescent physical activity intervention. When looking at the individual constructs, self-efficacy is the most commonly studied SCT determinant of physical activity and has consistently shown to be associated with behavior, with correlations ranging from 0.07-0.46. While less often studied, both outcome expectations/outcome expectancies and self-regulation appear to be highly related to adolescent physical activity as well, with correlations ranging from 0.25-0.49 for outcome expectations and correlations ranging from 0.41-0.44 for self-regulation. Measures of parental support, direct help from parents, and support from "significant others" has been consistently documented as a determinant of adolescent physical activity (Sallis, Prochaska, & Taylor, 1999). Within the studies presented in this review, the social environment was inconsistently associated with adolescent physical activity, with correlations ranging from 0.00-0.23. Social support similarly had varying associations with physical activity, with correlations between it and the constructs ranging from 0.01-0.28. These inconsistencies may be due to the varying operational definitions for the construct. Bandura suggests that, within SCT, the social environment is insufficient to change behavior on its own; rather, the social environment indirectly influences behavior through the mediating effect that self-efficacy has on behavior (Bandura, 2004). This mediating effect should be examined when determining the influence of the social environment on behavior. The physical environment appears to be a null predictor of adolescent physical activity. Behavioral capability is the most understudied of all the SCT constructs.

While studying the determinants of physical activity and the ability of the theoretical constructs to predict variance in behavior is important, further research is needed to assess the causal relationships between the SCT constructs and behavior. Descriptive studies, such those presented here, further our understanding of the utility of SCT to predict behavior and they guide the development of interventions. Based on this review, self-efficacy, outcome expectancy values, self-regulation, and social situation have been the most consistently documented predictors of adolescent physical activity and will therefore be targets for intervention.

While the theory can be used to predict or explain health behaviors, there are some problems within this body of literature. First, none of the studies cited tested the ability of the entire theory, composed of each of the constructs cited in the first section of the review, to explain behavior. Several studies were identified which cited the use of SCT but then only tested the ability of one SCT construct to predict behavior. Second, none of the studies assessed the relationships among the SCT constructs. Bandura clearly states that researchers should expect to find dynamic and reciprocal relationships between the constructs: "It should be noted in passing that reciprocal processes also operate within each of the three constituent factors" (Bandura, 1986). These inter-relationships should be accounted for, as they will decrease the ability of the theory to explain variance in the behavioral outcome.

Future research could focus on several advancements which would increase our ability to use the theory in studying health behaviors. First, more standardized operational definitions for constructs should be developed, followed by improvements in measurement of those constructs. This would make comparisons across studies more feasible and would improve the potentiality of explaining variance in behavior. Second, studies should attempt to explain or control for the inter-relationships among the constructs. One of the problems with SCT is that it is a very complex and dynamic theory, and it incorporates reciprocal relationships in several stages of the theory, making it difficult to test the theory. Bandura does not propose a framework through which this theory could be tested by analysis such as structural equation modeling. Future researchers should attempt to develop a framework through which the interrelationships among the constructs could be accounted for.

Section Three: Evaluation in Health Education

The primary purpose of evaluation in health education is to determine the efficacy and effectiveness of interventions. A secondary purpose is to test educational theories, the relationships between constructs within educational theories, and the link between the educational constructs, behavior, and a health outcome. As Brian Flay (1986) proposed, an intervention's efficacy should be tested before its effectiveness. Efficacy is established by testing the intervention under ideal circumstances, with maximum control. An efficacious intervention should then be evaluated for its effectiveness. Evaluations of program effectiveness are tested under real world circumstances. Most often, evaluations are conducted for the purpose of reporting back to funding agencies. A funding agency will fund a health promotion program for a specific purpose, and they need to be assured that the program they are funding is meeting the program goals. If they are not, the program needs to be revised and re-evaluated or the program team faces a loss of funding.

Evaluation in health education links research to practice. If the role of the health education practitioner is to plan and develop programs, the role of the researcher in health education is to test the program's educational, behavioral, and health impact. These roles often occur simultaneously and within the same research team. In order to test a program's educational, behavioral, and health impact, three components of an evaluation must be completed. The process evaluation examines the fidelity of program implementation. The impact evaluation examines the effect that the intervention had on educational constructs and on behavior; at this point, the evaluator can also examine construct validity of the treatment, whether changes in the educational constructs mediated changes in behavior. The outcome evaluation examines the effect that the intervention had on health, or measures of morbidity and mortality. As Flay (1986) suggests, the outcome evaluation usually comes in the later stages of evaluation, during the effectiveness trials.

Process Evaluation

The first phase of evaluating the efficacy and effectiveness of a health intervention is the formative evaluation, or the process evaluation. Formative evaluations are a necessary first step in developing and stabilizing programs before evaluating behavioral or health outcomes. The formative evaluation refers to the provision of short-loop diagnostic feedback about the quality and implementation of (and immediate response to) methods, activities, or programs (Green & Lewis, 1986). The purpose of the formative evaluation is to provide feedback on the program implementation, the site response, the recipient response, the practitioner response, and the competencies of personnel. Issues of implementation deal with the appropriateness, integrity, and quality of the implemented program- the degree to which the program was implemented as designed. Issues of site response deal with the organizational and economic circumstances that may change the way the program is delivered at a specific site; for example, an organization may alter a program to reflect the organization's goals rather than the program's goals. Issues of recipient response deal with the participants' movement through the program, the quality of their progression, and their level of satisfaction with program components. In this phase, measures are taken on subject compliance and attrition. Issues of practitioner response assess the degree to which the practitioner delivered the program carefully and systematically, as designed, as well as their insights and feedback. Finally, assessing the competencies of personnel involves collecting feedback on the level of knowledge, skill, and attitudinal performance of the various professionals and nonprofessionals who deliver the program (Green & Lewis, 1986). Within Flay's framework for testing the efficacy and effectiveness of health interventions, the process evaluation would test the availability and acceptability of the intervention; that is, the degree to which the targeted audience accepted the program (dose received) and the degree to which the program was delivered as designed (dose delivered).

One of the more important components of the formative, or process, evaluation is the implementation evaluation, an assessment of the fidelity of treatment delivery. Type III error occurs when inferences are made about the causal link between a program and its impact on outcome measures when the program was not delivered with adequate fidelity. Fidelity of implementation has been defined as "the extent to which actual use of an innovation corresponds to intended or planned use" (Basch, Sliepcevich, Gold, Duncan, & Kolbe, 1985). Measures of program fidelity include: the percentages of curricular activities implemented as planned, modified, or omitted; the extent to which each activity was implemented; and, the extent to which program participants completed the activities as planned. Studying implementation of a program may be undertaken for at least four reasons: 1) improving understanding about the best techniques for promoting implementation, long-term maintenance, and further program dissemination; 2) providing accountability to agencies that allocated resources; 3) enhancing the validity of summative evaluations; and 4) learning how to modify programs and policies in order to improve their effectiveness and application (Basch et al, 1985). Implementation evaluation includes assessments of program availability; without adequate implementation evaluation, it is impossible to determine whether a lack of program effects is due to inadequate program delivery or an inefficacious treatment (Flay, 1986).

Impact Evaluation

Once conclusions can be drawn about the program being delivered with adequate fidelity, evaluations about program impact can be conducted (Green & Lewis, 1986). Evaluation here focuses on the immediate impact the program has on one or more variables of education (the educational constructs) and on behavior. Assuming that a program was delivered with adequate fidelity, the impact evaluation allows the research team to draw conclusions about the efficacy and effectiveness of the intervention at changing the predisposing, enabling, and reinforcing factors targeted and about the efficacy and effectiveness of the intervention at changing the targeted behavior. The impact evaluation is a more proximal indicator of the effectiveness of a program and is measured with valid, reliable, and acceptable measures of the educational constructs and the behavior.

An important causal link in the evaluation process is the link between the change in theoretical or educational constructs targeted by the intervention and the change in behavior. The assessment of this causal link is called construct validity of the treatment, and it should occur as part of the impact evaluation. Educational interventions are designed based on educational theories, which provide frameworks by which educational constructs interact to change behavior. The theories tell us what constructs to target, in what order, and how constructs should mediate changes in behavior. Through an assessment of construct validity of the treatment, the evaluator can test the theory under which the program was developed, making the causal link between changes in educational constructs and changes in behavior.

Construct validity of the treatment is often done mediation analysis, as most theories imply that educational constructs mediate behavioral change. McCaul and Glasgow (1985) and Baron and Kenney (1986) suggest a three step multiple regression analysis to test the mediating effect of constructs targeted by intervention on behavior to assess construct validity of the treatment. First, the outcome measure (behavior) is regressed on the treatment to assess whether the intervention changes behavior (whether the program accounts for a significant portion of the variance in the behavior). Second, the changes in the SCT constructs should be regressed on the treatment level to assess whether the intervention can account for a significant portion of the variance in changes in the constructs. The third and final step in the analysis assesses whether the effect of the treatment on the behavioral outcome is attenuated when the effect of the SCT construct on the behavior is controlled for (Baron & Kenny, 1986). To establish mediation, the following conditions must hold: first, the independent variable must affect the mediator in the first equation; second, the independent variable must be shown to affect the dependent variable in the second equation; and third, the mediator must affect the dependent variable in the third equation. If these conditions all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in the third equation than in the second (Baron & Kenny, 1986). If an assessment of changes in the constructs targeted through the intervention is not completed, the evaluator will not know how behavior change occurred or did not occur. Therefore, construct validity of the treatment is a crucial component of evaluating the efficacy and effectiveness of the intervention.

Outcome Evaluation

The final step in the evaluation process is the outcome evaluation, an assessment of whether the intervention was sufficient to changes health measures. An evaluation of adequate implementation fidelity allows us to make causal inferences about the program's effect on educational constructs and behavior. An evaluation of construct validity of the treatment allows us to draw causal inferences about changes in the constructs leading to changes in behavior through the intervention and to test the theoretical models by which we plan programs. The final link to be drawn would be the causal inference about changes in the behavior leading to changes in the health status of the targeted population, or the attainment of the health status goal; this final link is assessed in the outcome evaluation. The outcome evaluation is a more distal measure of program impact and often uses epidemiologic data to assess changes in incidence, prevalence, morbidity and mortality associated with diseases and in measures associated with quality of life and social definitions of health problems (Green & Lewis, 1986).

Section Four: Social Cognitive Theory Based Adolescent Physical Activity Interventions

Another body of literature, which has examined the use of Social Cognitive Theory in the study of health promotion/health education, is intervention research. Clearly, as presented in section two, SCT can be used to predict or explain behavior. To develop effective interventions to assist young people to maintain or increase activity levels, the literature on correlates of physical activity should be applied to intervention design (Sallis et al, 1999). Those variables consistently found to be associated with behavior in the descriptive studies become the targets for intervention in subsequent research.

Intervention research is conducted to determine the ability to manipulate SCT constructs and subsequently behavior through educational strategies. The studies most commonly use a quasi-experimental design to compare the ability of a treatment intervention (comprised of strategies to change

SCT constructs) and a comparison intervention (usually a typical curriculum or program) to change behavior. School-based, Social Cognitive Theory intervention studies designed to increase physical activity behavior among elementary, middle school, and high school students were identified for review. The design and effectiveness of these interventions at impacting SCT constructs, physical activity behavior, and health variables will be presented. When available, the methods and results of the process evaluations will be presented as well. Several of the interventions targeted more than one behavior, and each component of the interventions will be described. The focus of this review, however, will be on the results pertaining to physical activity behavior, the educational constructs targeted to impact physical activity behavior, and the health outcomes related to physical activity behavior change, as the current intervention is being developed to increase adolescent leisure-time physical activity levels.

Elementary School Interventions

Go for Health

The Go for Health Project used Social Learning Theory strategies incorporated into classroom health education, food services, and physical education to target physical activity and nutrition promotion among 3rd and 4th students in Texas (Parcel et al, 1989). The intervention was designed to target behavioral capability (both diet and exercise), outcome expectations (diet only), and self-efficacy for healthful eating and physical activity. Strategies involved in the program included modeling activities, behavioral self-monitoring, development of new behaviors, skill development, verbal praise, and material rewards. Cues and reinforcing messages were displayed around the schools. Modified school meals and physical education curricular changes allowed students to practice the behaviors they were addressing in the classroom.

The study used a pre-test, post-test, quasi-experimental design. Two schools were assigned to the intervention group and two schools were assigned to a measurement only comparison group. Schools in the intervention group received three program components: the New School Lunch, the Children's Active Physical Education (CAPE) program, and the Go for Health classroom instruction (Parcel et al, 1989). The New School Lunch Program was a food service intervention designed to modify purchasing, menu planning, recipe development, and food preparation practices in order to reduce students' consumption of sodium and fat during school meals. The CAPE physical education program consisted of two semester-long units (6-8 weeks each) structured to influence cardiorespiratory endurance, muscular strength and endurance, flexibility, agility, and balance through enjoyable (positive expectancy) movement. The Go for Health classroom curriculum, taught during three, 2-week health education sessions, consisted of six modules: two four-week healthful eating modules and one six-week physical activity module for each grade. For each module, a 30-minute main lesson on modeling of the desired behavior, development of skills necessary for performing the behavior, and opportunities to practice the behavior was provided at the beginning of the week. A series of 5-10-minute activities was conducted during the remaining days of the week, providing students opportunities for practice and reinforcement of the skills. Each of the classroom teachers implementing the program (n = 22) was trained for one hour, twice per school year.

Cognitive and behavioral assessments were conducted at pre-test and then at 2, one-year follow-ups (Parcel et al, 1989). The cognitive measures related to exercise (behavioral capability and self-efficacy) were measured in one third-grade cohort and one fourth-grade cohort at pretest and post-test only. Self-reported behavioral measures were assessed annually with fourth graders. All assessments were conducted through questionnaires with noted reliability. Data was examined using MANOVA and repeated measures ANOVA, using both the students and the school as the level of analysis.

Results for the exercise cognitive and behavioral variables were examined. The program had a significant impact on aerobic exercise from baseline to post-test 2 ($p<0.001$) at the student level (Parcel et al, 1989). This increase in aerobic exercise was found for one intervention school and one control school only, however. Except for the students in one school, the students in the third grade showed no improvement in behavioral capability or self-efficacy for physical activity. The fourth-graders showed improvements in both behavioral capability and self-efficacy. This study showed some effectiveness for the ability of a SCT-based intervention to promote changes in exercise self-efficacy and behavioral capability among 4th grade students, but the subsequent changes in physical activity occurred in both control and intervention groups.

A process evaluation was conducted through a 41-item interview with classroom teachers, physical education teachers, food service workers, and managers at the end of the second year of the intervention (Parcel et al, 1989). The interview questions assessed information about what the implementers liked and disliked about the program, perceived program strengths and weaknesses, and any programmatic changes they would recommend. Results of the interviews showed differences in program implementation, to which the authors attribute uneven program effects. The average percent of learning activities implemented in the first year was estimated by the teachers to be 94% in one intervention school and 69% in the other and in the second year was 94% and 86%, respectively. Teachers attributed lack of time as the primary reason for not fully implementing the modules.

A second evaluation of the Go for Health intervention reported the effects of the program on children's dietary intake and physical activity during school (Simons-Morton, Parcel, Baranowski, Forthofer, & O'Hara, 1991). The effect of the program on SCT constructs was not evaluated. Physical activity was measured as the time, in minutes, of moderate-to-vigorous physical activity (MVPA) performed by the children during physical education class and was assessed using the Children's Physical Activity Observation Form (CPAOF). Each school was observed on randomly selected days over a 2-month period in the spring. Observers recorded the type and intensity of physical activity during physical education classes on a minute-by-minute basis. The intensity categories were validated against heart rate monitoring, and interobserver agreement was high (97% among 57 paired observations). Data was analyzed as the percent of class time spent in MVPA.

Results indicated an increase in the median minutes spent in MVPA and in the percent of class time spent in MVPA in the intervention schools (Simons-Morton et al, 1991). At baseline, the mean MVPA for third and fourth graders was less than 3 minutes at each school, and the medians were 2 minutes or less. At post-test, the mean minutes had increased in one intervention school to 11.7 minutes for third graders and to 15.0 minutes for fourth graders; in the other intervention school the mean minutes increased to 16.2 minutes for third graders and 16.1 minutes for fourth graders. Examining the percent of class time spent in MVPA, median baseline measures were zero in three of the four schools for both grades and less than 10% in the fourth school. At post-test, the control schools still spent less than 5% of class time in

MVPA. The median percent of class time spent in MVPA in the intervention schools had increased to 28% of class time for third graders in one intervention school and 39% of class time in the other intervention groups. The confidence intervals were non-overlapping in both of the intervention schools for third grade and one of the intervention schools for fourth grade from baseline to post-test, indicating a significant increase in the time spent on MVPA during physical education classes.

SPARK

The SPARK (Sports, Play, and Active Recreation for Kids) Program was a health-related physical education program developed to target children's physical activity during physical education and after-school (McKenzie et al, 1993; Sallis et al, 1997; McKenzie et al, 1997). Three evaluations were conducted to determine the efficacy of a combined health-related curriculum and in-service training program on the quantity and quality of elementary physical education lessons as well as student physical activity levels. Evaluations examined the one-year impact of the program on the quality of the physical education program and on the children's physical activity during class, the 2-year impact of the program on the quality of the physical education program and on children's in-class activity levels, the maintenance of the program impact 1.5 years after SPARK was terminated, and the 2-year impact of the program on SCT constructs, out-of-class physical activity, and fitness indices. Each evaluation used a pretest, post-test, quasi-experimental design. An implementation evaluation was conducted using interview and questionnaire data but results were not reported. The impact evaluations compared physical education lessons implemented by classroom teachers who participated in an extensive in-service training program to lessons taught by teachers who did not receive the training and lessons taught by physical education specialists. The primary measures examined were measured in units of time, obtained through direct observation using the SOFIT observational method. The researchers examined the frequency and length of lessons, student activity levels, lesson context, and teacher behavior. The SOFIT method has reported validity and reliability.

SPARK was first evaluated in 1993, after one-year of implementation within fourth grade classrooms (McKenzie, Sallis, Faucette, Roby, & Kolody, 1993). Twenty-eight fourth grade classrooms in 7 schools were randomly assigned to three treatment conditions: control, trained classroom teacher, and trained physical education specialist. The control classes received a typical curriculum. The teacher-training classes were taught by certified classroom teachers who received 23 hours of in-service training in physical education, as well as weekly follow-up consultations. In-service training focused on creation of teacher awareness of the program goals, differences from the former program, specific-skill training, on-going administrative support, and group support with feedback. The physical education specialist classes were taught by licensed physical education teachers who were hired specifically for the study and were trained to implement the curriculum. The SPARK lessons were taught for 30 minutes, 3 times per week and included a 15-minute fitness segment and a 15-minute sport skill segment.

Data was analyzed using ANOVA methods. Significant differences were found for student engagement in the "very active" category, energy expenditure, and time spent on fitness activities ($p<0.01$) (McKenzie et al, 1993). Children in the physical education specialist group engaged in "very active" activity for an average of 5.4 minutes per class, compared to 4.1 minutes in the teacher trained classes and 2.8 minutes in the control. Children in the physical education specialist group expended 1.5 times the energy than children in the control group. The amount of time allocated for fitness activities varied by treatment condition; classes in the physical education specialist group spent an average of 12.7 minutes on fitness, while children in the teacher trained group spent 8.5 minutes on fitness and children in the control group spent 4.2 minutes on fitness. The authors concluded that classes taught by physical education specialists provide better physical education than non-specialists.

A second evaluation was conducted to examine the 3-year impact of the SPARK program among fourth and fifth graders enrolled in the program and to evaluate the in-class maintenance of the program approximately 1.5 years after it was terminated (McKenzie, Sallis, Kolody, & Faucette, 1997). Two consecutive cohorts of fourth grade students were examined, with students being examined in both the fourth and the fifth grades, as well as in a follow-up 1.5 years later. Frequency and duration of physical education, time spent at various physical activity levels, time spent in various lesson contexts, and time spent in various teacher behavior categories, as well as MVPA were examined using the SOFIT observational method.

Results of the second evaluation indicated that physical education taught by physical education specialists provided the best physical education after 3 years of intervention (McKenzie et al, 1997). Students in the physical education specialist group participated in more minutes of MVPA per week (40.2 minutes) than students in the trained teachers group (32.7 minutes) and students in the control group (17.8 minutes). Children spent a greater proportion of time being "very active" in the physical education specialist group and in the trained teacher group (22.0% and 20.7%, respectively) than in the control group (16.5% of class-time). Children in the specialist group spent more time in fitness activities and skill drills than those in the trained teacher group, who in turn spent more time on fitness and skill drills than the control group. Children in the control group spent more time in free play than children in the specialist or the trained teacher group.

The follow-up study, conducted 1.5 years after the termination of the SPARK program, used paired t-tests to examine the maintenance of the program, comparing the physical education specialist classes (specialists withdrawn) to the trained teacher classes (McKenzie et al, 1997). No significant differences were found in the number of physical education classes taught or the average weekly minutes spent in PE between the intervention and follow-up measures for the trained teachers group. The physical activity levels among children in the trained teachers group were not significantly different between the intervention and follow-up, but children tended to spend less time in the "very active" category at follow-up (14.4 minutes per week during intervention compared to 10.4 minutes at follow-up). Children spent a significantly smaller proportion of class-time in the "very active" category at follow-up than during the intervention (22.4% of class-time during intervention; 17.9% at follow-up). Children in the specialist group had significantly less energy expenditure, time in MVPA, minutes per week in PE, time in the "very active" category at the follow-up when compared to the intervention classes. The authors concluded that the curriculum and professional development program produced maintenance of effects in student physical activity levels and teacher behavior. The removal of physical education specialists in resulted in a substantial reduction in both the quantity and the quality of physical education. Three years of training with on-site consultation was sufficient to yield long-term gains in the quantity and quality of physical education taught by trained class-room teachers.

The third evaluation reported the primary 2-year health and physical activity outcomes of the SPARK program (Sallis, McKenzie, Alcaraz, Kolody, Faucette, & Hovell, 1997). This evaluation contained two program components: the physical education component and a self-management component. The physical education component was the same component reported in previous evaluations. The self-management program was developed to teach behavioral change skills to help children generalize regular physical activity outside of school and to teach self-management skills (including self-monitoring, goal setting, stimulus control, self-reinforcement, self-instruction, and problem solving). Rewards were given out for meeting physical activity goals. This component also involved homework and monthly newsletters to stimulate parent-child interaction and support for physical activity. The following SCT constructs were therefore targeted: self-efficacy, social support from family and friends, and outcome expectations.

The SPARK intervention was found to be effective at changing physical activity in physical education class and fitness measures, but ineffective at changing physical activity outside of class and the SCT constructs (Sallis et al, 1997). As reported in previous evaluations, the program was effective at increasing the amount of physical education provided per week and at increasing MVPA and energy expenditure during physical education ($p<0.01$). The specialist-led group participated in twice as much MVPA and expended twice as many calories per week as the control group, and the teacher-led group fell in between. These changes led to significant improvements in some of the fitness measures assessed among girls. Fitness improvements were found in the mile-run and sit-ups, with effect sizes of $\eta^2 = 0.30$, comparing the specialist-led group to controls. This effect could have been due to the relatively low fitness among girls at baseline, however. There were no significant intervention effects on the out of school physical activity, with effect sizes ranging from $\eta^2 = 0.04 – 0.23$. The program was ineffective at changing self-efficacy, social support from family and friends, and outcome expectations.

CATCH

One of the more widely disseminated and widely evaluated elementary school interventions is the CATCH (Child and Adolescent Trial for Cardiovascular Health) program. CATCH was evaluated as a multi-site study, involving over 6,000 elementary (grades 3-5) students, between 1991 and 1994. CATCH was a school-based health promotion program implemented to reduce or prevent the development of risk factors for cardiovascular disease (Edmundson et al, 1996; Edmundson et al, 1996; Luepker et al, 1996; McKenzie et al, 1996; Nader et al, 1996; Stone et al, 1996; Webber et al, 1996; McKenzie et al, 2003). Twenty-four elementary schools were recruited from each of four study centers across the country. Following baseline measures, 14 schools from each study center were randomized to receive the CATCH intervention and 10 schools were assigned to the control condition (Stone, Osganian, McKinley, Wu, Webber, Leupker et al, 1996). The intervention was designed to target the development of a healthful diet, physical activity promotion, and prevention of the onset of tobacco use. The intervention included 4 school components and a family component. The school components targeted food service, physical education, smoke-free school policies, and classroom curricula. The family component included home activity programs for all grades and a family fun night for third and fourth grades. The program targeted the following SCT constructs: knowledge, skills, self-efficacy, intentions, reinforcement, social norms, models, and access to resources. Related to physical activity, the program targeted self-efficacy, positive support, and negative support.

The study was evaluated using a pretest, post-test quasi-experimental design. An impact and outcome evaluation was conducted to determine the impact of the program on diet, physical activity behavior, health knowledge, self-efficacy, and physiologic variables including serum cholesterol, height, weight, skin fold thickness, blood pressure, and body mass index (Stone et al, 1996). Cardiovascular risk indices were evaluated at pretest and post-test only. Physical fitness (using a 9-minute distance run) and physical activity (using a physical activity checklist and the SOFIT observational method) were evaluated at baseline and 2-4 weeks after the curriculum was implemented each study year (Stone et al, 1996). While the program was designed to target several health-related behaviors, the effect of the program on psychosocial constructs related to physical activity, as well as physical activity behavioral measures, will be reviewed only.

An implementation evaluation was conducted and results were documented thoroughly (Stone et al, 1996). A Manual of Operation was provided to each study site to facilitate standardized data collection and intervention procedures. The manuals were created for both intervention and measurement protocols. A Procedures Manual was developed to explain the details of all study-related procedures, including recruitment, consent, and randomization. Data collection was monitored by a site visit to each study center within the first 2 months of data collection; a field coordinator, nutrition coordinator, and data manager visited each site to observe measurement protocols, randomization procedures, labeling of forms, collection and handling of specimens, and filing/confidentiality of hard data forms. Conference calls were conducted either monthly or bi-monthly with each CATCH subcommittee responsible for implementing an intervention or measurement protocol; these calls resulted in discussions about problems and sharing experiences during data collection and intervention implementation. School staffs implementing the program were asked to provide reports detailing the dose and fidelity of program implementation at the schools. Process evaluation data was collected through self-report implementation checklists, classroom and physical education observations, and food service implementation checklists. All data was reported at the school level so that problems with implementation could be discussed and remedied without singling out any individual staff member.

The overall implementation of the CATCH program was high based on data from teacher self-reports and independent classroom observations (Stone et al, 1996). Between 95.4% and 97.3% of all self-report implementation checklists were returned after each implementation year. A large percentage of the lessons were delivered in their entirety; 88.8% of lessons during the grade 4 "Go for Health" implementation, 96.0% of the lessons in the grade 5 "Go for Health" implementation, and 95.7% of the lessons on the grade 5 "FACTS for 5" implementation.   Teachers reported that at least 91.0% of the curriculum was followed all or most of the time during each implementation year. 82.9% – 96.0% of all key activities were completed. Based on observations, 86.6% – 90.6% of all lessons were completed without modifications, and 76.9% – 87.7% of all key activities were completed.

Two evaluations were identified which examined the effects of the CATCH program on Social Cognitive Theory constructs. The first evaluation examined the impact of the program after one-year of implementation within third grade classes (Edmundson, Parcel, Feldman, Elder, Perry, Johnson et al, 1996). A second evaluation examined the three-year impact of the program on the psychosocial constructs

(Edmundson, Parcel, Perry, Feldman, Smyth, Johnson et al, 1996). Measures were taken on all psychosocial constructs at the beginning and end of 3rd, 4th, and 5th grades. The intervention appeared to have a positive impact on physical activity support for positive reinforcement ($p<0.0001$), physical activity negative reinforcement ($p<0.0001$), and physical activity self-efficacy ($p<0.0001$) at the end of the first year of implementation (Edmundson et al, 1996). The impact of the program on these psychosocial constructs declined during the final two years of implementation, however. After the second year of implementation (4th grade), positive effect sizes for remained for physical activity positive support ($\eta^2 = 0.20$, $p<0.01$) and for physical activity self-efficacy ($\eta^2 = 0.17$, $p<0.01$) only (Edmundson et al, 1996). These effects diminished and no significant differences on any of the SCT constructs related to physical activity were found between treatment and control groups by the end of the intervention (5th grade).

The evaluation of the CATCH PE program on children's physical activity levels was reported by McKenzie, Nader, Strikmiller, Yang, Stone, Perry et al (1996). The goals of CATCH PE were to promote children's enjoyment of and participation MVPA during physical education class and to provide students with skills to increase physical activity levels outside of school. Intervention schools delivered the CATCH program in physical education classes for at least 90 minutes across 3 sessions per week. Teachers were asked to engage students in MVPA during at least 40% of the physical education class. The major intervention components included the CATCH PE curriculum and materials, as well as teacher training and on-site consultation with teachers. Physical activity was measured using the SOFIT observational method, a teacher self-report of the frequency and duration of physical education lessons provided for individual classes, and a self-administered student physical activity checklist for activities participated in during the previous day. Fitness was assessed through a 9-minute distance run.

The CATCH program had a significant and positive impact on physical activity during physical education class and vigorous physical activity outside of school, but no impact on fitness as measured by a 9-minute distance run (McKenzie et al, 1996). The CATCH program resulted in significant improvements in MVPA during physical education ($p<0.01$), energy expenditure during physical education ($p<0.01$) and rate of energy expenditure during physical education ($p<0.01$) when compared to controls. Active PE time increased from baseline by 39% among CATCH schools and 23% among control schools. Fifth grade students at the end of the CATCH program also reported more vigorous physical activity minutes inside and outside of school during the previous day when compared to control students ($p<0.01$); CATCH students reported an average of 12.1 more minutes of vigorous physical activity than control students at the end of 5th grade. There were no significant differences for total moderate physical activity, and students did not run significantly farther in the 9-minute distance run from the 3rd to the 5th grades.

The outcome evaluation of the CATCH program examined the impact of the program on cardiovascular risk factors (Webber, Osganian, Feldman, Wu, McKenzie, Nichaman et al, 1996). The cardiovascular risk factors and other physiologic measures examined included: anthropometry, blood pressure, heart rate, serum lipid, lipoprotein, and apolipoprotein-B levels among children. All measures were examined at baseline (before students entered the 3rd grade) and at follow-up, after 2 ½ years of implementation. The CATCH program appeared to have no effect on skinfold thickness, heart rate, serum lipids, lipoproteins, or apolipoprotein levels; no significant differences in these cardiovascular risk factors were found across the study between intervention and control students. An interaction ($p<0.02$) between ethnicity and treatment group was noted for body mass index; the change in BMI between the intervention and control groups was the same for Caucasians and Hispanics, but African American children in the intervention group had a significantly greater increase in BMI than children of other ethnicity and children in the control group. Mixed effects were found for measures of blood pressure, with a significant site by intervention group interaction for systolic blood pressure ($p<0.005$) and for diastolic blood pressure ($p<0.05$). Children in the Minnesota intervention groups had a systolic blood pressure that was 1.5 mm Hg higher than the control groups, while students in the Louisiana and Texas interventions schools had a systolic blood pressure that was 1.1 and 0.59 mm Hg lower than control schools, respectively. Similarly, children in the Minnesota and California intervention schools had a higher diastolic blood pressure (1.2 mm Hg higher in MN and 0.6 mm Hg higher in CA) than children in the control schools, while the reverse was found for children in the Louisiana (0.2 mm Hg lower) and Texas (0.2 mm Hg lower) schools. The authors attributed the lack of effect of the program on cardiovascular risk factors to low dose and a modest behavioral impact (Webber et al, 1996).

The CATCH family intervention was designed to supplement the school-based curricula and involved skill-building activity packets that the students took home to complete with their parents, as well as a Family Fun Night for 3rd and 4th graders (Nader, Sellers, Johnson, Perry, Stone, Cook, et al, 1996). The dose of the family intervention, by degree of adult participation, was evaluated on knowledge, attitudes, self-reported behaviors, and physiologic outcomes of children. Implementation of the home curricula was assessed by the percentage of classroom activities related to the family program that were completed by the teachers and by the degree of student participation. Adult participation was measured as the number of activity cards (0-15) on which an adult member of the students' household completed at least one activity with the child. Psychosocial data on dietary knowledge, intentions, food choices, social reinforcements and support, and self-efficacy were examined with a health behavior questionnaire each year of implementation. The number of minutes spent in MVPA before or after school was measured with a self-administered physical activity checklist during the 5th grade only. The only physiological data examined was total cholesterol.

Results of the implementation evaluation indicated that the family component of CATCH was implemented as intended (Nader et al, 1996). The number of minutes of MVPA was related to the dose of the family program; students with moderate dose levels had the highest number of minutes of physical activity; the dose-response relationship was not systematic, however. Results of the psychosocial analysis indicated that positive support for physical activity increased as the extent of adult participation increased for all students. Physical activity self-efficacy increased as the dose of parental participation increased among Hispanics and African Americans. Results of the outcome evaluation indicated that cholesterol did not change systematically by level of dose for the family program.

An evaluation of the overall impact of the CATCH program on psychosocial variables, behavior, and health outcomes was reported by Leupker, Perry, McKinlay, Nader, Parcel, Stone, et al (1996). Data was analyzed at the individual and the school level. Individual level behavioral and health measures were analyzed using mixed model ANCOVA with the follow-up value as the dependent variable and the baseline value as a covariate. School-level behavioral and health measures were analyzed using repeated measures ANCOVA with the CATCH intervention group as the independent variable.

Overall, there was a 21% drop out rate in students from baseline to the 5th grade follow-up (Luepker et al, 1996). At the school-level, the average physical education lesson length did not change significantly, remaining at about 30 minutes for both groups. The intensity of physical activity increased significantly more in the intervention group when compared to a control; this was demonstrated by higher levels of energy expenditure in the intervention groups during the intervention years and marginally higher energy expenditure in the intervention group at follow-up. The time spent at higher levels of activity during physical education increased significantly more across the study in the intervention schools than in the control schools ($p<0.05$). At the individual level, self-efficacy for physical activity was significantly higher at the end of the first intervention year ($p<0.01$) but showed no difference from the control group at the follow-up. Positive social support for physical activity differed between after the 3rd and 4th grades implementation only ($p<0.05$). Examining physical activity behavior, there were no differences in the number of minutes of MVPA reported by 5th graders in the intervention and control groups; 5th graders in the intervention group did report a higher number of minutes in vigorous physical activity ($p<0.01$), however. Total blood cholesterol concentration declined in both the intervention schools (4.39 – 4.35 mmol/L) and in the control schools (4.41-4.38 mmol/L); the differences were not significant. Measures of body size (height, weight, body mass index, and skinfolds) did not differ between the intervention and control groups at baseline or follow-up. Fitness, as measured by a 9-minute distance run, increased with age but did not differ by treatment condition.

The final evaluation of the CATCH program that was identified examined the 5-year maintenance effects of the CATCH physical education program. The purpose of this evaluation was to assess the sustainability of the CATCH PE component in former intervention schools and to identify the extent to which the CATCH PE was adopted in former control schools (McKenzie, Li, Derby, Webber, Luepker, & Cribb, 2003). Data was collected in 56 former CATCH intervention schools and 26 former CATCH control schools by observing physical education classes using the SOFIT observational system, and by administering self-report questionnaires to school staff during the 1998-1999 school year. Data examined included the percent of class time spent in vigorous physical activity (VPA), the percent of class time spent in moderate-to-vigorous physical activity (MVPA), and the class energy expenditure. There were no significant changes in these physical activity variables from the CATCH post-test to the follow-up within the intervention schools. Physical activity levels increased in the control schools from post-test to follow-up, however. There were no significant differences between the intervention and control groups on any of the three physical activity variables at any grade level during follow-up. The lack of differences between former intervention and control schools was attributed to a decrease in class time spent in VPA in the intervention schools and improvements in physical activity levels in control schools. Teachers in former CATCH intervention schools allocated a significant greater amount of class time to fitness activities and less time on skill practice than former control teachers at follow-up.

Know your Body

The Know your Body (KYB) program was a comprehensive skills-based health promotion program based on the Social Learning Theory (Resnicow, Cohn, Reingardt, Cross, Futterman, Kirschner et al, 1992). The program was developed to address a wide range of health behaviors, including smoking, diet, exercise, injury prevention, and drug use among students in grades K-7, using a variety of affective educational strategies and skills training. Three program evaluations were identified through a literature search, and two of the three evaluations included a process evaluation as well as an evaluation of the programmatic effects on health indices, attitudes towards health, and health behaviors (Marcus et al, 1987; Bush et al, 1989; Resnicow et al, 1992). Resnicow et al (1992) point out the importance of including an implementation evaluation; implementation rates of health education programs vary significantly across teachers, as there are numerous barriers to implementation of health curricula in primary grades (a crowded curriculum, inadequate teacher training, lack of administrative support, and competing demands for teacher time and energy). It is difficult to understand the true effectiveness of a program without an understanding of implementation fidelity due to the issue of type III error.

The Los Angeles Know Your Body health education program was implemented in 1981 and 1982 to determine whether short-term benefits in health knowledge, beliefs, and behavior could be achieved by a school-based health education curriculum (Marcus, Wheeler & Cullen, 1987). The study used a pretest, post-test, quasi-experimental design. Eighteen elementary schools were selected to participate in the program and were assigned to one of four conditions: the first group (7 schools, n = 668) received the full Know Your Body (KYB) intervention, consisting of both a specific health education curriculum and a complementary clinical health screening (including: height, weight, triceps skinfold thickness, blood pressure, cholesterol, and pulse rate recovery from an exercise test); the second group (3 schools, n = 333) received the clinical health screening only; the third group (5 schools, n = 253) received the KYB curriculum only; and, the fourth group (3 schools, n = 234) served as a comparison group.

The KYB curriculum included 9 modules addressing self-esteem, clinical assessment, prevention, health decision-making, physical fitness and exercise, nutrition, substance use, circulation, and respiration (Marcus et al, 1987). The intervention was delivered by either homeroom teachers (16 schools) or public health nurses (2 schools) who were given two separate 2-day training sessions. The curriculum was delivered over the course of 5 months and was implemented for a minimum of 45 minutes per week. The intervention was delivered for a second time the following year, when the students were in the 5th and 6th grades, with a 45% overall attrition rate. The main source of attrition was the overall transience rate, accounting for 23% of attrition.

Data was collected through three questionnaires addressing health knowledge, health beliefs/attitudes, and self-reported health behaviors (Marcus et al, 1987). Multiple regression results indicated significant differences between treatment and control groups on each of the six knowledge tests. The curriculum-only group scored higher than the control group on knowledge of cardiovascular health ($p<0.001$), physical fitness ($p<0.001$), first-aid ($p<0.01$), smoking ($p<0.001$), and nutrition ($p<0.01$). The curriculum plus screening group scored higher than the control group on knowledge of cardiovascular health ($p<0.001$), physical fitness ($p<0.05$), first aid ($p<0.05$) and somewhat higher on knowledge of nutrition ($p<0.06$). Differences in attitudes were found for beliefs/attitudes about alcohol, tobacco, and marijuana use only. Modest differences were found for aerobic exercise; the curriculum plus screening group scored higher on an aerobic activity index than the control group ($p<0.05$).

A second evaluation of the Know Your Body curriculum, also using a quasi-experimental, pretest-post-test design, examined the 2-year effects of the curriculum by measuring changes in the prevalence of risk factors for cardiovascular disease and the effectiveness of providing individual cholesterol results to students (Bush, Zuckerman, Theiss, Horowitz, Sheridan, & Walter,1989). For this study, the intervention was delivered in nine elementary schools within the District of Columbia. Students (n = 1,041) began the intervention in grades 4-6 and continued consecutively into grades 7-9. The schools were assigned to one of three experimental conditions. The full intervention group received the KYB curriculum with personal health screenings, and the results of the health screenings were released to the student. The part-intervention group received the curriculum and health screenings, but their parents were given their cholesterol test results. The control group did not receive the KYB curriculum and only the parents were provided with any of the health screening results. Classroom teachers at the elementary school level and health or science teachers at the junior high school level taught the KYB curriculum in two, 45-minute periods per week. The KYB staff trained all teachers in 4, 3-hour sessions spread throughout the school year. There was a 60% attrition rate after 2 years, approximately 50% of which was due to students transferring schools.

Data was collected through annual health screenings and the completion of surveys to assess health knowledge, health behavior, health attitudes, and psychosocial factors related to the performance of health behaviors (Bush et al, 1989). Measured health indices included height and weight, triceps skin fold thickness, systolic and diastolic blood pressures, pulse recovery rate after exercise (as a fitness test), serum thiocyanate, and total high density lipoprotein (HDL) cholesterol. Knowledge was examined through two questionnaires (one for elementary students and one for junior high students) measuring changes in subjects' knowledge of nutrition, physical fitness, and substance abuse prevention as they relate to the prevention of coronary heart disease and cancers. The behavioral survey assessed use of abuseable substances, participation in aerobic exercise, snacks in the previous 24 hours, and home milk consumption. The psychosocial factors examined included health locus of control and self-esteem.

The data for the second evaluation of the KYB program was examined in three ways (Bush et al, 1989). First, the observed mean differences in risk factor values from baseline to follow-up were examined for the control and intervention groups. Second, multiple regression analysis was used to examine the observed differences in scores between groups, adjusting for age, sex, SES, and baseline risk factor values.

Third, a comparison was made of the change from baseline to follow-up in the percentage of intervention subjects with risk factors compared to control subjects.

Results of the Washington, DC implementation indicated that the KYB program was effective when compared to a control group, but there were no differences when comparing the two intervention groups. The curriculum was effective at changing risk factors associated with cardiovascular disease, health knowledge, attitudes towards smoking, and preventing smoking initiation (Bush et al, 1989). Students enrolled in the intervention groups had significant decreases in systolic and diastolic blood pressures, significant increases in serum HDL cholesterol, significant decreases in the total cholesterol/HDL ratio, significant decreases in the serum thiocynate levels, and significant increases in fitness. Regression analysis revealed that subjects who were more likely to have an increase in HDL cholesterol were also more likely to be in the intervention group, to be younger, and to have had a decrease in their ponderosity scores compared with other students. Sex, socioeconomic status, and baseline fitness were not associated with changes in the risk factors. Fewer subjects in the intervention group compared to the control group exceeded the risk levels for systolic and diastolic blood pressures, the total cholesterol/HDL ratio, serum thiocyanate, and fitness after two years of program implementation. The program had a positive impact on health knowledge; subjects in the intervention groups scores significantly higher than subjects in the control group on health knowledge tests after year one and after year two of program implementation ($p<0.05$). The KYB program had a positive impact on attitudes towards smoking, but no impact on attitudes towards alcohol use, marijuana use, health locus of control, or self-esteem. Favorable program effects were found for cigarette smoking behavior only. The authors concluded that the program appeared to have a favorable impact on the distributions for several major risk factors for coronary heart disease, including systolic and diastolic blood pressures, HDL cholesterol, total cholesterol/HDL cholesterol ratio, smoking, and fitness (Bush et al, 1989).

Program implementation, measured as adherence to the curriculum and quality of instruction, was monitored by a system of teacher observations and questionnaires (Bush et al, 1989). The authors concluded that the KYB program was acceptable to school administrators, teachers, parents, and students; evidence for this conclusion was provide by the fact that all of the public schools in Washington DC decided to begin the process of implementing the program, beginning with the first grade classes, in 1987 and 1988 (Bush et al, 1989). However, problems were found with program implementation. One of the major problems cited was the loss of subjects to follow-up, particularly among overweight and obese students. Other problems cited included failure of students to return consent forms (accounting for non-participation) and teacher cooperation.

A third evaluation of the KYB program was conducted in the New York City, Bronx community schools. Using a pretest-post-test quasi-experimental design, this evaluation tracked 2,647 students in five elementary schools starting in grades 1-4, for 2 ½ years, and ending in grades 3-6 (Resnicow, Cohn, Reinhardt, Cross, Futterman, Kirschner, Wyndner et al, 1992). Three schools in the Bronx received the intervention curriculum and two schools (one from the Bronx and one from Huston, Texas) served as comparison schools. Students in the comparison schools received their typical health and science curricula. Students in the three KYB schools received two curricular components, a classroom curriculum and school-wide activities. The classroom curriculum was delivered through grade-specific teacher manuals and student activity books. The curriculum was delivered once a week, for 30-45 minutes, throughout the entire school year. Teachers implementing the program were trained for 1-2 days by the KYB staff, and each teacher met with the project coordinators twice per year to receive supplementary materials, to discuss teaching strategies, and to provide programmatic feedback with the KYB staff. Teacher implementation was monitored by a head teacher from each grade, specifically assigned to monitor and facilitate program implementation.

This evaluation included a detailed description of the evaluation of teacher implementation. Teacher implementation was assessed by three subjective measures: teachers were asked to complete a self-report assessment of the number of modules and activities covered and the number of minutes spent per week teaching the curriculum; head teachers were asked to rate each implementing teacher as either a "low", "medium" or "high" implementer; and, the project coordinator was asked to rate each implementing teachers as a "low", "medium", or "high" implementer (Resnicow et al, 1992). Based on the head teachers ratings, 19% of the teachers were low implementers, 31% were medium implementers, and 50% were high implementers. Using the more stringent, project coordinator ratings, 37% of the teachers were low implementers, 41% were moderate implementers, and 22% were high implementers. Based on the implementation evaluation, students were categorized into “low exposure”, “moderate exposure”, and “high exposure” groups for analysis. Students who had moderate or high implementation teachers for either of the first 2 program years and the final year of the study were classified as “high exposure” students; students who had moderate or high implementation teachers for either the first 2 years or the final year were classified as “moderate exposure” students; all other students were classified as “low exposure” students. Students in the comparison groups were classified as “no exposure” students. Using these criteria, 66% of the students were classified as “low exposure”, 22% were classified as “moderate exposure”, and 12% were classified as “high exposure”.

Variables used to examine the programmatic impact on health, behavior, and knowledge in the third evaluation included total cholesterol, body mass index, blood pressure, health knowledge, health attitudes, self-efficacy (to resist peer pressure and to perform health behaviors), and food intake frequency (Resnicow et al, 1992). Reliability validity measures for all indices were reported. Data was analyzed using MANCOVA and regression methods, with both the longitudinal and post-test only groups.

There was a 60% attrition rate over 3 years, and the final longitudinal sample size included 1,209 students (Resnicow et al, 1992). Attrition was attributed to transferring out of the school (19%), lack of parental consent (18%), and absenteeism (22%). Longitudinally, students in the “high exposure” group had a significantly lower systolic blood pressure ($p<0.05$) and significantly lower total cholesterol ($p<0.01$) than the comparison group; further, there was a significant linear decrease ($b = -0.08$, $p<0.05$) in the total cholesterol levels from “low” to “high” exposure groups. There was a coinciding significant decrease ($b = -0.08$, $p<0.05$) in health knowledge scores moving from the comparison to the “high” exposure group as well. Examining the post-test only data, there was a significant ($p<0.05$) linear trend in the expected direction across the three implementation exposure groups for the following variables: systolic blood pressure ($b = -0.06$), meat intake ($b = -0.08$), dessert consumption ($b = -0.06$), health knowledge ($b = 0.06$), and heart healthy food intake ($b = 0.07$). This finding supports the dose-response relationship between implementation fidelity and programmatic effects for the KYB curriculum.

Cardiovascular Health in Children (CHIC)

The Cardiovascular Health in Children (CHIC) intervention was a school-based intervention designed to improve serum cholesterol, blood pressure, measures of obesity (BMI and body fat), exercise tolerance, physical activity, smoking, and knowledge in 3^{rd} and 4^{th} grade children (Harrel, McMurray, Bangdiwala, Frauman, Gansky, & Bradley, 1996). The study used a pretest, post-test, quasi-experimental design. Twelve schools (n = 1,274 children) were randomly selected to participate in the study from 6 strata in rural and urban areas of North Carolina. Children in the intervention schools received the American Heart Association's Lower and Upper Elementary School Site Program Kits once a week for 8 weeks. The program included information about selecting heart healthy foods, the importance of regular exercise, the dangers of smoking, and ways to resist peer pressure to smoke. Children in the intervention schools also received a physical education intervention three times per week; the intervention included a warm-up, 20 minutes of noncompetitive aerobic activities, and a cool-down period. Children in the control schools received their typical health and physical education curriculum.

Data was collected at baseline and within 2 weeks of the completion of the 8-week intervention (Harrel et al, 1996). Physical activity and smoking behavior were measured through self-report questionnaires in a classroom setting. Physiologic data (height, weight, skin folds, cholesterol, blood pressure, and aerobic power) was collected in 3 stations of small groups of children in empty classrooms, gymnasiums, or media rooms. The effect of the CHIC program, comparing intervention and control schools, was analyzed using MANOVA and regression methods at both the school and the individual levels.

Results for the school-level analysis indicated a significant impact of the program on physical activity, heart health knowledge, and some of the health indices (Harrel et al, 1996). Clinically significant changes were found for cholesterol and diastolic blood pressure from pretest to post-test; these results were not statistically significant, however. Cholesterol levels of children in the intervention schools decreased by -5.27 mg/dl more than children in the control schools (95% CI: -12.11, 1.57). While diastolic blood pressure increased among all children in all schools, the increase was less among children in the intervention schools than the control schools. There were significant increases in physical activity among children in the intervention schools when compared to children in the control schools; physical activity increased 23% from baseline to post-test among children in the intervention schools and 15% among children in the control schools. Heart health knowledge was 7.86% higher in the intervention schools than the control schools at follow-up (95% CI: 3.89, 11.83).

Results for the individual level analysis indicated programmatic effects for total cholesterol, body fat, aerobic power, and health knowledge (Harrel et al, 1996). There was a significantly greater decrease in mean total cholesterol among children in the intervention group compared to children in the control group; on average, children in the intervention group had a reduction in total cholesterol of -4.88 mg/dl more than children in the control group (95% CI: -7.65, -2.11). Children in the intervention group had a somewhat smaller increase in diastolic blood pressure when compared to children in the control group; this difference was non-significant, however. Body fat was reduced among children in the intervention group but increased among children in the control group; children in the intervention group had a mean decrease in skin fold thickness of -0.9 mm (-2.9%), and children in the control group had a mean increase of 0.3 mm (1.1%). There was an increase in BMI among both groups; the difference in the increase between control and intervention children was non-significant. There was a significantly larger increase in predicted aerobic power (pVO_2) among children in the intervention group (8.3% increase) when compared to children in the control group (4.4% increase); the difference in change between groups was 1.73 (95% CI: 0.80, 2.66). The change in physical activity between children in the control group and children in the intervention group was non-significant, and at post-test, children in the intervention group scored 8.37% higher on a heart healthy knowledge test than children in the control group (95% CI: 6.36, 10.37).

Heart Smart

The Heart Smart program was delivered in four Louisiana elementary schools, to 556 4^{th} and 5^{th} grade students (Arbeit, Johnson, Mott, Harsha, Nicklas, Webber, & Berenson, 1992). The evaluation used a pretest, post-test quasi-experimental design. Two schools were randomly assigned to receive the 1-year Heart Smart intervention, and two schools served as a comparison. The intervention involved 3 components (a cardiovascular health curriculum, the Superkids-Superfit Exercise program, and a school lunch program) designed to impact dietary patterns, the adoption of physical activity patterns and behavioral skills conducive to lifetime fitness, and smoking prevention. The cardiovascular health curriculum was designed to be incorporated into a general science class. It focused on healthful eating habits and exercise, self-esteem, responsibility for one's own care, and the adoption of a healthful lifestyle. The content focused on four major areas: cardiovascular anatomy and physiology, nutrition and eating behavior, physical activity behavior, and behavioral and coping skills. The Superkids-Superfit exercise program was delivered in physical education classes. The purpose of the program was to promote knowledge, behavioral skills, and patterns of physical activity consistent with lifelong maintenance of cardiovascular health. The program consisted of 12 lessons and aerobic activities. Students learned the relationship of exercise to heart disease, the benefits and guidelines of exercise, the components of fitness, how to develop and monitor an exercise program, heart rate and blood pressure responses to exercise, care and prevention of fitness related injuries, and exercise anatomy and physiology. The school lunch program focused on teaching students to make healthy choices. While the details of an implementation evaluation were not reported, the authors indicate that the Heart Smart program was successfully implemented by school personnel.

The primary variables evaluated in the Heart Smart evaluation were cardiovascular risk factors, dietary and physical activity behavior, and cardiovascular knowledge (Arbeit et al, 1992). Physiologic variables examined included serum lipids, lipoproteins, height, weight, triceps and subscapular skinfolds, waist circumference, and blood pressure. Students dietary choices were examined as students' school lunch choices, measured through self-report. Fitness levels were evaluated by a timed 1-mile run/walk held in the fall and spring of the program, by physical educators. A cardiovascular knowledge test was administered to all students in the fall and spring.

The Heart Smart program appeared to have a significant impact on physical fitness, systolic blood pressure, skinfold thickness, and HDL cholesterol levels (Arbeit et al, 1992). Fifth grade boys in the intervention group had a significant decrease in their 1-mile walk/jog time when compared to boys in the control group; boys in the intervention group decreased their walk/jog time by 1.3 minutes ($p<0.05$) when compared to boys in the control group. Girls in the intervention group similarly had a decrease in their run/walk time when compared to a control; these differences were non-significant, however. Subjects who improved their run/walk times (n = 107) had a significant decrease in systolic blood pressure (an average of 1.6 mm Hg, $p<0.05$) and significant decreases in tricep and subscapular skin folds (2.8 mm and 4.3 mm decrease, respectively, $p<0.01$). The evaluation further indicated a significant increase in HDL cholesterol from pretest to post-test among intervention students when compared to control students ($p<0.05$). The authors concluded that the Heart Smart program demonstrated the feasibility and utility of a comprehensive cardiovascular health promotion program at the elementary school level.

Eat Well and Keep Moving

The Eat Well and Keep Moving Program was a 2-year school-based intervention designed to improve diet and physical activity levels among 4th and 5th grade children enrolled in Baltimore, MD elementary schools (Gortmaker, Cheung, Peterson, Chomitz, Hammond, Dart, Fox et al, 1999). The evaluation used a pretest, post-test quasi-experimental design. Six elementary schools received the Eat Well and Keep Moving intervention and 8 schools were recruited to serve as a comparison. The classroom-based intervention was delivered by classroom teachers, integrated into several course areas, including: math, science, language arts, and social studies classes. Program components also linked to food services, physical education, teacher/staff wellness programs, families, and classroom-based campaigns. Thirteen, 50-minute lessons were delivered during each of the 2 program years, to children in the 4th and 5th grades. In addition, 5 physical education lessons were incorporated into the program during the second programmatic year. Classroom teachers attended 1 day of teacher training and 2 staff wellness meetings each program year.

Variables examined included student dietary behavior, physical activity behavior, and dietary and physical activity knowledge (Gortmaker et al, 1999). All variables were collected through self-report measures. Physical activity and dietary behaviors were measured through the food and activity survey (FAS) and through a series of 24-hour recalls. For physical activity, students were asked to recall all physical activity they did in the previous 24 hours and to classify them into the following categories: sleep, stand, sit and watch TV, sit and watch videos or play games, walk, or other activity. Time spent in each category was recorded to the nearest minute. Dietary and physical activity knowledge was measured as students' knowledge of healthy food and activity choices. Validity and reliability of the questionnaires was reported. Data was analyzed using regression methods.

Program implementation was monitored by asking teachers to complete surveys after each classroom lesson was implemented (Gortmaker et al, 1999). The response rate to implementation surveys was high (71% after year-one and 81% after year-two). Survey data collected from teachers indicated that 22 of the possible 31 nutrition and physical activity lessons were delivered (71%). Teachers and students liked the intervention lessons, with 95% of teachers rating the lessons "effective" and 65% of students reporting that they "liked" the lessons.

The overall response rate for the intervention was high, and the program had a positive effect on knowledge and dietary behaviors, but not for physical activity behavior (Gortmaker et al, 1999). The response rate for the Eat Well and Keep Moving intervention was high; 90% of students returned all survey data at baseline (n = 785) and 88% of students in the control group and 89% of students in the intervention group returned all survey data at post-test. Follow-up data were obtained from 66% of the baseline subjects in both the intervention and control groups. After controlling for baseline measures, knowledge of healthy activities increased in the intervention schools when compared to the control schools; the change in knowledge scores represented a medium effect size (SD, 0.4 – 0.3, $p<0.05$). There was no change in vigorous physical activity for intervention or control schools. There was some evidence for a reduction in the time spent watching television and video viewing per day, but the difference was non-significant (-0.55 hours/day, 95% CI, -1.1 to 0.04, $p = 0.06$). The authors concluded that the program had a minimal impact on physical activity due to the minimal availability of physical education programs within intervention schools.

Middle School Interventions

CHIC II

The CHIC (Cardiovascular Health in Children) intervention, previously described, was evaluated a second time as CHIC II, within 5 rural middle schools in North Carolina (McMurray, Harrel, Bangdiwala, Bradley, Deng, & Levine, 2002). The second evaluation used a pretest, post-test, quasi-experimental design. Variables examined included blood pressure, blood lipids, obesity, and physical activity levels. Three schools were randomly assigned to receive one of three intervention levels: one school received the exercise only physical education component of the CHIC intervention, one school received the heart healthy knowledge classroom component of the CHIC intervention, and one school received both the physical education and the classroom knowledge components. Two schools, serving as a comparison, received their typical health and physical education programs. All variables, measures, and analyses were similar to the elementary CHIC evaluation.

The impact of the CHIC II program on health indices were reported in this evaluation (McMurray et al, 2002). In total, 1140 youth participated in the study, a 38.2% participation rate across all 5 schools. Significant changes were found between the groups for the following health indices: sum of four skin folds, predicted aerobic power, and blood pressure. The changes in BMI between intervention and control students were non-significant. The change in the sum of skin folds was significant across the four groups ($p<0.01$); the increase in the sum of skin folds among students in the exercise and education intervention group was smaller than the increase among the education-only students and the control students. The change in predicted aerobic power was significant across all four groups ($p<0.01$); the increase in predicted aerobic power was greater in the education and exercise intervention group than the education only group. Both diastolic and systolic blood pressures increased among students in the control group and decreased among students in the intervention groups ($p<0.01$); the decrease among students in the exercise only group was significantly greater than the education only group. The authors concluded that the CHIC physical education program had a significant impact on reducing the age-related increase in blood pressure commonly found among adolescents.

Fargo/Moorhead-250

The Fargo/Moorhead-250 Program was a peer-led physical activity program designed for 8th grade students as part of a larger Class of 1989 longitudinal school-based health promotion program (Kelder, Perry, & Klepp, 1993). The Class of 1989 Study was part of a large-scale, population-wide, community intervention called the Minnesota Heart Health Program (MHHP). MHHP was a 5-year educational intervention implemented in 3 North-Central US cities, targeting cardiovascular disease prevention through healthy changes in eating habits, physical activity, smoking, and high blood pressure control. Students from 13 primary schools, who continued into 7 high schools in the Class of 1989 Study, participated in baseline surveys during the spring of sixth grade; these students were exposed to each of the MHHP-sponsored health programs (including Fargo/Moorhead-250) and were surveyed annually until they graduated from high school in 1989. Analysis was conducted yearly to examine the impact of the MHHP program on the Class of 1989 cohort in comparison to a reference community.

The Fargo/Moorhead-250 program took place in the Class of 1989 schools, in classes other than physical education and targeted regular aerobic physical activity outside of school (Kelder et al, 1993). Students in the program were challenged in a community wide competition to bicycle 250 miles, the distance from the intervention community to Minneapolis, MN. Based on Social Learning Theory, FM-250 targeted knowledge of aerobic exercise, the importance of positively valuing regular physical activity, and creating functional meanings that exercise can be fun. Peer leaders were chosen as role models to demonstrate new physical activities within classes. Environmental factors focused on social support through group work outside of physical education classes. The behavioral component of FM-250 focused on positive reinforcement for participating in a variety of physical activities. Students were given post card reinforcements for meeting their weekly mileage goals, and groups with the highest weekly mileage were given gift certificates to a local sporting goods store.

The outcome evaluation of FM-250 was conducted through the Class of 1989 annual survey completed by students in their health, social science, or English classes (Kelder et al, 1999). The evaluation used a longitudinal design. The psychosocial constructs targeted through intervention were not evaluated. Physical activity was measured as self-reported hours of exercise per week outside of class and as a physical activity score computed by two variables assessing frequency and intensity of regular exercise. Data was analyzed using ANCOVA methods and the school as the unit of analysis. Although the details of a process evaluation were not presented, the authors mentioned that the process evaluation indicated high participation in physical activities during the mileage contest and positive feedback on the program.

Differences in physical activity behavior variables between the intervention and reference communities was compared within the Class of 1989 cohort each year, from 1983-1989 (Kelder et al, 1999). Females in the intervention community reported significantly more hours of exercise per week than females in the reference community at all but the 11th grade follow-up. Similarly, females in the intervention community reported higher physical activity scores than females in the reference community for 8th, 9th, and 11th grade ($p<0.05$). In the 12th grade, females in the intervention group were exercising 48 minutes longer per week than females in the reference community. Males in the intervention community reported exercising more frequently than males in the reference community as well; these differences were only significant in the 7th and 11th grades, however. While males in the intervention group maintained higher post-test physical activity scores, the difference between them and the control group was not statistically significant. A downward trend in leisure-time exercise behavior was found in the 7th grade and accelerated through the high school years, reflecting national trends. The authors indicate that this trend highlights the need for high school physical activity interventions.

Planet Health

Planet Health was a 2-year, interdisciplinary school-based intervention designed to reduce obesity in middle-school students by altering physical activity and dietary risk factors, including reduction in television viewing (Gortmaker, Peterson, Wiecha, Sobol, Dixit, Fox, & Laird, 1999). Ten schools were recruited and randomly assigned to receive the intervention or serve as a comparison school. The Planet Health intervention focused on 4 behavioral changes taught in multiple classroom and physical education settings: reducing television viewing to less than 2 hours per day, increasing moderate and vigorous physical activity, decreasing consumption of high-fat foods, and increasing fruit and vegetable consumption to 5 a day or more. The intervention was designed to provide students with cognitive and behavioral skills to enable change in target behaviors, practice using skills to strengthen perceived competence in employing the new behaviors effectively, and support for behaviors by classroom and physical education teachers. Each Planet Health theme was addressed in 1, 45-minute lesson per subject, for a total of 16 core lessons each intervention year. Each lesson consisted of teacher resources, behavioral and learning objectives which matched 1 of the 4 intervention behavioral targets, procedure, homework activities, and student resources. Physical education materials focused on activity and inactivity themes; physical education classes including self-assessments of activity and inactivity levels, goal setting and evaluation for reducing inactivity, and replacing inactive time with moderate and vigorous physical activities. Control school received their typical health and physical education curricula. The overall participation rate was 64.5% within control schools and 64.8% within intervention schools.

An implementation evaluation was conducted through direct observation and through the use of teacher reports (Gortmaker et al, 1999). Eighty-seven percent of the classroom teachers and 100% of physical education teachers completed the first year training sessions. Classroom teachers indicated that they implemented an average of 3.5 out of 4 lessons for the year. Qualitative data collected from the teachers indicated that the schools varied with the ease of implementation. Those schools who were experienced with an interdisciplinary curriculum found it easier to implement Planet Health.

The outcome measures of Planet Health were examined at baseline (fall of 1995) and at follow-up (spring of 1997) (Gortmaker et al, 1999). Therefore, the study used a pretest, post-test, quasi-experimental design. The primary outcome measure was obesity. Measures of obesity included height, weight, and triceps skin folds. Secondary outcome measures included self-report measures of moderate and vigorous physical activity, television viewing, percent of total dietary intake from fat, servings of fruits and vegetables, and total energy intake. All secondary outcome measures were collected through the Food and Activity Survey, completed by students independently during class under the supervision of trained teachers. The physical activity component was measured with a Youth Activity Questionnaire, which estimates the number of hours per day spent in moderate and vigorous activities over the past month. Validity and reliability of all measures was reported. Data was analyzed using regression methods.

The intervention proved effective for decreasing the prevalence of obesity among girls in the intervention group; it was also effective at decreasing the time spent watching television and reducing energy intake per day (Gortmaker et al, 1999). After controlling for baseline covariates, the prevalence of obesity among girls in the intervention schools was significantly reduced when compared to girls in the control schools (OR = 0.47, $p<0.05$). The prevalence of obesity among boys decreased within both intervention and control schools, and the difference in the reduction was non-significant. After adjusting for baseline covariates, the number of television hours per day decreased among girls in the intervention group (-0.58 hours, 95% CI: -0.85 - -0.31 hours, $p<0.01$) and among boys in the intervention group (-0.40 hours, 95% CI: -0.56 - -0.24 hours, $p>0.01$) when compared to the control group. There was no evidence for significant changes in moderate or vigorous physical activity, however. Regression results indicated that the only the change in television viewing mediated the change in obesity. Each hour reduction in television viewing was independently associated with a reduction of obesity prevalence (OR = 0.85, $p<0.05$), and the intervention effect was then only marginally significant ($p = 0.08$). This effect was found among girls, only.

Middle School Physical Activity and Nutrition (M-SPAN)

The Middle School Physical Activity and Nutrition (M-SPAN) intervention used environmental, policy, and social marketing interventions to increase physical activity and reduce fat intake of middle school students (McKenzie, Sallis, Prochaska, Conway, Marshall, & Rosengard, 2004). The study used a pre-test, post-test, quasi-experimental design. Forty-eight middle schools (grades 6-8) were stratified by school district and randomly assigned to receive a 2-year intervention (N = 12 schools) or serve as a measurement only comparison (N = 12 schools). The M-SPAN program focused on providing sample materials and assisting middle school physical educators with revising their current curricula and instructional strategies to increase moderate-to-vigorous physical activity (MVPA). Physical education teachers in the intervention schools were invited to five 3-hour in-service training sessions; three training sessions were held during the first intervention year (1997-1998) and two training sessions were held during the second intervention year (1998-1999). The training sessions were developed around four main goals: creating teacher awareness of the need for active, health-related physical education; assisting teachers to design and implement active physical education curricula; to develop teachers' class management and instructional skills to enhance physical activity and student learning; and to provide on-going support for change. During these training sessions, the physical education teachers set goals for modifying the physical education programs at their schools; they then implemented their modifications in their physical education classes.

A process evaluation was conducted to determine the quality of the intervention and the program's acceptability (McKenzie et al, 2004). Student enjoyment of the program and attendance in physical education was examined through anonymous questionnaires with 1578 students at baseline and 1434 students at year 2. Students were asked to what degree they liked physical education and how many days they went to physical education class. Teachers were asked to evaluate the quality of the M-SPAN training sessions and the usefulness of its content through an anonymous survey at the end of each staff development training day. Teacher satisfaction with the M-SPAN physical education component was assessed through a mailed questionnaire after the second year of intervention.

While the teachers found the staff development programs to be of high quality and were positive about the program, student enjoyment for physical education and attendance did not change as a result of the intervention (McKenzie et al, 2004). Student enjoyment and attendance were analyzed over time using ANOVA methods. There were no significant changes in enjoyment for physical education or attendance across time for either boys or girls. Students reported attending physical education 4.7 days per week at each measurement period. Teachers evaluated the quality and the usefulness of the program training sessions very highly. All questions were measured on a 5-point Likert-type scale, and mean responses ranged from 4.5 – 5.0 , indicating that the teachers found the training sessions to be useful and of high quality. Overall, the teachers were positive about the M-SPAN program and would recommend it to others.

The outcome variables examined were measured using the SOFIT observational system and included: student activity levels, the lesson context in which they occurred, and teacher behavior (McKenzie et al, 2004). The SOFIT system has known validity. Inter-observer agreement ranged from 80% for student activity, 95% for lesson context, and 80% for teacher behavior; the intraclass correlation for independent observers was 0.96 for MVPA minutes, showing that the measure was reliable. Observations were made during lessons on 11 randomly selected days at each school. Regression models were used to examine changes over time by condition in minutes and the proportion of lessons spent in

MVPA, both with students combined and by gender. School was the unit of analysis and measurement was conducted at baseline, after the first year of intervention, and after the second year of intervention.

Results of the outcome evaluation indicated that the length of lesson did not change and the amount of time teachers allocated for lesson contexts did not change, but the amount of time students spent in MVPA and the proportion of class time students spent in MVPA did significantly change in the intervention schools when compared to the control schools (McKenzie et al, 2004). The intervention had a large effect ($d = 0.88$) on the time students spent in MVPA during each lesson; students in the intervention schools increased the time they spent in MVPA during each lesson by approximately 3 minutes ($F(1, 46) = 5.43$, $p<0.05$). This effect was primarily found for boys. While girls had a moderate increase in time on MVPA ($d = 0.68$), the amount of time they spent in MVPA after 2 intervention years was similar to boys in the control schools. From baseline to the end of the 2-year intervention, intervention schools increased MVPA by 18%, compared to 3% for controls. The intervention had a moderate effect ($d = 0.66$) for increasing the proportion of class time spent in MVPA; the trend for increasing the proportion spent in MVPA was non-significant, however. During the final intervention year, students in the intervention schools spent 52% of class time in MVPA, compared to 48% of class time for controls. The researchers accounted the increase in time spent on MVPA without a change in lesson context to the proportion of time students were active within selected lesson contexts, specifically fitness activities, game play, free play, and management. While the increase in time spent on MVPA were not significant within individual contexts, the combined increased time spent in MVPA across contexts was significant.

High School Interventions

Lifestyle Education for Activity Project (LEAP)

The Lifestyle Education for Activity Project (LEAP) was a comprehensive school-based, 2-year intervention delivered in South Carolina high schools (Dishman, Motl, Saunders, Felton, Ward, Dowda, & Pate, 2004). The program emphasized changes in instruction and the school environment to increase physical activity among 9th grade girls. The program was designed around six of the eight components of the Coordinated School Health Project: physical education, health education, school environment, school health services, faculty and staff health promotion, and parent and community involvement. The LEAP program was implemented in whatever class setting health was integrated into the school curriculum: health education, physical education, family and consumer science, or biology. The intervention staff worked with teachers in the intervention school to change their curricula to help the girls increase physical activity self-efficacy through mastery experiences with physical activity inside and outside of school, and to develop personal and behavioral skills necessary to adopt and maintain a physically active lifestyle. The implementing teachers developed specific LEAP units to target the following self-regulatory skills: time management, goal setting, identifying and overcoming barriers, and self-reinforcement. The LEAP physical education component (LEAP PE) included a 1-year curriculum designed to teach students motor skills in a variety of physical activities that were popular with high school girls, including: aerobics, weight training, dance, and self defense. The lessons were taught in small groups to facilitate mastery learning experiences.

The evaluation of LEAP was conducted to determine whether the program had an impact on SCT constructs and on physical activity behavior (Dishman et al, 2004). The following SCT constructs were targeted: self-efficacy, outcome-expectancy value, goal setting, and exercise satisfaction. The study used a pretest, post-test, quasi-experimental design. Twenty-four high schools were randomly selected from a pool of 54 schools willing to participate in the study; the schools were then randomly assigned to either receive the intervention or serve as a comparison school (n = 12 schools per condition). Students in the intervention group received the LEAP intervention, and students in the comparison group received their typical health and physical education programs. Baseline measures were conducted when the girls (n = 2744) were in the end of their 8th grade year, and then again after the first year of the LEAP program, in the spring of their 9th grade year (n = 2087). Each of the psychosocial constructs was measured using self-report measures with reported validity and reliability. Physical activity was measured using a 3-Day Physical Activity Recall (3DPAR), developed as a modification of the Previous Day Physical Activity Recall (PDPAR).

Data was analyzed using latent variable structural equation modeling to test whether the intervention had an effect on the presumed mediators of change in physical activity (Dishman et al, 2004).

Path coefficients were examined between the SCT theoretical constructs and physical activity at baseline and then again at follow-up. At baseline, significant path coefficients were found between self-efficacy to physical activity and between exercise satisfaction to physical activity. At follow-up, significant path coefficients were found between self-efficacy, outcome-expectancy values, and satisfaction to physical activity. The magnitude of the relationship between satisfaction and physical activity was larger at follow-up than baseline. The relationship between self-efficacy and physical activity was smaller at follow-up than baseline. Data was also analyzed to determine the direct path coefficients between the intervention and the theoretical constructs and physical activity, and then the direct path coefficients between the theoretical constructs and physical activity after accounting for the effects of the intervention. The intervention had a statistically significant but small direct effect on self-efficacy, goal setting, and physical activity. The following theoretical constructs, after exposure to the intervention, had a direct effect on physical activity: self-efficacy, outcome-expectancy value, and satisfaction. The authors concluded that the effect of the intervention on physical activity was partially mediated by self-efficacy.

A process evaluation was conducted to categorize the schools as low implementers and high implementers for the purpose of statistical analysis (Dishman et al, 2004). Four measures were used to evaluate the degree of implementation of each of the intervention components. An independent process evaluator kept records of all intervention elements. An independent process evaluator observed physical education classes. A LEAP criteria total was created using an implementation rating from the LEAP staff. Finally, the adherence to the LEAP criteria for LEAP PE was evaluated using staff ratings of the LEAP PE implementation. Staff ratings were scored out of a 3 or 4-point ordinal scale; a score of zero indicated “no effort to implement” and a score of 3 indicated “full implementation”.

New Moves

The New Moves program was developed as an alternative physical education class for high school girls who were overweight or at risk for becoming overweight due to low levels of physical activity (Neumark-Sztainer, Story, Hannan, & Rex, 2003). New Moves was designed to bring about positive changes in physical activity and eating behaviors for weight loss and weight maintenance, to help high school girls avoid unhealthy weight control behaviors, and to help girls function in a thin-oriented society and feel good about themselves. Girls in the treatment group participated in the New Moves program 5 days per week for 1 semester (16 weeks). The program addressed social-environmental factors (supportive atmosphere and opportunities for physical activity), personal factors (self-perceptions, self-efficacy, and attitudes towards physical activity), and behavioral factors (goal setting and skills). Physical activity sessions were delivered 4 days per week throughout the intervention; 1 day a week was devoted to bringing in community guest instructors, 1 day per week was devoted to strength training, and 2 days per week were devoted for a variety of life-long activities that were selected by the physical education teachers. The program also included a social support component aimed at improving students' self-perception, as well as a nutritional component. Girls in the control schools received a minimal intervention that included written materials on healthy eating and physical activity, distributed during the baseline assessment.

The evaluation of New Moves used a pretest, post-test, follow-up, quasi-experimental design. Eighty-nine girls from three schools were enrolled in the intervention, and 112 girls were enrolled in three comparison high schools (Neumark-Sztainer et al, 2003). The girls' mean BMI was 26.7 (SD = 6.5) and the majority of the girls were enrolled in the 9th and 10th grades during the intervention. Both a process and an impact evaluation were conducted. The process evaluation included four components: individual interviews with intervention-school physical education teachers and principals regarding program satisfaction and sustainability (response rate = 100%), mailed surveys to parents of the intervention girls at the end of the program (response rate = 70%), process evaluation surveys completed by intervention girls at the end of the program (response rate = 89%), and in-person interviews conducted with a sample of 30 intervention girls after program completion. The process evaluation primarily focused on program satisfaction.

An impact evaluation was conducted to assess the program's impact on physical measures, as well as behavioral, personal, and social-environmental variables (Neumark-Sztainer et al, 2003). Data was collected at baseline, post-intervention, and at an 8-month follow-up. Data was analyzed using ANOVA methods to compare intervention and control means at post-test (16 weeks) and at the 8-month follow-up. The primary outcome variable examined was BMI. The psychosocial variables examined included self-worth, benefits of physical activity, self-efficacy for physical activity, enjoyment of physical activity, and social support (from parents, peers, and staff). Physical activity behavior was examined through stage of change, self-reported hours per week of physical activity, and self-reported hours per week of sedentary behavior. All variables were measured using valid and reliable instruments. There were no significant changes from baseline to post-intervention (16 weeks). Stage of change was the only variable to significantly change from baseline to follow-up ($p<0.01$). While girls in the control schools did not change stages, 38% of the intervention girls progressed in stage while 11% regressed in stage at follow-up.

Project Active Teens

Project Active Teens was a conceptual physical education program designed to increase the proportion of high school students meeting national physical activity goals (Dale, Corbin, & Cuddihy, 1998). The project was developed for 9th grade students enrolled in a new high school in Arizona. The Project Active Teens curriculum was implemented in high school physical education classes, and used a combination of classroom and gym settings. High school physical education teachers delivered the conceptual physical education program once a week in a classroom and once a week in the gymnasium for an entire school year. The classroom based activities were designed to teach students concepts and facts about physical activity and fitness, as well as behavioral skills. Program concepts targeted included activity logging, goal setting, and program planning. Physical activity sessions in the gym were designed to teach fitness self-assessment, personal program-building skills, and methods for performing lifelong physical activities. During the remaining 3 days per week, students participated in their typical sport-based physical education program. Students enrolled in the Project Active Teens conceptual physical education classes were compared to transfer students, enrolled at the same high school but in a traditional physical education program.

The evaluation of Project Active Teens (PAT) used a post-test only, quasi-experimental design. Data on moderate and vigorous physical activity was assessed using four questions from the Youth Risk Behavior Survey on two occasions after the program implementation: when the first round of 9th grade PAT students were in the 11th and then12th grades; simultaneously the second round of 9th grade PAT students were in the 10th and then 11th grades.(Dale et al, 1998). The YRBS questions asked students to report the number of days in the preceding week they had been physically active. Data on muscle fitness activities, flexibility exercises, and sedentary behaviors were collected during the first data collection only. Data was analyzed using Chi-Square statistics to compare the number of students in the Project Active Teens conceptual physical education classes meeting national standards for moderate and vigorous physical activity compared to the student enrolled in the traditional physical education program.

The Project Active Teens program was delivered during two years, to students enrolled in 9th grade physical education (Dale et al, 1998). Among the students enrolled in the first year of program implementation, a greater proportion of boys reported meeting the recommended guidelines for moderate physical activity (30+ minutes on 5+ days per week) during the 12th grade. 34% of boys who were exposed to first year of Project Active Teens reported meeting guidelines for moderate physical activity, compared to 13% of boys enrolled in the traditional physical education program during the same year ($p<0.05$). A greater percentage of 11th grade girls exposed to the first year of Project Active teens reported engaging in muscle fitness activities on three or more days a week (58%) compared to girls in the traditional physical education program (48%), ($p<0.05$). No significant differences in the proportion of students meeting physical activity standards were found between students enrolled in the second year of Project Active Teens and those enrolled in the traditional physical education program. The authors concluded that the program was effective at reducing sedentary behavior among adolescent girls. A major limitation of the study was that the subjects in the control group attended the same school as those in the PAT conceptual physical education class.

Stanford Adolescent Heart Health Program

The Stanford Adolescent Heart Health Program was developed as a multiple risk factor reduction curriculum for 10th grade students (Killen, Telch, Robinson, Maccoby, Taylor, & Farquhar, 1988). The intervention consisted of 20 classroom sessions, each lasting 50 minutes within physical education classes; students received the intervention 3 days a week for 7 weeks. The 20 sessions were divided among 5 modules: physical activity, nutrition, cigarette smoking, stress, and personal problem solving. Each module provided students with information on the effects of health behaviors designed to increase the attractiveness of healthful lifestyles, cognitive and behavioral skills enabling students to change personal behaviors, skills to resist the adoption of unhealthy behaviors, and specific practice in using skills to improve performance. The evaluation used a pretest, post-test, quasi-experimental design. All 10th graders (n = 1447) enrolled in 4 high schools in northern California were recruited to participate in the study. Two schools were randomly assigned to receive the intervention, and two schools served as a comparison.

The study aimed to evaluate the effectiveness of the program at: increasing students' knowledge of cardiovascular disease risk behaviors, decreasing cardiovascular disease risk factors (smoking and consumption of foods high in fat, cholesterol, and salt), increasing levels of aerobic physical activity and consumption of complex carbohydrates, and lowering heart rate, BMI, blood pressure, and skinfold thickness (Killen et al, 1988). Knowledge was examined through a multiple choice knowledge test. Physical activity behavior was examined with a self-report measure; students were asked to check, on a checklist, different forms of physical activity they engaged in for more than 20 minutes nonstop and the frequency at which they did the activities. Students who reported participating in activities 3 or more times per week for at least 20 minutes were classified as aerobic exercisers. Physiologic variables examined included height, weight, BMI, skinfold thickness, resting heart rate, and blood pressure. Measurements were collected at baseline and again two months after the completion of the 7-week intervention. Data analysis was conducted using ANCOVA and Chi-square statistics, with the individual as the unit of analysis.

The intervention appeared to have a positive effect on knowledge of cardiovascular disease risk factors, physical activity, resting heart rate, BMI, and skinfold thickness (Killen et al, 1988). Knowledge gains were significantly greater for students in the treatment group when compared to students in the control schools on each of the risk factor domains tested ($p<0.01$). A higher proportion of students who classified as non-exercisers at baseline were classified as regular exercisers at follow-up in the treatment group when compared to the control group. 30.2% of non-exercisers at pretest became regular exercisers at post-test in the treatment group, compared to 20.0% in the comparison group ($p<0.01$). Both boys and girls in the treatment group reduced their resting heart rate compared with students in the comparison schools.

Resting heart rate decreased an average of 2.3 beats per minute among boys and an average of 4.1 beats per minute among girls in the intervention group, compared to an increase of 0.4 beats per minute among both boys and girls in the control group ($p<0.01$). There was a significant decrease in BMI among girls in the intervention group ($p<0.05$), while the BMI among girls in the control group remained the same. There were increases in BMI among boys in both the intervention and control groups, but the increase among boys in the control group was larger ($p<0.05$). There was a significant decrease in tricep and subscapular skin fold thickness among girls in the intervention group ($p<0.05$), with an increase in skin folds among girls in the comparison group. There was a non-significant decrease in skin fold thickness among boys in both the intervention and comparison groups. The intervention had no effect on blood pressure.

Slice of Life

Slice of Life was a 10-sesson, peer-led high school curriculum designed to promote healthy eating and physical activity patterns among adolescents (Perry, Klepp, Dudovitz, Golden, Griffin, & Smyth, 1987). The program was delivered during the fall of 1984 and the winter of 1985 by university staff and peer leaders elected by their classmates. Slice of life targeted the following Social Learning Theory constructs: knowledge, environmental awareness, health values, internal locus of control, peer modeling, opportunities, environmental barriers, social support, self-monitoring, direct reinforcement, and behavioral skills. The Slice of Life lessons focused on fitness, recommendations for exercise, self-monitoring exercise and eating behaviors, environmental influences, weight control, and social influences for diet and exercise.

A process evaluation was conducted to measure the students' satisfaction and perceived quality of the Slice of Life program (Perry et al, 1987). Three sets of questionnaires were administered to all peer leaders and students in the intervention class during the program. Questions addressed the degree to which the students and peer leaders liked the program activities, whether they liked the university staff and peer leaders delivering the program, whether the right peer leaders were chosen, whether they thought the peer leader training was adequate, and whether or not they thought the program impacted their eating and physical activity behaviors. Results indicated that females were more positive about the quality of the program overall, more responsive to the peer-leader method of instruction, and more reaffirming about the influence the program had on their eating and physical activity habits when compared to boys involved in the program.

The outcome evaluation was conducted using a pretest, post-test, quasi-experimental design. All variables were measured through self-report means. An outcome survey instrument was developed to measure self-reported behavior, knowledge, intentions, and skills related to heart-health eating and exercise patterns (Perry et al, 1987). Physical activity was reported as time spent on aerobic exercise outside of gym class and by having students select aerobic activities as usual choices from 12 activity pairs. Students were asked if they had a regular exercise program (3 times per week for at least 20 minutes) and the intensity of their physical activity. Validity and reliability of all measures were reported. All outcome data was analyzed by gender using ANCOVA statistical analysis, with the baseline scores as a covariate.

The Slice of Life intervention had a positive effect among girls in the intervention group but no effect among the boys when compared to a control. Females reported increased knowledge of heart heath activities ($p<0.05$), following an a regular exercise program more frequently after school ($p<0.05$), increased intensity of their physical activity when exercising ($p<0.01$), and increase in their intentions to increase the frequency, duration, and intensity of their exercise behavior ($p<0.05$) when compared to a the girls in the comparison group (Perry et al, 1987). Both boys and girls in the intervention and control groups showed a decrease in time spent exercising; the change was non-significant, however. None of the variables significantly changed among the boys in the intervention group compared to the boys in the control group.

Winters Dissertation

Winters (2001) developed an intervention to increase leisure-time moderate and vigorous physical activity among Ohio high school students. The intervention targeted the frequency of physical activity, as well as four SCT constructs: self-control, social situation, outcome expectations, and self-efficacy. Two schools were recruited to participate in the study. Students in one school served as a comparison school and received their typical physical education class for 10 weeks. Students in the intervention school received their typical physical education class, plus the Winters intervention components. The intervention was delivered once a week and included 10-15 minute mini-lessons, as well as an exercise incentive program. Each mini-lesson was designed to address a specific SCT construct, including: goal setting, gaining and maintaining social support, securing intrinsic and extrinsic reinforcements, self-monitoring, and planning to overcome barriers to physical activity. The exercise incentive program was designed to help students gain mastery experiences with exercise by setting weekly goals; students were rewarded for using the knowledge they received during mini-lessons to achieve their weekly exercise goals.

An implementation evaluation was conducted to determine the degree to which the designed educational treatment was delivered to students and received by the students (Winters, 2001). Teachers were asked to identify, from a list, which teaching objectives were met after each lesson. Teachers not implementing at least 80% of the teaching objectives were removed from the study for not implementing with adequate fidelity. The degree to which the program was received by students was examined through graded learning objectives; students who failed to complete at least 80% of the learning objectives were removed from the study for a lack of implementation received.

The evaluation of the Winters intervention used a pretest, post-test, quasi-experimental design (Winters, 2001). All measures for the SCT had reported validity and reliability. Moderate and vigorous physical activity was measured using the PDPAR, also with known reliability and validity. Data was analyzed using ANCOVA measures, using the pretest as the covariate, as well as with paired t-test statistics. Results indicated that the program had an effect on the SCT construct self-control and moderate physical activity. Students in the treatment group increased their frequency of moderate exercise from 1.29 days to 2.35 days (t-test, $p<0.01$), while students in the comparison group had a significant decrease in the frequency of moderate physical activity from pretest to post-test (t-test, $p<0.01$). There was a particular decrease in the number of students in the experimental group categorized as sedentary at post-test when compared to pretest. This decrease was not found within the comparison groups.

Hortz Dissertation

Hortz (2005) developed a Social Cognitive Theory-based intervention to increase the frequency of moderate and vigorous leisure-time, planned physical activity among Ohio high school students. Two Ohio high schools were recruited to participate in the study. Both schools received a typical physical education program. The intervention school also received a Social Cognitive Theory based curricular component, as an addition to their regular physical education class. The intervention focused on specific skill-building exercises and targeted the following SCT constructs: knowledge, self-efficacy for overcoming barriers to physical activity, outcome expectancy values, self-regulation, and social situation. Particularly, students were taught self-regulatory skills aimed at their ability to self-direct their physical activity behavior. Through a series of 10 in-class lessons and homework activities, students were engaged in mastery experiences through goal setting and changing students' perceptions of outcomes related to physical activity, through identifying barriers to physical activity and developing strategies to overcome barriers, and through acquiring and evaluating feedback from their social environment (family and peers).

An implementation evaluation was conducted to determine the degree to implementation delivered by the teacher and the degree of implementation received by the students (Hortz, 2005). The degree of implementation delivered by the teacher was examined as the proportion of teaching objectives within each lesson delivered by the teacher. Each lesson was evaluated to determine if all teaching objectives were met. The exposure of students to the intervention was assessed by tracking the amount of time students were exposed to each curricular component, through class attendance, and through homework completion. If less than 80% of the teaching objectives were met, and if students were exposed to less than 80% of the curricular components, the implementation was considered low.

The evaluation of the Hortz intervention used a quasi-experimental non-equivalent control group design (Hortz, 2005). Measures of all SCT constructs were conducted using instruments with known reliability and validity. Moderate and vigorous physical activity was measured using the PDPAR, also with known validity and reliability. Data was analyzed using a 2X2 mixed factor ANOVA. The impact of the program on the SCT constructs and behavior was examined across treatment groups and over time. The study was found to have an impact on moderate physical activity, particularly among previously sedentary students. The intervention group increased their frequency of moderate physical activity by 2.05 days from pretest to post-test, while the frequency of moderate physical activity within the comparison group increased by only 0.47 days. The interaction between treatment and time was significant ($p<0.025$) and the effect size was large ($\mu = 0.14$). There was a 19.9% increase in the number of students meeting the guidelines for moderate physical activity (30+ minutes on 5+ days per week) within the intervention group. Examining the SCT constructs, the intervention was found to have a positive impact on self-regulation (medium effect size, $\mu = 0.08$) and on social situation (small effect size, $\mu = 0.03$). There were no significant effects of the intervention on outcome expectancy-value, self-efficacy for physical activity, or the frequency of vigorous physical activity.

Summary of Intervention Studies

Elementary School Interventions

A total of 7 SCT, elementary school-based physical activity interventions were identified for review. Among those interventions, 16 evaluations were identified. A summary of the elementary school interventions is presented in Table 2.3. For each evaluation, the intervention setting lesson length (intervention dose) is presented. A summary of the process evaluations, the impact evaluations on the SCT constructs and physical activity behaviors, and the outcome evaluations on health indices are also presented. Each of the intervention evaluations used quasi-experimental methods, with schools randomly assigned to receive a treatment or comparison condition. Data on SCT constructs was generally collected through self-report means. Data on physical activity in physical education class was collected using observational methods. In only a few cases was data regarding physical activity outside of school examined, and these variables were measured using self-report questionnaires. In the large-scale studies, data was analyzed at the school level, but more commonly data was analyzed with the student as the unit of analysis.

Elementary school physical activity interventions have primarily been conducted in health and physical education class settings, by either trained classroom or physical education teachers. Process evaluation was described in four of the seven interventions, and primarily used self-report and observational methods to determine the degree of implementation delivery as well as teacher, staff, and/or student satisfaction with the intervention. The most commonly cited educational construct targeted was knowledge for cardiovascular health. Three programs were able to show programmatic effects on knowledge. There was minimal evidence to support the use of interventions to change other SCT constructs (including self-efficacy, social support, behavioral capability, and outcome expectations) among elementary students; when change in the construct did occur, the effects tended to occur in the later years (3^{rd} grade for Go for Health and 4^{th} grade for CATCH) and then diminish over time (CATCH). There is evidence to suggest that interventions targeting physical activity within physical education class are effective at increasing the students' energy expenditure, time on MVPA, and time in higher activity categories during physical education (Go for Health, CATCH, SPARK). There is minimal evidence to suggest that these interventions are effective at increasing physical activity outside of school, however. None of the studies reported construct validity of the treatment, connecting the change in the theoretical constructs to change in physical activity. While the outcome evaluations indicated a tendency for health indices such as HDL, total cholesterol, blood pressure, and skin-fold thickness to decrease as result of the intervention, results varied and none of the programs that reported an impact on outcome variables indicated a change in physical activity, particularly outside of school.

Intervention	Evaluation	Setting	Length	Process Evaluation		Impact Evaluation		Outcome Evaluation
				How	What	SCT Construct	Physical Activity	
Know Your Body	Marcus et al (1987)	Health	45 min/wk, 5 months	Not Reported	Not Reported	↑ Knowledge	↑ Aerobic Activity Index	Not Measured
	Bush et al (1989)	Health, Science	2 X 45 min/wk	Teacher Observations; Teacher Questionnaires	Adherence to curriculum; Quality of instruction	↑ Knowledge	No Change	↓BP; ↑HDL; ↓Chol:HDL; ↓Serum Thiocynate; ↑Fitness
	Resnicow et al (1992)	Health, Science	45 min/wk	Head teacher rating; Project coordinator rating	Rating; Low implementer, medium implementer, high implementer	Linear ↑ Knowledge with ↑ Implementation	No Change	↓Total Cholesterol; ↓Systolic BP
Go for Health	Parcel et al (1989) Simons-Morton et al (1991)	Health, PE	6-8 wks Health; 6-wk PE	School staff interviews	Perceived quality; Program satisfaction	3^{rd} Grade: No Change 4^{th} Grade: ↑BC, ↑ SE	↑Aerobic exercise (int. and cont.); ↑time on MVPA; ↑% of PE on MVPA	Not Measured

Continued

Table 2.3: Summary of Elementary School SCT-Based Physical Activity Interventions

Table 2.3 Continued

Intervention	Evaluation	Setting	Length	Process Evaluation		Impact Evaluation		Outcome Evaluation
				How	What	SCT Construct	Physical Activity	
Heart Smart	Arbeit et al (1992)	Science PE	12 Lessons	Not Reported	Not Reported	Not Measured	Not Measured	Boys: ↓Fitness; ↓ SysBP; ↓Tri Skinfold; ↑HDL
SPARK	McKenzie et al (1993)	PE, 1-yr impact	30 min, 3/wk	Interview, Questionnaires	Not Reported	Not Measured	↑EE on PE; ↑PE fitness time; ↑PE % students very active	Not Measured
	McKenzie et al (1997)	PE, 2-yr.impact	30 min, 3/wk	Not Reported	Not Reported	Not Measured	↑MVPA time; ↑very active time; ↑ fitness activities	Not Measured
	Sallis et al (1997)	Self-management	Not Reported	Not Reported	Not Reported	No Change: SE, OE, SS	No Change	Girls: ↑Fitness: 1-mi. run, sit-ups
CHIC	Harrel et al (1996)	Health PE	30 min, 3/wk	Not Reported	Not Reported	↑ Knowledge	No Change	Not Measured
Eat Well and Keep Moving	Gortmaker et al (1999)	Multiple Classes	13, 50-min lessons, 5 PE lessons	Teacher surveys; Student surveys	Program delivery; Teacher, Student Satisfaction	↑ Knowledge	No Change	Not Measured

Continued

Table 2.3 Continued

Intervention	Evaluation	Setting	Length	Process Evaluation		Impact Evaluation		Outcome Evaluation
				How	What	SCT Construct	Physical Activity	
CATCH	Stone et al (1989)			Staff reports; Self-report check-lists; Observations	Dose and fidelity of implementation	Not Reported	Not Measured	Not Measured
	Edmundson et al (1996)	1-yr Classroom, PE	90 min, 3/wk	Not Reported	Not Reported	↑SE; ↑ Pos. Support; ↓ Neg. Support	Not Measured	Not Measured
	Edmundson (1996)	2+3 yr, Classroom, PE	90 min, 3/wk	Not Reported	Not Reported	2nd Yr: Maintain ↑SE, ↑ Pos. Support	Not Measured	Not Measured
	McKenzie et al (1996)	PE	90 min, 3/wk	Not Reported	Not Reported	Not Measured	PE: ↑ MVPA time, ↑EE, ↑rate EE, ↑active PE time: ↑Vig Min PA	Not Measured
	Webber et al (1996)	Classroom, PE	30 min, 3/wk	Not Reported	Not Reported	Not Measured	Not Measured	No Change; Mixed results for BP
	McKenzie et al (2003)	5-yr post-test to follow-up	NA	Not Reported	Not Reported	Not Measured	No Differences Int/Cont	Not Measured

Note:
PE = Physical Education; MVPA = Moderate-to-Vigorous Physical Activity; EE = Energy Expenditure; BC = Behavioral Capability; SE = Self-Efficacy; OE = Outcome Expectations; SS = Social Support

Middle School Interventions

A total of four SCT based, middle school interventions aimed at increasing physical activity were identified for review. A summary of the middle school interventions is presented in Table 2.4. For each evaluation, the intervention setting lesson length (intervention dose) is presented, along with a summary of the process evaluations, the impact evaluation, and the outcome evaluation. The evaluations of three of the middle school interventions used a pre-test, post-test, quasi-experimental design. One evaluation (Fargo/Moorhead-250) used a longitudinal design, tracking students each spring from the time they were in the 6^{th} grade, until they graduated from high school; this study was part of the large-scale, community-based, Minnesota Heart Health Program. Data on the SCT constructs was either not collected or not reported within these evaluations. Similar to the elementary school interventions, data on physical activity in physical education class was collected using observational methods, and more specifically the SOFIT observational method. Data regarding physical activity outside of school was measured using self-report questionnaires. While schools were recruited and randomized, the student was the level of analysis for these studies.

Many of the characteristics of middle school physical activity interventions are very similar to the elementary school interventions. Three of the middle school interventions were delivered in physical education settings. Two of the intervention studies (Fargo/Moorhead-250 and Planet Health) also took on an interdisciplinary approach, with lessons incorporated into multiple classroom settings (math, language arts, science, etc). Each of the middle school interventions was implemented by school teachers, who were trained in some way with the intervention staff. While 3 of the 4 interventions reported the type of information that was collected for a process evaluation, only 2 of the interventions reported how the process data was collected. The primary process variable examined was perceived program quality, or satisfaction.

The results of the impact evaluations for the middle school interventions were not very promising. While each of the interventions were described as being based on Social Cognitive Theory, none of the evaluations included measures of the SCT constructs targeted. It is therefore impossible to make any conclusions regarding construct validity of the treatment. Physical activity behavior was measured in 3 of the 4 interventions but was only impacted in 2 of the 4 programs. The Fargo-Moorhead-250 intervention appeared to have a positive effect on physical activity among girls; this intervention was a small part of a larger, community-based intervention, however; as a result, the source of the programmatic effect could come into question. The authors also mentioned that, while the physical activity levels remained higher among girls in the intervention group compared to the control group throughout most of the study, there was a decreasing trend in physical activity with age (Kelder et al, 1993). While the intervention was successful in increasing physical activity when compared to a control (particularly among girls), it was not sufficient enough to alter the decreasing age-physical activity trend. Similar to elementary programs targeting in-class physical education behavior, the M-SPAN program targeted and had an impact on in-class physical activity behavior; boys in the M-SPAN PE classes showed in increase in the time spent on MVPA and in the proportion of class time spent in MVPA when compared to a control (McKenzie et al, 2004).

Finally, changes in health outcomes were reported for 2 interventions, but the results were inconsistent with the impact that the program had on physical activity. While Planet Health reported decreasing the prevalence of obesity, the program had no impact on physical activity behavior directly. The CHIC II program reported a positive impact of the program on decreasing blood pressure, increasing predicted aerobic power, and on attenuating the increase in skinfolds that typically comes with age, the study did not report changes in physical activity behavior. We must assume, therefore, that the changes in health indices in these programs were due to aspects of the interventions other than the physical activity targets, or due to confounding factors.

Intervention	Evaluation	Setting	Length	Process Evaluation		Impact Evaluation		Outcome Evaluation (Health)
				How	**What**	**SCT Construct**	**Physical Activity**	
Fargo/Moorhead-250	Kelder et al (1993)	Various Classes	Not reported	Not Reported	Student Participation; Student Satisfaction	Not Measured	Girls: ↑hours of exercise all but 11^{th} grade; ↑PA score 8^{th}, 9^{th}, 11^{th}, 12^{th} grades Boys: ↑hours of exercise 7^{th} &11^{th} grades	Not measured
Planet Health	Gortmaker et al (1999)	Various Classes, PE	1, 45-mi lesson per subject	Direct Observation; Teacher Reports	Degree of Implementation; Perceived Ease of Implementation	Not Measured	No change in PA; ↓Sedentary Behavior	Girls: ↓Prevalence of Obesity
CHIC II	McMurray et al (2002)	Health, PE	30-min, 3X per week	Not Reported	Not Reported	Not Reported	Not Reported	↑sum skinfolds; ↑pVO_2; ↓BP Effects largest for Ex & Ed Group
M-SPAN	McKenzie et al (2004)	PE	Not reported	Student Questionnaires; Teacher Surveys;	Perceived Quality of Program; Program Acceptability	Not Measured	↑PE time on MVPA; ↑Proportion PE on MVPA Primarily Boys	Not Measured

Note:
PE = Physical Education; MVPA = Moderate-to-Vigorous Physical Activity
pVO_2 = Predicted Aerobic Power
BP = Blood Pressure

Table 2.4: Summary of Middle School SCT-based Physical Activity Interventions

High School Interventions

A total of 7 SCT, high school interventions aimed at increasing physical activity were identified for review. A summary of the high school interventions is presented in Table 2.5. For each evaluation, the intervention setting lesson length (intervention dose) is presented, along with a summary of the process evaluations, the impact evaluation, and the outcome evaluation. The evaluations of 6 of the high school interventions used a pre-test, post-test, quasi-experimental design. One of the interventions (Project Active Teens) used a post-test only, quasi-experimental design. Data on all SCT constructs and physical activity were collected using self-report measures. Similar to the middle school, as well as most of the elementary school interventions, while the school was the level of randomization, data was analyzed using the student as the unit of analysis.

Many of the characteristics of high school interventions were similar to both the middle school and the elementary school physical activity interventions. The interventions were delivered in health and physical education settings. The interventions were delivered by school teachers (Project Active Teens, Stanford Adolescent Heart Health Program, LEAP, New Moves), research staff (Winters Dissertation, Hortz Dissertation), or through combination of peer leaders and program staff (Slice of Life). Only two of the intervention evaluations failed to report measures of process evaluation. Two of the programs who reported process evaluation measures (Slice of Life and New Moves) examined implementation through perceived quality of the program, or program satisfaction. Three of the programs (LEAP, Winters Dissertation, and Hortz Dissertation) used more objective measures of implementation; the number and quality of lesson components, teaching objectives, and/or learning objectives were measured to determine the degree of implementation fidelity. In the case of the LEAP program, schools participating in the program were then classified as either low implementers or high implementers.

Results of the impact evaluations were more promising in these interventions compared to the middle school and elementary school interventions. All but one of the interventions measured SCT constructs targeted through intervention. Two of the programs reported increases in knowledge, one reported an increase in self-control, one an increase in self-efficacy, and two an increase in measures associated with self-regulation. Each of the interventions reported a programmatic effect on some measure of physical activity. While each of the studies used self-report methods to examine physical activity, the actual measure used and the way that physical activity was operationally defined varied. This makes it very difficult to compare programmatic effects between studies. Three of the studies (LEAP, Winters Dissertation, and Hortz Dissertation) reported results regarding construct validity of the treatment. Only one study (LEAP) used statistical analyses (Structural Equation Modeling) to examine the mediating effects of the SCT constructs on behavior. Reporting construct validity of the treatment is an important addition to the intervention evaluation literature, as it increases our ability to make conclusions regarding both the means through which physical activity was impacted and the utility of using the SCT in the development of physical activity interventions.

Outcome evaluations were reported for only 2 of the high school interventions. The evidence supporting the effectiveness of high school interventions at changing health indices was minimal; while one intervention (Stanford Adolescent Heart Health) showed decreases in heart rate among both girls and boys and decreases in BMI and skinfolds among girls, the other (New Moves) showed no impact on health indices. This could be due to the fact that each of the interventions was shown to impact moderate, rather than vigorous, physical activity.

Intervention	Evaluation	Setting	Length	Process Evaluation		Impact Evaluation		Outcome Evaluation
				How	What	SCT Construct	Physical Activity	
Slice of Life	Perry et al (1987)	Health	Not Reported	Student Self-Report; Peer Leader Questionnaires	Student Satisfaction ; Program Satisfaction	Girls: ↑ Knowledge	Girls: ↑ Proportion Exercising Regularly; ↑ Intensity; ↑ Intentions	Not Measured
Stanford Adolescent Heart Health	Killen et al (1988)	PE	50-min, 3/wk, 7 wks	Not Reported	Not Reported	↑ Knowledge	↑ % Students Classified as “Exercisers”	↓HR; Girls: ↓BMI; ↓ Skinfolds
Project Active Teens	Dale et al (1998)	PE	1-yr, PE	Not Reported	Not Reported	Not Reported	1st Yr: ↑ Proportion boys meeting mod. Guidelines; ↑ proportion girls doing muscle fitness activities	Not Measured
Winters Dissertation	Winters (2001)	PE	15-min, 1/wk, 10 wks	% Teaching Objectives Met; % Learning Objectives Met	Degree of treatment delivered; degree of program received	↑ Self-Control	↑ Mod. Days; ↓Sedentary Students	Not Meaured

Continued

Table 2.5: Summary of High School SCT-based Physical Activity Interventions

Table 2.5 Continued

Intervention	Evaluation	Setting	Length	Process Evaluation		Impact Evaluation		Outcome Evaluation
				How	What	SCT Construct	Physical Activity	
New Moves	Neumark-Sztainer et al (2003	PE, girls	5/wk, 16 wks	Teacher Interviews ; Principal interviews ; Student survyes ; Student interviews	Perceived sustainability ; perceived satisfaction	No Change	38% Progressed SOC; 11% Regressed SOC	No Change (BMI)
LEAP	Dishman et al (2004)	Health, PE	1-yr, all classes	Records of Implementation; Observation of PE; Staff Ratings	LEAP Criteria: categorized as low vs. high implementers	↑ SE, ↑Goal Setting	↑ PA Score, partially mediated by SE	Not Measured
Hortz Dissertation	Hortz (2005)	PE	1 class/wk, 10 wks	Number of teaching objectives delivered; Time on lessons, class attendance, homework completions	% Teaching objectives delivered; students exposure to treatment	↑ SR, ↑ SS	↑Moderate days, ↑% students meeting moderate guidelines	Not Measured

Note:
PE = Physical Education; HR = Heart Rate; BMI = Body Mass Index; SE = Self-Efficacy, SR = Self-Regulation, SS = Social Situation

Section Five: Physical Education Curricular Foundation and Objectives

The fifth section of this review examines the foundations and curricular objectives of physical education. The intervention under study was developed to be integrated into physical education, health, and life skills courses. The intervention contains concepts and exercises which teach students skills to be physically active not only during physical education class, but in their leisure time. An Examination of the foundations and the objectives of physical education aided in the development of an intervention appropriate for integrating into any physical education courses.

Physical education has been documented as being integrated into school curricula since as far back as 1850. Throughout the years physical educators developed and published varying objectives for physical education. A primary objective that has been consistent throughout the literature is that physical education should teach students to lead a physically active lifestyle. One of the first statements lending itself to physical education's contribution to education as a whole came from The National Educational Association's Cardinal Principles of Secondary Education in 1918; these principles stated seven objectives of education: health, command of fundamental processes, worthy home membership, vocation, worthy use of leisure time, and ethical character (Bucher, 1979). Physical education was thought to contribute towards those educational objectives by teaching the benefits of exercise to physical health, by teaching fundamental physical skills to make for "a more interesting, efficient, and vigorous life", and by contributing to social education through the development of character and good human relations (Bucher, 1979).

In 1936 the Committee on Curriculum Research of the College of Physical Education Association could identify 174 physical education objectives within the literature, illustrating the lack of organized standards for the field. By 1950, the American Association for Health, Physical Education, and Recreation (AAHPER) and the Society of State Directors of Health, Physical Education, and Recreation consolidated the many objectives into a platform for physical education which included a statement of objectives: 1) to develop and maintain maximum physical efficiency, 2) to develop useful skills, 3) to conduct oneself in socially useful ways, and 4) to enjoy wholesome recreation (Bucher, 1979). It is quite clear by examining the early literature, that there were no standard set of objectives or purposes for physical education curricula; researchers and practitioners were identifying and publishing what they thought to be objectives of their own curricula.

In 1970, Anthony Annarino published the five traditional objectives of physical education. According to Annarino, physical education lent itself to five categories of development: organic, neuromuscular, interpretive, social, and emotional (Annarino, 1970). The organic, or physical, development objective targeted proper functioning of the body systems so that the individual could adequately meet environmental demands. This objective included current measures of fitness, including muscular strength, muscular endurance, cardiovascular endurance, and flexibility. The value of this objective was based on the fact that an individual would be more physically active, would have better performance, and would be healthier if the organic systems of the body were adequately developed and functioning property. The neuromuscular objective targeted the harmonious functioning of the nervous and muscular systems to produce desired movements. Physical educators met this objective by teaching skills: locomotor skills, nonlocomotor skills, sport skills, and recreational skills. The interpretive objective dealt with the ability to explore, to discover, to understand, to acquire knowledge, and to make value judgements; it was targeted by teaching game rules, safety measures, etiquette, the use of strategies and techniques involved in organized activities, and knowledge about how the body functions and its relationship to physical activity. The social objective dealt with the ability to make judgements in a group situation; it was targeted by teaching skills to communicate with others, the ability to exchange and evaluate ideas within a group, and by teaching constructive use of the leisure time. Finally, the emotional objective targeted a healthy response to physical activity through the fulfillment of basic needs, including the release of tension through suitable physical activities and by providing an outlet for self-expression and creativity (Annarino, 1970).

At a similar time when Annarino was outlining a standard list of the objectives of physical education, Billy Wireman (1965) published the standards for a physically educated person. According to Wireman, a physically educated person should have six distinct qualities: A physically educated person understands the history of physical education; is proficient in leisure-time skill and utilizes this skill for relaxation and recreation; is cognizant of the relationship of exercise, diet, and weight control; is knowledgeable about the role of sports in the nation's culture; has a body capable of meeting the demands of day-to-day living, and; understands the concept of total health. (Wireman, 1965). These standards represented an effort to establish standards for the profession as a whole (Bucher, 1979).

Researchers on the foundations of physical education have further cited the ways in which physical education contributes to general education, specifically within the cognitive, affective, and psychomotor domains (Bucher, 1979). As cited by Bucher, the objective of cognitive development is concerned with knowledge and understanding. Physical education contributes to cognitive development in six ways: by contributing to academic achievement, by contributing to knowledge of exercise, health, and disease, by contributing to an understanding of the human body, by contributing to an understanding of the role of physical activity and sports in American and other cultures of the world, and by contributing to the wise consumption of goods and services. The affective domain is primarily concerned with interests, appreciations, attitudes, and values. Physical education contributes to the affective domain in seven ways: by contributing to an appreciation of beauty, by contributing to directing one's life toward worthwhile goals, by stressing human relations, by enabling each individual to enjoy a rich social experience through play, by helping individuals to play cooperatively with others, by teaching courtesy, fair play, and good sportsmanship, and by contributing to humanitarianism. In physical education, the psychomotor domain is concerned with the motor skills, and physical education is offered as a planned program of physical activity as an essential to optimum body functioning during a developmental period of life. In this domain, physical education contributes to skill as a participant and spectator in sports, to skill in utilizing leisure hours in mental and cultural pursuits, and to skills essential to the preservation of the natural environment (Bucher, 1979).

As outlined in the review above, it took years for researchers and practitioners to develop standard objectives and standardized curricular outcomes for the field. When standardized, they centered on fitness; skill development; teaching judgment values for technique and etiquette; teamwork and social interaction; self-expression and creativity; and constructive use of leisure time. The foundations of physical education lay the groundwork for the outlined purposes and objectives for physical educators today.

Similar to the objectives of physical education of the past, current physical education organizations and researchers publish varying notations of the current objectives of physical education. Central to each variation, however, is the idea that physical education should teach students to lead physically active lifestyles. Stated clearly, the main purpose of physical education is to guide children in the process of becoming physically active for the rest of their lives (Himberg, 2003; Kelly & Melograno, 2004). Corbin (2002) states that skills taught in physical education include physical movement along with cognitive, social, and personal abilities; these ideas clearly match those of the past. Corbin further states that the skills taught within those domains include problem solving, critical thinking, acceptance, cooperation, and self-management skills such as goal setting, self-monitoring, program planning, and overcoming barriers (Corbin, 2002).

In 1995, the National Association for Sport and Physical Education (NASPE) published the most recent version of the standards for physical education (NASPE, 2005). The appropriateness of implementing an intervention for increasing leisure-time physical activity in secondary physical education is apparent upon review of the 10th grade benchmarks for meeting the standards (Kelly & Melograno, 2004). The first standard is that a physically educated person should demonstrate the competency in many movement forms and proficiency in a few movement forms; a 10th grade student would demonstrate this standard through the use of appropriate skills. The second standard is that a physically educated person applies movement concepts and principles to the learning and development of motor skills, demonstrated by a student describing the significance of some basic physiological principles to the development of a personal fitness program. The third standard states that a physically educated person exhibits a physically active lifestyle; this standard should be demonstrated by finding health enhancing activities which the student can pursue in the community, by analyzing and evaluating personal fitness profiles, by comparing health and fitness benefits derived from various physical activities, and by overcoming barriers to carry a physical activity program into adulthood. The fourth standard states that a physically educated person achieves and maintains a health-enhancing level of physical fitness; a 10th grader should demonstrate this standard by using the results of self-monitoring to guide changes in a personal physical activity program, by assessing personal fitness status, by designing and implementing a personal fitness program, by participating in a variety of physical activities appropriate for enhancing fitness, and through the use of goal setting, self-management, and reinforcements. The fifth standard states that a physically educated student should demonstrate responsible personal and social behavior in physical activity settings; a 10th grader would demonstrate this standard through the identification of negative and positive peer influences. The final two standards for physical education state that a physically educated person should demonstrate understanding and respect for differences among people in physical activity settings and understand that physical activity provides opportunities for enjoyment, challenge, self-expression, and social interaction (Kelly & Melograno, 2004).

A physical activity intervention designed to teach high school students skills to develop and implement a physical activity program in their leisure time is appropriate for high school physical education courses and would aid in the demonstration of national standards. "Physical education teaches students how to add the habit of physical activity into their daily lives by aligning instruction with the National Standards for Physical Education, and by providing content and learning experiences that develop the skills and desire to be active for life" (Young, 1997). This idea has been illustrated by physical activity and physical education researchers. In 1988, the American College of Sports Medicine (ACSM) issued a statement stating that school physical education programs should focus on education and behavior change to encourage engagement in appropriate activities outside of class (Himberg, 2003). Researchers in physical activity have further stated that the goal of physical education should be for students to become educated with the knowledge and skills to be physically active outside of school and throughout life (Simons-Morton, 1994).

Physical education provides an appropriate setting for the implementation of a high school physical activity intervention. Students can be reached through physical education; 94% of middle schools and high schools require physical education, and 67% of high schools require physical education five days per week (CDC, *SHPPS*, 2000). As outlined above, the foundations of physical education identify that a programmatic priority for physical education as a field is to foster the development of a physically active lifestyle and, as stated it the review, "the appropriate use of leisure time" (Bucher, 1979). A review of the benchmarks for meeting physical education standards indicates that several of the targets for a SCT based physical activity intervention (goal setting, self-monitoring, reinforcing behavior, identifying the benefits of activity, the development and use of a personal fitness program) and benchmarks for meeting national standards are in alignment. 60.8% of high schools require the school to follow physical education standards (CDC, *SHPPS*, 2000). This illustrates the appropriateness of the development of a physical activity intervention in alignment with national physical education standards.

Summary of Literature Review

The review of Social Cognitive Theory outlines that the use of the theory relies on five behavioral capabilities: symbolizing capability, forethought capability, vicarious capability, self-regulatory capability, and self-reflective capability. It is possible that there have been minimal effects for SCT-based interventions within elementary school and middle school settings because the students in those settings are too young to possess these underlying behavioral capabilities. As outlined, the theory should not hold without these underlying behavioral capabilities. Older adolescents may benefit more from prevention education because they possess the cognitive and behavioral competencies necessary to understand and act on health and behavior-change instruction (Killen et al, 1988).

Evidence supports the development of psychosocial physical activity interventions for high school students, rather than younger students. Based on a review of the descriptive literature, SCT constructs have been shown to predict adolescent physical activity. Based on a review of the SCT, school-based intervention literature, high school interventions have had the most promising impact on the SCT constructs and subsequently on behavior. Elementary school and middle school interventions which have focused on increasing physical activity levels within physical education class have been successful in doing so. In these physical education settings, educators have students as a captive audience in a physical activity setting, for a specific amount of time. Elementary school and middle school interventions have had minimal effects on leisure-time physical activity levels, however. Although information on the SCT constructs targeted through middle school interventions has not been collected, there is little evidence to suggest that interventions prior to high school have been effective at changing SCT constructs other than knowledge. Gains in knowledge are insufficient to change physical activity behavior, as evidenced by the lack of support for the impact of the interventions on physical activity behavior which have been shown to increase knowledge scores alone. High school interventions have been able to change some of the SCT constructs targeted (self-efficacy, self-control, self-regulation, social situation) and have been shown to impact moderate physical activity behavior. Few of the high school interventions have statistically linked changes in the SCT constructs to changes in physical activity behavior. Those that have evaluated construct validity of the treatment have supported the utility of SCT in adolescent physical activity interventions.

The results of the review suggest that the more appropriate setting to develop and deliver a SCT-based physical activity intervention is a high school physical education or health setting. Most of the school-based interventions have been delivered in physical education and/or health education classes. While the goals of a physical activity intervention fit into the goals and objectives of physical education as a field, no study has examined the impact of implementing a physical activity intervention in various settings. Rates of physical activity among high school students are low. Rates of physical activity among college students and adults are even lower. High school health and physical education could provide a potentially critical target for teaching students to adopt a physically active lifestyle, one that students could potentially carry into college and adulthood. A line of research in the development and evaluation of interventions to increase physical activity among adolescents must continue to try and attenuate the increasing prevalence of overweight and obesity and the low rates of physical activity in our country.

CHAPTER 3

METHODS

Purpose of the Study

The purpose of the current study was to conduct an impact evaluation of the *Plan for Exercise, Plan for Health* intervention. The primary purpose was to evaluate the efficacy of the *Plan for Exercise, Plan for Health* intervention at changing the frequency of adolescent moderate and vigorous physical activity. There were two secondary purposes to this study. First, the study sought to examine whether changes in following four Social Cognitive Theory (SCT) constructs were able to predict changes in the frequency of adolescent moderate and vigorous physical activity: self-efficacy for overcoming barriers to physical activity, self-regulation of physical activity, social support from family and friends for physical activity, and outcome expectancy-values for physical activity. Second, the study sought to test whether changes in the targeted SCT constructs mediated changes in adolescent moderate and vigorous physical activity, thereby testing construct validity of the treatment and the utility of the use of SCT in the development of physical activity interventions.

The Plan for Exercise, Plan for Health intervention was designed to be integrated as a nine-week educational unit into high school physical education, health, and life-skills courses. The program was designed to teach students the following self-regulatory skills to develop and manage a personal leisure-time physical activity program: goal setting, goal evaluation, self-monitoring, identifying barriers to physical activity, identifying strategies to overcome barriers to physical activity, identifying reasons to be active, building a physical activity program around exercise motivators, enlisting positive rewards for physical activity, planning where to exercise, and enlisting social support for a physical activity program. The following SCT educational constructs were targeted: self-efficacy, self-regulation, outcome expectancy values, and social support. Support for the association between each of these educational constructs and adolescent physical activity is well documented within the literature, supporting the use of SCT in the promotion of physical activity among adolescents (Petosa et al, 2005;Petosa et al, 2003; Winterset al, 2003; Motl et al, 2002; Sallis et al, 1999; Trost et al, 1997; Biddle et al, 1996; Zakarian et al, 1994; Reynolds et al, 1990).

The Current Study within the Context of Health Education Evaluation

As was described in the Literature Review, evaluations of health education programs consist of three primary components: a process evaluation, an impact evaluation (including construct validity of the treatment), and an outcome evaluation. A former process evaluation of *the Plan for Exercise, Plan for Health* program was conducted and reported by Laura Mowad (2006). Based on measures of implementation fidelity, a criterion was established for the inclusion of schools recruited to deliver the *Plan for Exercise, Plan for Health* intervention to participate in the impact evaluation. Each teacher within the participating schools had to deliver each program lesson with at least 80% fidelity in order to be included in the impact evaluation; this criterion was established in order to avoid Type III error in the conclusions drawn from the impact evaluation. Based on the results from Mowad (2006), each participating school met the criterion for inclusion in the impact evaluation, reported in this dissertation. The outcome evaluation will be conducted in future studies, as the current study was developed as a primary efficacy evaluation; as Brian Flay (1986) suggests, measures of morbidity and mortality should be introduced into evaluations of health interventions during the later effectiveness trials.

Study Population

The population under study included high school students attending school within the Ohio Appalachian counties. A map of the Ohio Appalachian region is presented in Figure 3.1. In total, there are 29 Appalachian counties in Ohio and 137 high schools within those counties. A list of each of the Appalachian counties eligible to participate in the study and the number of high schools within each county is presented in Table 3.1. In order to be eligible to participate in the study, the high school had to have a physical education, health, and/or life-skills program.

Figure 3.1: Map of the Ohio Appalachian Counties

Ohio Appalachian County	Number of High Schools within County
Adams	4
Athens	5
Belmont	9
Brown	5
Carroll	2
Clermont	10
Columbiana	11
Coshocton	3
Gallia	3
Guernsey	3
Harrison	2
Highland	5
Hocking	1
Holmes	2
Jackson	3
Jefferson	6
Lawrence	8
Meigs	3
Monroe	3
Morgan	1
Muskingum	7
Noble	2
Perry	4
Pike	4
Ross	7
Scioto	12
Tuscarawas	9
Vinton	1
Washington	6

Table 3.1: Ohio Appalachian Counties and the Corresponding Number of High Schools

Subject Recruitment

The researcher attempted to recruit 4-5 high schools from Ohio Appalachian counties to participate in the study: one school to serve as a comparison school and 3-4 schools in which to implement and evaluate the *Plan for Exercise, Plan for Health* intervention. An a priori power calculation was conducted using the number of predictor variables used within the proposed regression models, an expected effect size, an alpha level set a priori, and a targeted power for detecting the expected statistical effect. Regression models were developed to predict changes in physical activity at each of the participating high schools, containing the following eleven predictor variables: residual change score for self-efficacy, residual change score for self-regulation, residual change score for social support, residual change score for outcome expectancy-value, score on a post knowledge test, rate of class attendance, rate of homework completions, type of course (when applicable), teacher (when applicable), gender, and athletic status. An effect size of 0.25 for multiple regression was chosen based on a literature review (Table 2.2). The alpha level was set at 0.05 and power was set at 0.80, both conventional for research in the behavioral sciences. Based on an a priori power calculation, 72 subjects were needed for each regression model developed to predict changes in physical activity behavior at each school to have adequate statistical power. Expecting a 50% subject mortality rate, the researcher attempted to recruit schools with roughly 150 students enrolled in the participating health, physical education, and/or life skills courses.

Recruitment of schools and teachers began in December of 2005 and continued through February, 2006. The research staff attended the annual conference for the Ohio Association for Physical Education, Recreation, and Dance (OHPHERD), held in Columbus, Ohio, during December of 2005. Members of the research team stood at a booth for 2 conference days to pass out fliers and talk to physical education teachers attending the conference. Any interested teachers were given a flier containing information about the program, expectations for participation, and the incentives for participating. The recruitment flier is presented in Appendix A. The following incentives were provided for teachers/schools participating in the delivery and evaluation of the *Plan for Exercise, Plan for Health* program: each teacher delivering the program was enrolled in a graduate level course providing him or her with 3 credit hours for professional development; participating teachers received all of the *Plan for Exercise, Plan for Health* curricular materials (including student workbooks and pedometers); each participating teacher was given $400 worth of equipment for their current program; all of the students and the teachers were given access to a program internet website for tracking their exercise behavior; the school principals received progress reports detailing the impact of the program on student learning, as well as student physical activity profiles; and, the research team helped participating schools build the *Plan for Exercise, Plan for Health* program into their school health promotion plan; the state of Ohio is requiring that each school have a school health promotion plan in writing as of June, 2006.

Following the OHPHERD annual conference, a list of suggested schools were identified through five people, all of whom were active in physical education within Ohio Appalachian counties: a colleague grew up and now teaches physical education in an Ohio Appalachian county, a professor working in the physical education department at The Ohio State University, a professor working in the physical education department at Ohio University, and an employee who works at the Ohio Department of Health. A total of 23 schools were recommended for contacting through the above network. The schools' addresses as well as the contact information for the principals, superintendents, and physical education teachers were collected through an internet search and through the contacts who recommended the schools. All principals, superintendents, and physical education teachers were mailed a recruitment letter (Appendix A) inviting them to participate in the *Plan for Exercise, Plan for Health* program. The recruitment letter described the purpose of the program, provided brief details about the program components, described the benefits of participating in the program, and described the voluntary nature of the program. When an email address was provided, an electronic copy of the recruitment letter was sent to each of the school contacts, as well. All interested principals, superintendents, and physical education teachers were invited to contact the study's co-investigator/project manager to either enroll in the program or to learn more about the program.

A total of eight schools within six counties contacted the program manager to find more information about the program. The project manager spoke with each of the interested teachers/principals to describe the *Plan for Exercise, Plan for Health* program in more detail. Several of the interested teachers also asked for an additional letter detailing the program and the study, which they could share with an administrator. Four schools expressed interest in participating in the program but felt that it would work better for their current curricular schedule and grading plan to wait until the fall, 2006 implementation. Of these, one school was willing to serve as a comparison school for the spring, 2006 implementation. The remaining 3 schools were interested in the spring, 2006 implementation. Within the 3 schools recruited to deliver the program, a total of 6 teachers were interested in participating. The implementing teachers taught 475 students within the following classes: 12 physical education classes, 2 health classes, and 5 life-skills classes. The comparison school recruited had one physical education teacher interested in working with the project; the participating teacher taught 221 students within six physical education classes.

An initial meeting was scheduled at each of the three schools interested in participating in the spring, 2006 implementation. The initial meeting was scheduled for one hour at the school site, with a member of the research staff, the participating teachers, and at least one school administrator. The initial meeting provided the staff with a face-to-face meeting with teachers and administrators to: describe the program, describe the process of the program evaluation, schedule a training session and a pre-test administration date, collect teacher volunteer forms from each of the participating teachers, and collect letters of support from each of the school administrators. The teacher volunteer forms ensured that the participating teachers understood the expectations of participating in the program, the voluntary nature of their participation, and the benefits of participating in the program. The letters of support ensured that the participating school administration understood the components of the program, the benefits of participating in the program development, the voluntary nature of program participation, and the purpose and components of the program evaluation. All volunteer teacher forms and letters of support were submitted to IRB upon receipt. A template for the letter of support and the teacher volunteer form are presented in Appendix B.

Description of the Recruited Schools

Six teachers within four schools volunteered to deliver and participate in the evaluation of the *Plan for Exercise, Plan for Health* intervention. A description of each of the schools that participated in the delivery and evaluation of the intervention is presented in Table 3.2. The table lists the name of the school, whether the school agreed to participate as an intervention or comparison school, the teachers who volunteered to deliver the intervention in each school, the classes in which the teachers delivered the intervention, and the number of students in each of the classes. Because the teachers volunteered to deliver the intervention as a weekly component of the classes they taught, each student received the intervention.

High School	Intervention/Comparison	Teacher	Course	Classes	Students
Jackson HS	Comparison	Haller	Physical Education	6	221
Oak Hill HS	Intervention	Hamilton	Life Skills	5	64
Shanendoah HS	Intervention	Miley	Physical Education	4	113
			Health	2	41
		Penrod	Physical Education	2	29
Trivalley HS	Intervention	Hill	Physical Education	2	57
		Longaburger	Physical Education	2	39
		Nezbeth	Physical Education	3	64

Table 3.2: Description of the Participating Schools

Subject Inclusion Criteria

A subject inclusion criterion was created for the schools, the teachers, and the students. In order to be considered eligible to participate in the delivery of the *Plan for Exercise, Plan for Health* program, the interested high schools had to have a physical education, health, and/or life-skills program. A school administrator had to provide the research team with a signed a letter of support on school letterhead, when available, for the school participating in the delivery and evaluation of the *Plan for Exercise, Plan for Health* intervention. Interested teachers had to teach physical education, health, and/or life-skills classes. They also had to agree to the following criteria for participation: they had to be willing to deliver each of the program lessons in their entirety, integrated into their curriculum once a week for 9 weeks; they had to complete a lesson evaluation form after each lesson delivery day; they had to record student attendance and collect homework assignments weekly; they had to agree to allow the research staff to visit their classes on two occasions to collect pretest and post-test data; and, they had to allow the project staff to observe the delivery of the *Plan for Exercise, Plan for Health* lessons. The teachers provided approval for the conditions of program participation by signing a teacher volunteer form.

Students had to meet three criteria to be included in the evaluation of the *Plan for Exercise, Plan for Health* intervention. Each participating student had to turn in a signed parental/guardian consent form and a signed student assent form (presented in Appendix C). Each student had to complete at least 80% of the SCT instruments at pretest and at post-test, and each student had to complete at least five days of physical activity logs at pretest and at post-test. An 80% completion of the SCT instruments was met if the student answered at least 80% of the questions included in the instrument; for example, if an instrument had ten items, a student would have to answer at least eight of the items at pretest and eight of the items at post-test to be included in the final sample. Any student who did not turn-in a signed parental/guardian consent form, a signed student assent form, completed at least 80% of the SCT instruments at pretest and at post-test, and completed a minimum of five physical activity logs at pretest and at post-test was excluded from the program evaluation.

Teacher Training

Following the initial meeting, the program staff scheduled a time for the teachers to attend a program training session. The teachers' willingness to participate in program training was a requirement both for participating in the program and for the graduate level class in which the teachers were enrolled for professional development. The teacher training session took three hours and was held at the participating school. During the teacher training session, the participating teachers received: the *Plan for Exercise, Plan for Health* student workbooks for each student participating in the program, the *Plan for Exercise, Plan for Health* teacher manual, pedometers for each student participating in the program, a homework collection box, a box of pens for students to use if they do not bring a pen to class (particularly for physical education classes), and the lesson evaluation forms for the first three *Plan for Exercise, Plan for Health* lessons. The following topics were covered during the training session: a detailed description of the procedures for the pretest and post-test assessment days, procedures for taking and reporting weekly student attendance, training on how to deliver each *Plan for Exercise, Plan for Health* lesson, training on how to assign and collect homework as well as a description of the importance of the homework assignments to the program lessons, training on how to complete the lesson evaluation forms, and a discussion on procedures for problem solving difficult situations (e.g. what to do if a student loses his/her workbook, if a student loses a pedometer, if a student is absent on a *Plan for Exercise, Plan for Health* lesson day). Finally, the research team scheduled two dates for lesson observations and a date for post-test assessments.

<u>Description of the *Plan for Exercise, Plan for Health* Intervention</u>

The participating teachers integrated the *Plan for Exercise, Plan for Health* program into their classes as a 9-week educational unit within their existing curricula between March, 2006 and May, 2006. The intervention lessons were packaged within a student workbook and were designed to be implemented during one class per week, for nine consecutive weeks. Each lesson within the *Plan for Exercise, Plan for Health* curriculum was designed to help students develop a personal exercise program by addressing one of the following SCT educational constructs each week: self-efficacy, self-regulation, outcome expectancy values, and social support. A list of the program lesson and the SCT construct targeted through each lesson is provided in Table 3.3.

Lesson	Lesson Title	SCT Construct Targeted
1	Completing Exercise Logs	Self-Regulation
2	Exercise and Health	Outcome Expectancy-Values
3	Goal Setting	Self-Regulation
4	Reasons Not to Exercise	Self-Efficacy
5	Keeping Track of Your Exercise: Pedometers	Self-Regulation
6	Where to Exercise and Exercise Motivators	Outcome Expectancy-Values
7	Friends and Family can Help you Exercise	Social Support
8	Exercise Intensity	Outcome Expectancy-Values, Self-Efficacy
9	Plan to Keep Going	Self-Regulation

Table 3.3: *Plan for Exercise, Plan for Health* Lesson Outline and Targeted SCT Construct

Each intervention lesson included the presentation of curricular concepts, in-class activities, and homework activities. The lessons particularly targeted: the social and health benefits of physical activity, the social and physical outcomes of long-term physical activity, trends in physical activity, health risks associated with inactivity, as well as self-regulatory skills such as goal setting, goal evaluation, identification of barriers to physical activity, the development of strategies to overcome barriers, self-monitoring exercise behavior with exercise logs and a pedometer, enlisting social support from family and peers for behavioral change, planning for where to exercise in their community, and incorporating positive reinforcement for meeting personal goals. A detailed intervention outline, describing the concepts and activities involved within each lesson, is presented in Figure 3.2.

1. Completing Exercise Logs (45 Minutes)
    a. In-Class
        i. Students read course introduction
        ii. Students read about exercise logs and how to fill out the PDPAR
        iii. Students review an example of a completed PDPAR
        iv. Students complete a PDPAR
    b. Homework
        i. Students complete 7 X PDPAR

2. Exercise and Health (45 Minutes)
    a. In-Class
        i. Students summarize their PDPAR's to list: medium activities they did, hard activities they did, and time that they exercised each day
        ii. Students indicate the number of days they did medium/hard activities
        iii. Students read about medium/hard activities and examples
        iv. Students indicate whether they enjoy medium or hard activities more
        v. Students list 3 medium activities they enjoy
        vi. Students list 3 hard activities they enjoy
        vii. Students write why they did/did not exercise last week
        viii. Students read about reasons to exercise
        ix. Students list 3 adults who are active, their age, and what activities they do
        x. Students list 3 adults who are inactive, their age
        xi. Students list whether older or younger people are more active and why
    b. Homework
        i. Students interview 3 adults about their weekly exercise behavior, age, and health history

3. Goal Setting (45 Minutes)
    a. In-Class
        i. Students summarize the adult interviews: adult names, age, days a week they exercise, active/inactive, and health problems
        ii. Students read about age and exercise, exercise and health
        iii. Students read about benefits of goal setting, short-term vs. long-term goals, class long-term goal
        iv. Students read the 5 components to a goal
        v. Students list how active they were last week and read how they can develop a goal to improve their exercise from last week
        vi. As a class, students correct a pre-formulated goal
        vii. Students set a weekly personal exercise goal
        viii. As a class, students evaluate goals and make any needed correction to their personal weekly exercise goal
    b. Homework
        i. Students ask a parent /guardian to sign their personal weekly exercise goal
        ii. Students complete a goal correction activity
        iii. Students keep a daily log of exercise, time, and barriers to exercise that they face

Continued

Figure 3.2: The *Plan for Exercise, Plan for Health* Intervention Outline

Figure 3.2 Continued

4. Reasons Not to Exercise (40 Minutes)
    a. In-Class
        i. Students list barriers to exercise identified through homework logs
        ii. Students read about barriers to exercise and developing strategies to overcome barriers
        iii. In groups, students list barriers to exercise from the previous week
        iv. In groups, students list other barriers to exercise
        v. In groups, students identify 3 barriers and develop strategies to overcome them
        vi. Students write personal weekly exercise goals
        vii. Students write a weekly exercise strategy, planning to overcome a personal exercise barrier
    b. Homework
        i. Students ask a parent/guardian to sign their weekly goal
        ii. Students keep a daily log of exercise, time, and how they used their exercise strategy for the week
        iii. Students write how the weekly exercise strategy worked

5. Keeping Track of Your Exercise: Pedometers (40 Minutes)
    a. In-Class
        i. Students read about how tracking behavior can help an exercise program
        ii. Students read about pedometers
        iii. Students learn to use the pedometer by zeroing it, walking in the gym for 5 minutes and recording steps, resetting it, and then jogging in the gym for 5 minutes and recording steps
        iv. Students write a personal weekly exercise goal
        v. Students write a weekly exercise strategy, identifying step goals for each day
        vi. Students walk in exercise groups for the remainder of class
    b. Homework
        i. Students ask a parent/guardian to sign their weekly exercise goal
        ii. Students keep a daily log of exercise, number of steps with a pedometer, time spent exercising, and where they exercised

6. Where to Exercise and Exercise Motivators (45 minutes)
    a. In-Class
        i. Students list what exercise activities they did each day last week and where they did them
        ii. Students read why it is important to think about where they will exercise in their planning
        iii. In groups, students list places in their community that they can do specific exercises
        iv. Students list 3 specific activities they will do this week and where in their community they will do them
        v. In groups, students list reasons to exercise and rank them according to importance
        vi. Students read about exercise motivators, exercise expectations

Continued

Figure 3.2 Continued

   vii. Students list specific activities that would lead to specific exercise outcomes
   viii. Students read about setting personal rewards as motivators
   ix. Students write a way they could ask a parent/guardian to reward them for meeting their exercise goals
   x. Students write personal weekly exercise goals
   xi. Students write a weekly exercise strategy, planning ways to reward themselves for meeting their goals, negotiating with parents/guardians for that reward

  b. Homework
   i. Students ask a parent/guardian to sign their weekly goal
   ii. Students keep a daily log of exercise activities, number of minutes they exercised, number of steps with pedometer (optional), where they exercised, and motivators they realized as a result of exercising
   iii. Students complete Exercise Self-Efficacy questionnaire

7. Friends and Family can help with Exercise Goals (40 minutes)
  a. In-Class
   i. Students read how friends and family can provide support for exercise goals
   ii. In groups, students list family members, how they can support their exercise, and what type of support that is
   iii. In groups, students list friends, how they can support their exercise, and what type of support that is
   iv. Students list 3 people they will negotiate to provide support for their exercise with this week, type of support they will provide, describe the actual support, and how the person agreed to support them (homework)
   v. Students write personal weekly exercise goals
   vi. Students write a weekly exercise strategy, planning to exercise with a specific exercise buddy for the week and writing a goal with that exercise buddy involved
   vii. Students choose an exercise buddy from class and walk with that exercise buddy for the remainder of class
  b. Homework
   i. Students talk to 3 people about providing support and describe the ways they negotiated the support in the table from class
   ii. Students ask a parent/guardian to sign their exercise goal
   iii. Students keep a log of their daily exercise, time, steps taken (optional), who provided support, and how they provided support

8. Exercise Intensity (45 Minutes)
  a. In-Class
   i. Students read about medium and high intensity exercise, finding the exercise comfort zone, what their pulse should be at each intensity
   ii. Students read about taking their radial pulse
   iii. Students take their pulse sitting where they are
   iv. Students answer questions about how they feel after sitting, then they will list other light intensity activities
   v. Students walk around the gym for 5 minutes and take their pulse for 1 minute
   vi. Students answer questions about how they feel after walking and they will list other medium intensity activities

Continued

Figure 3.2 Continued

vii. Students jog around the gym for 5 minutes and take their pulse for 1 minute
viii. Students answer questions about how they feel after running and they will list other high intensity activities
ix. Students do shuttle sprints for up to 5 minutes and will take their pulse for 1 minute
x. Students answer questions about how they feel after sprinting and they will list other maximum effort activities
xi. Students identify what their comfort zone is, what intensity they enjoy participating in the most
xii. Students write personal weekly exercise goals
xiii. Students write a weekly exercise strategy, planning to exercise in their comfort zones using 3 different activities in that week

b. Homework
i. Students ask a parent/guardian to sign their personal weekly exercise goal
ii. Students keep a daily log of their exercise behavior, including: exercise activity, number of steps taken (optional), minutes spent exercising, and zone in which they exercised

9. Plan to Keep Going (40 Minutes)
a. In-Class
i. Students read about planning to continue exercising
ii. Students read bout avoiding boredom by mixing it up
iii. In groups, students list 3 ways they can mix up their exercise program to avoid boredom
iv. Students read about planning to exercise during the summer
v. Students complete a table to plan to exercise during the summer, including: 4 specific activities, time they will do them, days of the week they will do them, time of day they will do them, and where they will do them
vi. Students review whether they met the class long-term goal last week
vii. Students write a personal long-term exercise goal for the summer
viii. Students write a personal weekly exercise goal
ix. Students read how they can continue with their exercise program over the summer. Resources are available to them on the internet, through the Plan for Exercise, Plan for Health website. A blank page is available for students who do not have internet access to write goals and track exercise weekly

b. Homework
i. Students complete 7 X PDPAR

Program Evaluation

Process Evaluation

The process evaluation for the current study was conducted and evaluated by Laura Mowad (2006). It included an evaluation of the context in which the program was delivered, program reach, the fidelity of the teacher implementation (dose delivered), and an evaluation of student participation (dose received). The context in which the program was delivered was evaluated through descriptive analysis of the school delivering the program. Program reach was evaluated through a knowledge test of the exercise concepts taught through the intervention, delivered at the post-test. The program dose delivered evaluated the degree to which the participating teachers implemented the intervention with fidelity. Dose delivered was examined through two components. First, the participating teachers were asked to complete a lesson evaluation form at the close of each program delivery day documenting the teacher implementation fidelity for each lesson. Second, each participating teacher was observed for two previously scheduled days of program implementation, during Lesson 3 and Lesson 8. The acceptability of the program, or dose received, evaluated the degree to which students interacted with the components of the intervention. Dose received was examined records of class attendance and student homework completions.

While Mowad (2006) reported the results of the process evaluation for the entire eligible sample (those students who turned in a parental consent form and a parental assent form), the current study focused on the results of the process evaluation for the students included in the final sample only (meeting the subject inclusion criteria). As discussed in the Literature Review, measures of process evaluation are crucial to the avoidance of Type III error in the interpretation of the results of an impact evaluation. In order to avoid Type III error and to account for rival hypotheses for the prediction of adolescent physical activity behavior, the following measures of process evaluation will be included in the regression models predicting changes in adolescent moderate and vigorous physical activity for students in the final sample at each school: teacher (for those schools in which it varied), course type (for those schools in which it varied), student attendance rate, student homework completion rate, and program reach (scores on the post knowledge test).

Impact Evaluation

The behavioral impact of *the Plan for Exercise, Plan for Health* program was evaluated using a series of previous day exercise recalls that were completed as a part of the program curriculum. Participating students were asked to complete seven Previous Day Physical Activity Recalls (PDPAR), between the first and second *Plan for Exercise, Plan for Health* lessons and then again after the ninth intervention lesson. The logs provided the researcher with information regarding the days of leisure-time physical activity (physical activity outside of school sports and physical education) students participated in throughout one week in the beginning of the program and then again at the end of the program. The program evaluator examined the intervention's impact on the frequency of leisure-time moderate and vigorous physical activity using these two series of one-day recalls. Multiple regression models were developed for each of the intervention schools and for the comparison school to determine the degree to which the *Plan for Exercise, Plan for Health* intervention could predict changes in the frequency of moderate and vigorous physical activity behavior.

The educational impact evaluation was assessed using previously validated questionnaires which provided measures of each of the SCT constructs targeted through intervention, including: self-efficacy for overcoming barriers to physical activity, self-regulation for physical activity, outcome expectancy-values for physical activity, and social support for physical activity. Students completed a questionnaire on each of the SCT construct targeted prior to the delivery of the first *Plan for Exercise, Plan for Health* lesson and then again after receiving the 9th *Plan for Exercise, Plan for Health* lesson. Each student was assigned a residualized changes score on each of the SCT constructs targeted. The residualized change scores were included in the multiple regression models predicting changes in physical activity. After determining whether the intervention, represented by the entire model, could predict changes in physical activity behavior, the ability of changes in each SCT construct to predict changes in physical activity behavior was evaluated. The percent of variance in the changes in student physical activity explained by changes in each of the SCT construct scores allowed for conclusions to be drawn regarding the efficacy of the intervention at targeting SCT constructs to impact student physical activity rates.

Construct Validity of the Treatment

In order to assess construct validity of the treatment, a three step multiple regression analysis was used to test the mediating effect of any SCT construct found to significantly predict changes in moderate or vigorous physical activity in the regression models developed for the impact evaluation. If the *Plan for Exercise, Plan for Health* intervention was insufficient to change any SCT educational construct, accounted for by a lack of significance in predicting variance in the physical activity residualized change scores, further investigation of whether the changes in the construct mediated changes in behavior was not warranted. Mediation analysis for those constructs for which the intervention was sufficient to impact provided the researcher with information regarding the mechanism through which leisure-time physical activity behavior was impacted. If an assessment of changes in the targeted educational constructs is not completed, the evaluator cannot understand how behavior change occurred. Therefore, construct validity of the treatment is a crucial component to evaluating the effectiveness of the intervention.

Mediation of the SCT constructs was evaluated through a three step multiple regression analysis (McCaul & Glasgow, 1985; Baron & Kenny, 1986). First, changes in the SCT constructs were regressed on the intervention to see if the intervention could account for a significant portion of the variance in changes in the constructs. Second, changes in the frequency of moderate or vigorous physical activity were regressed on the intervention to assess whether the program accounted for a significant portion of the variance in the behavior. The third and final step in the analysis assessed whether the effect of the treatment on the behavioral outcome was attenuated when the effect of the SCT construct on the behavior was controlled for (Baron & Kenny, 1986). The changes in the frequency of moderate and vigorous physical activity were regressed upon the intervention, controlling for the effect of changes in the SCT construct on the behavior. If the intervention was found to account for less variance in changes in physical activity behavior in the third equation (when the SCT was controlled for) than in the second equation (when the SCT was not controlled for), evidence of mediation existed.

Measurement of Social Cognitive Theory Constructs

Diagnosing educational needs and documenting program effects and processes both presuppose the use of measures that are relevant, valid, and reliable (Green & Lewis, 1986). Poor measurement (not valid, not reliable, and/or not relevant) introduces measurement error into the evaluation process. Measurement error decreases the confidence a researcher can place in the data produced. If you cannot depend on the measurements, you cannot depend on the results or implications of your measurements. Moreover, you cannot contribute to theory; nor can you confidently recommend changes in policy or in programs (Green & Lewis, 1986).

The following SCT educational constructs were assessed at pretest and at post-test for the current study: self-efficacy, self-regulation, social support, and outcome expectancy values. Each of the educational constructs targeted in the *Plan for Exercise, Plan for Health* intervention was evaluated using previously developed instruments with reported validity and reliability. The reliability of each instrument was re-evaluated for internal consistency at pretest and post-test, using all students who completed each instrument at pretest and all students who completed the instruments at post-test. A data coding scheme and the equations used to sum the SCT constructs is presented in Appendix D.

Self-Efficacy

Self-efficacy was examined as the students' ability to overcome specific barriers to physical activity. The educational construct was evaluated by a 7-item instrument developed by Saunders et al (1997) and altered and re-evaluated by Winters (2001). Internal consistency for the instrument was reported as $\alpha = 0.89$, and test-retest reliability was $r = 0.82$ (Winters, 2001). The students rated, on a 6-point Likert-type scale, how often they felt they could exercise under specific challenging conditions, such as when it was hot out, when they had a lot of homework, or when they were tired. Each student was given a self-efficacy for overcoming barriers to physical activity score, calculated as the sum of 7-item instrument, at both pretest and post-test. The internal consistency of the instrument was confirmed in this study; at pretest $\alpha = 0.90$ and at post test $\alpha = 0.92$.

Self-Regulation

Self-regulation was examined using an instrument developed by Petosa (1993) and altered to be appropriate for an adolescent population by Winters (2001, 2003). This was a 25-item instrument that examined the following five properties of self-regulation: goal setting, self-monitoring, gaining social support, planning to overcome barriers to physical activity, and securing positive reinforcements. Internal consistencies for the subscales range from $\alpha = 0.78$ to 0.94, and the test-retest reliability was found to be $r = 0.92$ (Petosa, 1993). Students answered questions regarding the frequency of using self-regulatory skills in their exercise behavior over the previous four weeks. Students responded to each item using a 6-point Likert-type scale. Each student was given a self-regulation score, calculated as the sum of the 25-item instrument, at both pretest and post-test. The internal consistency of the scale was confirmed in this study, $\alpha = 0.94$ at pretest and $\alpha = 0.96$ at post-test.

Outcome Expectancy-values

Outcome expectancy-values were examined in two dimensions; as outcome expectancy-values (a person's beliefs about the outcomes that occur as a result of physical activity) and as outcome expectancies (the value a person places on the perceived outcomes of physical activities). The dimensions were computed as a multiplicative function, or the product of the outcome expectation and the coinciding outcome expectancy. These two dimensions were examined through a 23-item instrument developed and validated by Winters (2001) to examine the following six dimensions of the construct: social continuation, social growth, competition, relaxation, fitness, and thrills. Internal consistencies for the six dimensions of outcome expectancy-values ranged from $\alpha = 0.86$ to 0.94 (Winters, 2001). Students first responded to a statement regarding their beliefs about the outcomes of physical activity. They then responded to a statement that asked about the value they placed on the outcome statement. Students responded to each belief and value statement on a 6-point Likert-type scale. Each student was given an outcome expectancy-value score, calculated as the sum of the belief-value products, at pretest and at post-test. The internal consistency of the instrument was confirmed in this study, $\alpha = 0.96$ at pretest and $\alpha = 0.96$ at post-test.

Social Support

Social support was examined through an 8-item instrument, assessing students' perceptions of the support of parents and friends for physical activity, developed by Saunders et al (1997) and altered by Winters (2001) for use in adolescent populations. The internal consistency for the scale was reported as $\alpha = 0.75$, and test-retest reliability was reported as $r = 0.78$ (Winters, 2001). Students responded to four questions regarding specific supports that their family may have provided them for their exercise in the past two weeks. Students then responded to four questions regarding specific supports that their friends may have provided them for exercise in the past two weeks. Students were asked to respond to each support statement on a 6-point Likert-type scale. Each student was given a social support from family and friends score, calculated as the sum of the 8-item instrument, at pretest and at post-test. The internal consistency of the instrument was confirmed in this study, $\alpha = 0.85$ at pretest and $\alpha = 0.89$ at post-test.

Measurement of Physical Activity

Both moderate and vigorous leisure-time physical activity behavior were examined using a series of five consecutive one-day recalls. The Previous Day Physical Activity Recall (PDPAR) was developed as a recall designed to address the limitations of other recall instruments and to provide accurate data on the mode, frequency, intensity, and duration of physical activity (Weston, Petosa, & Pate, 1997). The questionnaire involves the completion of a recall of the previous day's activities between the hours of 7:00 am and 11:30 pm. The instrument is segmented into 30-minute time intervals. Participants recall the mode and intensity of activities that they were engaged in during each 30-minute time interval of the previous day. In order to enhance the quality of the data recorded, researchers use contextual cues to enhance the recalled data; all participants are given a list of activities in which youth normally engage, and the activities are grouped into the following categories: eating, sleeping/bathing, transportation, work/school, spare time, play/recreation, exercise/workout (Weston et al, 1997). The participants recall the activity mode by recording the code number corresponding to the primary activity in which he/she was engaged during each specified 30-minute time interval. After recording the mode of activity, participants rate the intensity of the activity during each 30-minute interval, qued by a cartoon illustration depicting activities specific to each level of intensity. Intensities are rated as either very light (requiring slow breathing with little or no movement), light (requiring normal breathing with some movement), medium (requiring increased breathing with moderate movement), or hard (requiring hard breathing with quick movement) (Weston et al, 1997).

Reliability and validity of the PDPAR for the measurement of physical activity has been reported. Test-retest reliability for the instrument administered twice in one hour revealed high reliability for the recall, $r = 0.98$, $p<0.01$ (Weston et al, 1997). The recall has been validated against pedometer step counts, Caltrac accelerometer counts, and heart rate monitoring. The correlation between total pedometer counts and estimated relative energy expenditure by the PDPAR was $r = 0.88$, and the correlation between Caltrac counts and the estimated relative energy expenditure by the recall was $r = 0.77$, both significant (Weston et al, 1997). Significant correlation coefficients were observed for the number of recalled blocks with an intensity greater than 4 METS and the number of 30-minute intervals in which heart rate was 50% heart rate range for 20 minutes or longer (Weston et al, 1997). The results of the validity and reliability of the PDPAR for physical activity revealed that the instrument was valid and reliable, able to provide an acceptable estimate of daily relative energy expenditure, and allowed for the identification of bouts of moderate and vigorous physical activity.

Estimate of the Dependent Variables

Students were asked to complete a series of seven consecutive PDPAR's so that the students could evaluate their day-to-day behavior throughout a given week and so that the researcher could estimate students' weekly moderate and vigorous leisure-time physical activity behavior. Upon receipt of the pretest and post-test PDPAR logs, the researcher determined that an inadequate number of students returned seven complete PDAR logs for the study to have adequate statistical power, however. Six students at Jackson High School, 25 students at Oak Hill High School, 57 students at Shenandoah High School, and 63 students at Trivalley High School completed seven PDPAR logs both at pretest and post-test. Using seven days of physical activity data to evaluate the dependent variables would not allow for adequate statistical power in this study, particularly for the comparison school (Jackson High School). A decision had to be made, therefore, regarding the number of days of physical activity data to use to evaluate the dependent variables, the frequency of moderate and vigorous physical activity. The options for the number of days of data to use and the associated final sample at each school are presented in Table 3.4.

	3 Days of Data	4 Days of Data	5 Days of Data	6 Days of Data	7 Days of Data
Jackson High School	73	65	33	19	6
Oak Hill High School	30	30	25	25	25
Shenandoah High School	88	87	80	59	57
Trivalley High School	86	81	73	63	63
Sample Size Needed Based on A Priori Power Analysis	**72**	**72**	**72**	**72**	**72**

Table 3.4: Subjects Available for the Final Sample Based on Days of Physical Activity Data Used

Using too few days of data would provide an unreliable estimate of physical activity behavior. (Baranowski & De Moor, 2000). A study by Trost, Pate, Freedson, Sallis, & Taylor (2000) assessed the number of days that were needed to reliably estimate physical activity among children and adolescents using objective measures of physical activity (CSA accelerometers). The study indicated that between eight and nine days of monitoring are needed to estimate physical activity among junior and senior high school students with a reliability of 0.80 (Trost et al, 2000). The greater the reliability of a measure, the fewer assessments are necessary to reliably assess the behavior (Baranowski & de Moor, 2000); therefore, a physical activity recall would require more days of monitoring than an objective measure (such as accelerometers) to reliably assess physical activity behavior. This implication was supported by Baranowski & De Moore (2000); their review indicated that between 1.8 and 2.0 weeks of physical activity diaries are needed to attain a reliability of 0.80. While 1.8 – 2.0 weeks of data was not available for the current study, using seven days of data to evaluate the dependent variables would provide the most reliable estimate of weekly moderate and vigorous physical activity.

The researcher was left with a choice between practical significance and statistical significance in the choice for the dependent variables. Using three days of data would provide adequate subjects to have statistical power at Jackson High School, Shenandoah High School, and Trivalley High School. The number of days that students participated in physical activity, out of three days or four days, does not provide a practical estimate of physical activity, however. Current physical activity recommendations for children and adolescents suggest that they participate in five or more days of moderate or vigorous physical activity; past recommendations suggested that students participate in three or more days of vigorous physical activity or five or more days of moderate physical activity. Therefore, the use of five days of data is the minimum number of days that a researcher could use to estimate the rates that students are meeting recommended guidelines. This led the researcher to believe that five days of data was the most practical estimate of physical activity available; five days would allow the researcher to estimate whether some adolescents were meeting the recommended guidelines for physical activity. Further, five days of data retains the number of subjects needed for statistical significance at Shenandoah High School and Trivalley High School; lacking statistical power, measures of practical significance will be relied upon to make conclusions with the results from Jackson High School and Oak Hill High School, particularly when statistical significance is not achieved.

Coding for Moderate and Vigorous Physical Activity

Moderate leisure-time physical activity was evaluated as the number of days in which students reported meeting the past recommended guidelines for moderate physical activity (30+ minutes on 5+ days per week) outside of school activities. Vigorous leisure-time physical activity was evaluated as the number of days in which students reported meeting the past recommended guidelines for vigorous physical activity (20+ minutes on 3+ days per week) outside of school activities. The past recommended guidelines were used because the intervention stressed that if students chose vigorous exercise activities, they should try to exercise for at least 20 minutes on three or more days per week; if they chose moderate exercise activities, they should try to exercise for at least 30 minutes on five or more days per week. Each student was given a score for moderate and vigorous physical activity, calculated as the number of days students met the recommended guidelines, at both pretest and post-test. The coding scheme developed for the PDPAR is presented in Appendix D.

Because the recall asked students to recall the activities they were engaged in during each 30-minute interval of the previous day, leisure-time physical activity could be distinguished from physical activity conducted within physical education class and within the context of school sports. Physical activity conducted for a class period during the school day on three or more days within the school week was coded as physical activity within physical education class and was not included in the analysis. Physical activity conducted as a sport, indicated as a PDPAR activity code of 34, was coded as school sport participation. Physical activity conducted as part of a physical education class or as part of an organized school sport was not included in leisure-time physical activity for the analysis.

Other Variables Examined

Demographic information was collected for each student during the pretest and the post-test. The following demographic information was collected from each student: school grade level, age, seasons in which they participate in an organized school sport, gender, race, height, weight, and their family environment. Students were asked to circle the school grade in which they were enrolled (9^{th}, 10^{th}, 11^{th}, or 12^{th}). Students were asked to report, in years, their age. Students were asked to circle each season that they played an organized school sport (freshmen, junior varsity, or varsity): fall, winter, spring, and summer. They were then asked to circle their gender and race. Students were asked to report their height in feet and inches and their weight in pounds. This allowed for a calculation of self-reported BMI. Finally, students were asked to provide information regarding the number of parents/guardians, grandparents, and siblings living in their home environment to provide an indication of family environment. Each of these variables was examined, as they could potentially influence the physical activity outcome variable.

Missing Data

Each subject had to complete a minimum of 80% of each SCT construct instrument and at least five days of PDPAR logs at pretest and post-test in order to be included in the data analysis. Any subject who did not have at least 80% of all SCT instruments completed was excluded from the data analysis. Any subject who completed less than 5 days of PDPAR logs was excluded from the data analysis. If a subject completed more than 5 days of PDPAR logs, the first 5 week-day logs were used in the data analysis. In the case that a subject completed at least 80% but less than 100% of any SCT construct instrument, mean replacement (from the whole sample) was used for any ratio or ordinal-level variable. If a demographic variable was missing, missing data was not replaced.

Project Timeline

The study was completed under the following timeline:

- Development of the Plan for Exercise, Plan for Health Intervention: October, 2005 – January, 2006
- School Recruitment: December, 2005 – February, 2006
- Initial Meetings with Teachers and Administrators: February, 2006
- Teacher Training: February, 2006
- Pretest Assessments: February – March, 2006
- 9-Week Intervention Implementation: March – May, 2006
- Implementation Observation 1 (Lesson 3): March, 2006
- Implementation Observation 2 (Lesson 8): April, 2006
- Post-Test Assessments: May, 2006
- Data Analysis: June-July, 2006
- Reporting of Results: August – September, 2006

Study Design

The study used an ex-post facto, nonequivalent comparison group design. The researcher was attempting to explain the ability of the *Plan for Exercise, Plan for Health* intervention to predict changes in the frequency of adolescent physical activity behavior, while allowing the implementation fidelity to naturally vary. The treatment was allowed to naturally vary by having existing teachers implement the program freely within natural classroom settings. Because the treatment groups were naturally occurring as school classes, random assignment was not possible. Through statistical analysis, the researcher evaluated the ability the intervention to predict changes in physical activity, as well as the sufficiency of the intervention to produce changes in the SCT constructs that predict changes in physical activity behavior, after accounting for alternative hypotheses (such as variation in implementation, as measured by dose delivered and dose received, and student demographics). Data from schools where teachers implemented the *Plan for Exercise, Plan for Health* intervention were compared to data from a comparison school that received a typical physical education curriculum during the same time period that the intervention was implementation. This design involved naturally assembled experimental and comparison groups, who were given both a pretest and a post-test.

Internal Validity

Internal validity refers to the ability of the researcher to make conclusions regarding the effectiveness of the intervention. If a study has high internal validity, the researcher can say with confidence that the changes that occurred over time and across treatment conditions were a result of the treatment, rather than the result of confounding variables. The internal validity of the nonequivalent comparison group design is strong. The primary threats to internal validity are regression and the interaction between selection and other sources of internal invalidity.

The threat to internal validity associated with regression exists only in the case that one of the groups is chosen to participate in the study based on their extreme scores (Cambell & Stanley, 1963). Each of the schools for the current study was recruited in the same manner. Information about the schools and the demographic backgrounds of students attending the schools was collected from the Ohio Department of Education; the schools were compared based on this collected information. Further, the data collected for this study was examined to determine whether pretest differences existed among any of the physical activity or SCT variables included in the analysis. These procedures should control for the threat to internal validity.

The second major threat to internal validity with the nonequivalent comparison groups design is the interaction between selection and other sources of invalidity (history, maturation, testing, etc). This threat to internal validity exists because the groups were allowed to vary naturally; there was no random assignment. Therefore, the groups cannot be assumed to be equivalent from the start. In this case, treatment gains or losses may occur over the course of the study from between-group individual differences present from the start; the changes attributed to individual differences could be mistaken for changes associated with the treatment. Results from previous studies (Winters, 2001; Hortz, 2005) comparing pretest scores using the same instruments and a similar sample suggest that the sample was homogenous at pretest. The pretest data will be examined to determine whether pretest differences exist among students at the participating schools. Residual change scores used in the statistical analysis further accounts for individual pretest differences among the SCT and physical activity variables.

External Validity

External validity refers to the ability of the researcher to generalize the results of the study from the sample recruited across populations and to different populations. High external validity in this study would allow the researchers to assume that if the intervention is sufficient to impact leisure-time physical activity behavior and the targeted SCT constructs among students in the participating high schools, then it would also be an effective intervention within other high schools in the Ohio Appalachian counties. The major threat to external validity with the nonequivalent comparison group design is the interaction of testing and the treatment; in the case of this study, student results on the SCT instruments could change from pretest to post-test due to a practice effect of the students completing the same instruments at pretest and post-test rather than due to the effects of the intervention. Other possible sources of external invalidity include the interaction between selection and the treatment and reactive arrangements (Cambell & Stanley, 1963).

The interaction between testing and the treatment may be a problem because this study used both a pretest and a post-test. Changes may have occurred among the students in the study that may not necessarily occur among students not enrolled in the study due to testing effects. In other words, learning may have occurred among students enrolled in the study due to the students taking a pretest; in this way, the pretest becomes a treatment in itself. This source of external invalidity must be accepted, as the pretest is necessary to control for threats to internal validity.

The threat to external validity due to the interaction between the treatment and selection may be a problem as this study does not involve random selection of students from the population. Teachers within Appalachian high schools volunteered to participate in the study, and each student enrolled in the participating teachers' classes participated in the intervention. Because there was no random selection, the researcher cannot assume that the subjects included in the study match the demographics of the population at large. This threat to external validity was minimized by recruiting schools from the same region of Ohio as the population, Appalachian counties. The threat to external validity was minimized by using residualized change scores in the data analysis, which partial out pretest scores from post-test scores in the analysis.

The threat to external validity due to reactive arrangements states that subjects who are involved in the experiment and know that they are part of an experiment may act differently than subjects who are not part of the experiment. This threat would minimize generalizing results to a population who was not aware that they were part of an experiment. This threat to external validity was addressed by conducting the intervention under "real world" conditions. The intervention was being delivered within the schools, when students were in their naturally occurring classroom settings, and with the existing teachers implementing the program. Minimizing the changes to the school environment during the treatment implementation should minimize experimental reactivity.

Research Questions and Statistical Hypotheses

Research questions were developed to evaluate the efficacy of the *Plan for Exercise, Plan for Health* intervention at changing the frequency of adolescent moderate and vigorous physical activity and to evaluate the ability of the intervention to produce changes in the targeted SCT constructs sufficient to predict changes in physical activity behavior. Primary research questions were developed to determine whether multiple regression models, developed to represent the *Plan for Exercise, Plan for Health* intervention, could predict changes in adolescent moderate and vigorous physical activity behavior. Secondary research questions were developed to determine whether changes in the SCT constructs targeted through intervention were sufficient to predict changes in adolescent physical activity. A secondary research question was further developed to describe the mechanism through which changes in the SCT constructs mediated changes in adolescent leisure-time physical activity, thereby testing the utility of SCT in the development of adolescent physical activity interventions. Both research and statistical null and alternative hypotheses were developed for each research question.

Primary Research Questions

1. Did the *Plan for Exercise, Plan for Health* intervention account for a significant portion of the variance in the changes in the frequency of adolescent moderate physical activity?
    a. Research H_o: The *Plan for Exercise, Plan for Health* intervention did not explain variance in the changes in the frequency of adolescent moderate physical activity.
        i. Statistical H_0: $R^2 = 0$
    b. Research H_1: The *Plan for Exercise, Plan for Health* intervention explained a significant portion of the variance in the changes in the frequency of adolescent moderate physical activity.
        i. Statistical H_1: $R^2 \neq 0$
2. Did the *Plan for Exercise, Plan for Health* intervention account for a significant portion of the variance in the changes in the frequency of adolescent vigorous physical activity?
    c. Research H_o: The *Plan for Exercise, Plan for Health* intervention did not explain variance in the changes in the frequency of adolescent vigorous physical activity.
        i. Statistical H_0: $R^2 = 0$
    d. Research H_1: The *Plan for Exercise, Plan for Health* intervention explained a significant portion of the variance in the changes in the frequency of adolescent vigorous physical activity.
        i. Statistical H_1: $R^2 \neq 0$

Secondary Research Questions

1. After accounting for all other variables in the model, did changes in student social support scores predict changes in the frequency of adolescent moderate physical activity?
    a. Research H_o: After accounting for all other variables in the model, changes in social support for physical activity did not explain variance in changes in the frequency of adolescent moderate physical activity.
        i. Statistical H_0: $b_{social\ support} = 0$

b. Research H_1: After accounting for all other variables in the model, changes in social support for physical activity explained a significant portion of the variance in changes in the frequency of adolescent moderate physical activity.

   i. Statistical H_1: $b_{\text{social support}} \neq 0$

2. After accounting for all other variables in the model, did changes in student social support scores predict changes in the frequency of adolescent vigorous physical activity?

   a. Research H_o: After accounting for all other variables in the model, changes in social support for physical activity did not explain variance in changes in the frequency of adolescent vigorous physical activity.

      i. Statistical H_0: $b_{\text{social support}} = 0$

   b. Research H_1: After accounting for all other variables in the model, changes in social support for physical activity explained a significant portion of the variance in changes in the frequency of adolescent vigorous physical activity.

      i. Statistical H_1: $b_{\text{social support}} \neq 0$

3. After accounting for all other variables in the model, did changes in student outcome expectancy-value scores predict changes in the frequency of adolescent moderate physical activity?

   a. Research H_o: After accounting for all other variables in the model, changes in outcome expectancy-value for physical activity did not explain variance in changes in the frequency of adolescent moderate physical activity.

      i. Statistical H_0: $b_{\text{outcome expectancy-value}} = 0$

   b. Research H_1: After accounting for all other variables in the model, changes in outcome expectancy-value for physical activity explained a significant portion of the variance in changes in the frequency of adolescent moderate physical activity.

      i. Statistical H_1: $b_{\text{outcome expectancy-value}} \neq 0$

4. After accounting for all other variables in the model, did changes in student outcome expectancy-value scores predict changes in the frequency of adolescent vigorous physical activity?
    a. Research H_o: After accounting for all other variables in the model, changes in outcome expectancy-value for physical activity did not explain variance in changes in the frequency of adolescent vigorous physical activity.
        i. Statistical H_0: $b_{\text{outcome expectancy-value}} = 0$
    b. Research H_1: After accounting for all other variables in the model, changes in outcome expectancy-value for physical activity explained a significant portion of the variance in changes in the frequency of adolescent vigorous physical activity.
        i. Statistical H_1: $b_{\text{outcome expectancy-value}} \neq 0$
5. After accounting for all other variables in the model, did changes in student self-efficacy scores predict changes in the frequency of adolescent moderate physical activity?
    a. Research H_o: After accounting for all other variables in the model, changes in self-efficacy for overcoming barriers to physical activity did not explain variance in changes in the frequency of adolescent moderate physical activity.
        i. Statistical H_0: $b_{\text{self-efficacy}} = 0$
    b. Research H_1: After accounting for all other variables in the model, changes in self-efficacy for overcoming barriers to physical activity explained a significant portion of the variance in changes in the frequency of adolescent moderate physical activity.
        i. Statistical H_1: $b_{\text{self-efficacy}} \neq 0$
6. After accounting for all other variables in the model, did changes in student self-efficacy scores predict changes in the frequency of adolescent vigorous physical activity?
    a. Research H_o: After accounting for all other variables in the model, changes in self-efficacy for overcoming barriers to physical activity did not explain variance in changes in the frequency of adolescent vigorous physical activity.
        i. Statistical H_0: $b_{\text{self-efficacyt}} = 0$

b. Research H_1: After accounting for all other variables in the model, changes in self-efficacy for overcoming barriers to physical activity explained a significant portion of the variance in changes in the frequency of adolescent vigorous physical activity.

    i. Statistical H_1: $b_{self\text{-}efficacy} \neq 0$

7. After accounting for all other variables in the model, did changes in student self-regulation scores predict changes in the frequency of adolescent moderate physical activity?

    a. Research H_o: After accounting for all other variables in the model, changes in self-regulation for physical activity did not explain variance in changes in the frequency of adolescent moderate physical activity.

        i. Statistical H_0: $b_{self\text{-}regulation} = 0$

    b. Research H_1: After accounting for all other variables in the model, changes in self-regulation for physical activity explained a significant portion of the variance in changes in the frequency of adolescent moderate physical activity.

        i. Statistical H_1: $b_{self\text{-}regulation} \neq 0$

8. After accounting for all other variables in the model, did changes in student self-regulation scores predict changes in the frequency of adolescent vigorous physical activity?

    a. Research H_o: After accounting for all other variables in the model, changes in self-regulation for physical activity did not explain variance in changes in the frequency of adolescent vigorous physical activity.

        i. Statistical H_0: $b_{self\text{-}regulation} = 0$

    b. Research H_1: After accounting for all other variables in the model, changes in self-regulation for physical activity explained a significant portion of the variance in changes in the frequency of adolescent vigorous physical activity.

        i. Statistical H_1: $b_{self\text{-}regulation} \neq 0$

9. Among those SCT constructs that significantly predicted changes in adolescent physical activity behavior, did changes in the Social Cognitive Theory constructs mediate changes in the frequency of adolescent leisure-time physical activity from the intervention?

a. H_{01}: The educational intervention did not explain a significant portion of the variance in the changes in adolescent moderate and vigorous leisure-time physical activity.

   i. Statistical H_0: $R^2 = 0$

b. H_{11}: The educational intervention explained a significant portion of the variance in the changes in adolescent moderate and vigorous leisure-time physical activity.

   i. Statistical H_1: $R^2 \neq 0$

c. H_{02}: The educational intervention did not explain variance in the changes in the SCT constructs.

   i. Statistical H_0: $R^2 = 0$

d. H_{12}: The educational intervention explained a significant portion of the variance in the changes in the SCT constructs.

   i. Statistical H_1: $R^2 \neq 0$

e. H_{03}: The intervention explained more or the same portion of the variance in the changes in adolescent moderate and vigorous leisure-time physical activity when the effects of the intervention on the SCT constructs were controlled for.

   i. R^2change (for the addition of the intervention after the SCT variable) = 0

f. H_{13}: The educational intervention explained a smaller portion of the variance in the changes in adolescent moderate and vigorous leisure-time physical activity when the effects of the intervention on the SCT constructs were controlled for.

   i. R^2change (for the addition of the intervention after the SCT variable) $\neq 0$

Statistical Analysis

Process Evaluation

Measures of the process evaluation (dose delivered, dose received, and programmatic reach) were analyzed for the current study for the final sample only; these data were produced to aid in the interpretation of the results from the impact evaluation. Data for the process evaluation are presented as descriptive statistics. Programmatic reach was examined through a post-test conceptual knowledge test;

each student received a score out of 100 points on a knowledge test evaluating learning of the main concepts targeted through intervention. Descriptive statistics are presented for student scores on the knowledge test. Dose received was evaluated through program attendance and the percent of homework assignments completed by each student. Descriptive statistics are presented to describe the attendance and homework completion rates by class and by teacher. Dose delivered was evaluated through the teacher lesson evaluation forms and lesson observations. Descriptive statistics are presented to describe program implementation fidelity based on the teacher self-reports. A narrative description of teacher implementation is described based on researcher observations for the delivery of two intervention lessons.

Descriptive Statistics

Descriptive statistics, frequency distributions, and an examination of bivariate correlations between the independent and dependent variables allowed for an examination of the distributions and central tendencies of the data. Descriptive statistics and frequency distributions were calculated at pretest on: student demographic variables, frequency of student moderate and vigorous physical activity behavior, and measures of each of the SCT constructs targeted through intervention. Descriptive data was examined for the sample as a whole, by school, by gender, and to compare student athletes and non-athletes. Based on previous research examining adolescent leisure-time physical activity within Ohio Appalachian counties, no differences were expected in leisure-time physical activity between athletes and non-athletes (Winters, 2001; Hortz, 2005). If the descriptive statistics suggested differences between athletes and non-athletes on any of the SCT or physical activity variables, a separate nominal-level variable (athlete or non-athlete) was entered into the regression models predicting changes in adolescent physical activity before the variables accounting for changes in the SCT constructs; this procedure controlled for the independent effect of athletic status on changes in physical activity behavior.

Primary Research Questions

The primary research questions were examined using multiple regression models designed to evaluate the efficacy of the *Plan for Exercise, Plan for Health* intervention to predict changes in the frequency of student moderate and vigorous physical activity. Two multiple regression models were developed for each of the intervention schools and the comparison school. An example of the regression models developed, depicted in Figure 3.3, contains the following variables to represent the *Plan for Exercise, Plan for Health* intervention, as well as variables to account for individual differences shown to impact physical activity behavior: teacher implementing the program, course in which the student was enrolled, student homework completion rate, knowledge test score, student attendance rate, gender, athletic status, residualized change score for social support, residualized change score for outcome expectancy-values, residualized change score for self-efficacy, and residualized changes score for self-regulation.

$$Y' = a + b_1X_{\text{Teacher}} + b_2X_{\text{Course}} + b_3X_{\text{Homework Rate}} + b_4X_{\text{Attendance Rate}} + b_5X_{\text{Knowledge}} + b_6X_{\text{Gender}} + b_7X_{\text{Atthletic status}} + b_8X_{\text{Social Support Residual}} + b_9X_{\text{Outcome Expectancy-Values Residual}} + b_{10}X_{\text{Self-Efficacy Residual}} + b_{11}X_{\text{Self-Regulation Residual}}$$

Where:
Y' = the residual change score for the frequency of moderate and vigorous physical activity
a = the intercept, or value of Y when all X's are set to zero
b_k = the partial regression coefficient
X_k = the independent variables

Figure 3.3: Proposed Multiple Regression Model

Using residualized change scores allows for the researcher to take pretest differences into account in the models. The residualized score is the post-test score with the pre-test score partialed out; it is a measure of the degree to which an individual increased his/her score on a variable more than would be expected given his/her initial status (Miller, Trost, & Brown, 2002). The residualized change scores were calculated by subtracting predicted scores from observed scores. The predicted score was computed by regressing pretest values on post-test values. Using residualized change scores is preferable to simple change scores because they eliminate autocorrelated error and effects related to regression to the mean (Miller at al, 2002).

The residual change scores for moderate and vigorous physical activity were regressed upon the proposed models to determine whether the models could account for a significant portion of the variance in the physical activity behavior change. The ability of the regression model to predict physical activity behavior was evaluated through an F-test; the F-test examines the proportion of the mean-square due to regression and the mean-square due to error, or residual. The F-test evaluates whether the coefficient of determination, or $R^2 = 0$; if the F-test is significant, $R^2 \neq 0$, and the model statistically predicts a significant portion of the variance in the dependent variable. In the case that the $R^2 \neq 0$, the Coefficient of Determinatino (R^2) will describe the proportion of the variance in the dependent variable accounted for by the linear combination of the independent variables in the model. The alpha level for hypothesis testing was set a priori at 0.05, conventional for the behavioral sciences, and SPSS version 14.0 was used for all statistical analyses.

Secondary Research Questions

The first 8 secondary research questions were designed to evaluate the efficacy of *the Plan for Exercise, Plan for Health* intervention to produce changes in the targeted SCT educational constructs, which predict changes in adolescent moderate and vigorous physical activity behavior. In the case that the multiple regression models developed to answer the primary research questions were found to significantly predict changes in adolescent moderate and/or vigorous physical activity, further analysis was conducted to determine whether changes in the targeted SCT constructs could independently predict changes in physical activity behavior. In order to examine the relationship between changes in the targeted SCT constructs and changes in the frequency of student physical activity behavior, an analysis of the semipartial correlations, or R^2 Change, was conducted. An analysis of the semipartial correlations tests whether each independent variable, as it is entered into the regression model, uniquely contributes to a significant portion of the variance in the dependent variable; it tests the null hypothesis that R^2 $\text{Change}_k = 0$. In the case of a significant R^2 Change, the R^2 Change value will describe the additional variance in the dependent variable explained by the variable added into the model, after accounting for all of the other variables in the model.

Hierarchical model entry was used to develop the regression models in order to first account for rival hypotheses that could explain changes in physical activity behavior and then, based on a literature review, to evaluate the independent ability of the SCT variables targeted by intervention to predict changes in physical activity behavior. Measures of program implementation fidelity (dose delivered and dose received) and measures of student demographics were entered into the models first, and then the residualized change scores for the targeted SCT variables were entered into the model. Entering the measures of implementation fidelity and student demographics into the models first allowed for the variance predicted by these naturally occurring rival hypotheses to be partialed out; this allowed the researcher to examine the independent ability of the changes in the SCT variables, produced by the intervention, to predict changes in adolescent physical activity behavior, after accounting for variance explained by implementation and student individual differences.

As described in the literature review, the use of SCT in the development of health interventions suggests intercorrelations between constructs in the environmental, personal/cognitive, and behavioral domains exist; these intercorrelations are inherent within the framework of Triadic Reciprocality, the foundation of SCT. Because intercorrelations are expected among the SCT constructs, the variables were entered into the model in hierarchical order from the lowest expected relationship to the highest expected relationship, based on the literature review (Table 2.1). Descriptive research using SCT to predict adolescent physical activity behavior has consistently found social support to have the lowest relationship with adolescent physical activity (with correlations ranging from $r = 0.14 – 0.28$), followed by outcome expectancy-values (correlations ranging from $r = 0.22 – 0.49$), self-efficacy for overcoming barriers to physical activity ($r = 0.23 – 0.40$), and then self-regulation ($r = 0.26 – 0.44$). The residualized change scores for these SCT variables were entered into the regression models predicting changes in physical activity behavior in this order to partial out the shared variance between the variables and allow for an interpretation of the independent ability of the constructs to predict changes in physical activity behavior.

The 9th secondary research question was developed to examine the mediating effect of the SCT constructs on physical activity behavior and was analyzed using a series of regression equations. McCaul and Glasgow (1985) and Baron and Kenny (1986) suggest a three step multiple regression analysis using residualized change scores to test the mediating effect of the educational constructs targeted by intervention on behavior; this was used to assess construct validity of the treatment. This analysis was conducted only with those SCT constructs found to significantly predict variance in physical activity residualized change scores, evaluated through the regression models developed to examine the first 8 secondary research questions; without evidence that the intervention was sufficient to impact the targeted construct and predict changes in behavior, an analysis of the mechanism through which changes in the construct could change behavior is not warranted.

The mediation regression analysis was conducted using residualized change scores. Residualized change scores for the applicable SCT constructs (self-efficacy, self-regulation, social support, and outcome expectancy-values) and for frequency of moderate and vigorous physical activity were computed by subtracting post-test scores from predicted scores. Using regression analysis, the change in the outcome measure (frequency of physical activity) was regressed on the treatment level to assess whether the program accounted for a significant portion of the variance in the behavior. Second, the change in the SCT construct was regressed on the treatment level to assess whether the intervention could account for a significant portion of the variance in changes in the constructs. The third and final step in the analysis assessed whether the effect of the treatment on the behavioral outcome was attenuated when the effect of the SCT construct on the behavior was controlled (Baron & Kenny, 1986). In order to test this, the change in the frequency of physical activity was regressed upon the treatment level and the SCT construct. If the effect of the treatment on the frequency of physical activity is less in this equation (after accounting for effects of the SCT construct on behavior) than in the first equation, evidence of mediation exists.

Assumptions of Multiple Regression

Four assumptions must be met in order to accurately interpret the statistics produced by the multiple regression models; the use of multiple regression makes assumptions regarding: specification errors, measurement error, residuals, and collinearity. The assumption of specification errors states that the relationships between the independent and dependent variables are linear, that no relevant independent variables have been excluded, and that no irrelevant independent variables have been included in the models. Violations of this assumption pertain to interpretation of the partial correlation coefficients and their use in estimating population parameters. The use of theory in the current study takes into account the assumption related to specification errors; because a well developed theory and background literature are driving the development of the regression models, it can be assumed that no relevant variables have been excluded and no irrelevant variables have been included in the models.

The second assumption of multiple regression states that there should be no measurement error; the dependent and independent variables should be measured accurately. Measurement error of the dependent variable reduces the potential variance explained by the regression models; it drives the potential R^2 value down. Measurement error of the independent variables can also drive the R^2 value down and can lead to bias in the estimation of the partial regression coefficients. Measurement error has been minimized in this study by using instruments to measure the dependent and independent variables with known reliability and validity and by confirming the reliability of the instruments used in the current study.

Several assumptions exist in multiple regression regarding the residuals. The residuals must be independent, have a mean of zero, be normally distributed, have homoscedasticity at each level of X_k, and must not be correlated with the independent variables. When the residuals are not independent, do not have homoscedasticity at each level of X_k, and are correlated with the independent variables, tests of statistical significance will be inaccurate; this reduces the ability to generalize the findings. In order to test for this, the residuals were plotted against the predicted values and against each independent variable; the assumption is met if the residuals scatter randomly about a horizontal line defined by $r = 0$. The assumption of the residuals being normally distributed is also necessary for tests of statistical significance. This assumption was examined through a normal probability plot; the residuals are normally distributed if they fall approximately on a straight line in the normal probability plot. The residual assumptions dealing with the residuals having a mean of zero are not a concern in this study. The residuals must have a mean of zero only when the researcher is trying to evaluate a precise value of the intercept (a); this is not the case in this study.

The final assumption in multiple regression deals with multicollinearity. Multicollinearity occurs when some or all of the independent variables are substantially correlated with each other or when one or more of the independent variables are almost linear combinations of the other independent variables. A violation of this assumption will limit the size of the model R value and the Coefficient of Determination, or R^2 value. Multicollinearity will also make the regression models unstable. Multicollinearity was evaluated through examining the intercorrelations between the independent variables in the bivariate correlation matrix, and through the Tolerance and VIF statistics. High Tolerance values (near 1.0) indicate that multicollinearity is not a problem; low values (near 0.00) indicate multicollinearity. A VIF value greater than 10 is another indicator of multicollinearity.

CHAPTER 4

RESULTS

Introduction

The purpose of the current study was to conduct an impact evaluation of the *Plan for Exercise, Plan for Health* intervention. The primary purpose was to evaluate the efficacy of the *Plan for Exercise, Plan for Health* intervention at changing the frequency of adolescent moderate and vigorous physical activity. There were two secondary purposes to this study. First, the study sought to examine whether changes in following four Social Cognitive Theory (SCT) constructs were able to predict changes in the frequency of adolescent moderate and vigorous physical activity: self-efficacy for overcoming barriers to physical activity, self-regulation of physical activity, social support from family and friends for physical activity, and outcome expectancy-values for physical activity. Second, the study sought to test whether changes in the targeted SCT constructs mediated changes in adolescent moderate and vigorous physical activity, thereby testing the utility of the theory in the development of physical activity interventions.

The results of this study are presented in eleven sections. The first section presents a description of the schools recruited to participate in the study. Information on school demographics, student enrollment, student performance indices, and teacher experience are presented. The second section provides a description of the eligible sample, including the number of students eligible to participate in the study from each school and the demographics of the eligible students. The third section describes subject mortality and whether differential mortality occurred. The fourth section provides a description of the students included in the final sample at each school. The fifth and sixth sections describe the distributions and central tendencies of the dependent variables (frequency of moderate and vigorous physical activity) and the independent variables (self-efficacy, self-regulation, social support, and outcome expectancy-values) of interest in the study. Data is also presented to determine whether differences in the data exist among students in the final sample based on gender and athletic status. The seventh section presents the Pearson correlations between the independent and dependent variables in the study; such information helps to describe the relationships between variables in the study and aids in the process of model building. The eighth section presents a brief summary of the results of the process evaluation, formerly conducted by Mowad (2006); as described in Chapter 2, the results of the process evaluation are crucial to the avoidance of Type III error in the interpretation of the impact evaluation. The results of the process evaluation presented here are limited to subjects included in the final sample. The ninth and tenth sections present the analysis conducted to answer the primary and secondary research questions; the multiple regression models developed to predict changes in the frequency of moderate and vigorous physical activity at each participating school is presented. The eleventh and final section presents the mediation analysis; it describes whether changes in the SCT variables found to significantly predict changes in the dependent variables actually mediated those changes, thereby testing the theory under which the intervention was developed.

Description of the Recruited Schools

Information for the schools recruited to participate in the study was collected in order to describe the participating schools and to determine whether evidence existed to support the homogeneity of the sample for purposes of generalizing the results of the current study. Information for each of the participating schools was collected through the Ohio Department of Education (2005) and is presented in Table 4.1. Data collected included: student enrollment, the schools' performance index rating, Ohio Graduation Test statistics, teacher information, and student information. The enrollment indicates the number of students enrolled in the high school (grades 9-12); Oak Hill High School was an exception because the school contains grades 1-12. The performance index provides an overall indication of how well students perform on standardized tests each year; the scores can range from 1-120, and the state goal for each school is 100. Schools earn a range of zero points for each untested student to 1.2 points for each student testing at the advanced level (Ohio Department of Education, 2005). This means that if a student does not take the standardized tests the school does not earn points for that student; the school does not lose points for untested students either, however. The Ohio Graduation Test assesses students' ability to master content covered through Grade 10. It is a standards-based test; it measures how well students are mastering specific skills defined by the state (Ohio Department of Education, 2005). Information collected about the teachers included: the percent of teachers in the school who are fully certified, the average years of teaching experience, and the number of students per teacher within the school. Information collected about the students included: the percent of students who are considered to be economically disadvantaged, the attendance rate (percent of students in attendance each day), and student ethnicity.

			Trivalley High School	Shenandoah High School	Oak Hill High School	Jackson High School
Enrollment			936	425	674 (grades 1-12)	854
Performance Index (2005)			94	96	88	95
Ohio Graduation Test	Reading	'05	89%	95%	87%	90%
		'04	78%	75%	69%	79%
	Writing	'05	81%	81%	84%	78%
		'04	NA	NA	NA	NA
	Math	'05	80%	81%	75%	79%
		'04	69%	71%	52%	62%
Teachers	Fully Certified		100%	100%	92%	98%
	Average Years Teaching		10	16	14	13
	Students per Teacher		20	20	20	21
Students	Attendance		96%	94%	93%	93%
	Economically Disadvantaged		12%	18%	32%	19%
Student Ethnicity	White (Non-Hispanic)		97%	100%	100%	97%
	Black (Non-Hispanic)		1%	0	<1%	<1%
	Hispanic		<1%	<1%	0	1%
	Multiracial		1%	0	0	<1%
	American Indian/Alaskan Native		0	0	<1%	<1%
	Asian/Pacific Islander		0	0	0	<1%

Table 4.1: Description of Recruited Schools

Based on the information collected through the Ohio Department of Education and previous studies with similar schools, the study sample appears to be homogenous. Previous research suggests no pretest differences among students within Appalachian Ohio high schools on demographics, physical activity, or on any of the SCT constructs examined, using the same instruments used in the current study (Winters, 2001; Hortz, 2005). Information collected from the Ohio Department of Education supports the homogeneity of the sample. The schools' performance index scores range from 88 – 96 and the latest Ohio Graduate Test results indicate similar performance, with 87% - 95% of 10th grade students passing the reading portion of the exam; 78% - 84% of students passing the writing portion of the exam; and, 75% - 81% of students passing the math portion of the exam in 2005 (Table 4.1). More than 90% of the teachers in each school are certified by the state and the student to teacher ratio within each school is nearly identical. While Oak Hill High School appears to have a higher rate of economically disadvantaged students, the remaining 3 schools have similar rates. This was confirmed through a series of 2X2 Chi-Square Tables. Oak Hill has a greater percentage of economically disadvantaged students than Jackson High School (χ^2 (1) = 11.66, p <0.01), Shenandoah High School (χ^2 (1) = 5.23, p <0.05), and Trivalley High School (χ^2 (1) = 4.45, p <0.05). Attendance rates are high within all 4 schools, with 93% or more of students, on average, attending school each day. The school population appears to be homogenous, with almost 100% of the students in each school being White, Non-Hispanic.

<u>Description of the Eligible Sample</u>

The original sample recruited to participate in the evaluation of the *Plan for Exercise, Plan for Health* intervention included 628 students enrolled in 19 physical education classes, 2 health classes, and 5 life skills classes. In order to be eligible for inclusion in the intervention evaluation, the students had to provide the research team with a signed parental consent form and a signed student assent form. Of the 628 students enrolled in the intervention, a total of n = 458 students returned signed parental consent forms (a return rate of 72.93%), and a total of n = 534 returned signed student assent forms (a return rate of 85.03%). Jackson High School, the comparison school, had the lowest return rate for consent and assent; 128 (57.92%) students returned signed parental consent forms and 174 (78.73%) students returned signed student assent forms. Trivalley High School returned 120 (76.10%) parental consent forms and 135 (84.91%) student assent forms. Oak Hill High School returned 49 (79.03%) parental consent forms and 61 (98.39%) student assent forms. Shenandoah High School returned 161 (87.50%) parental consent forms and 164 (89.13%) student assent forms.

After taking parental consent and student assent into account, the eligible sample at pretest included n = 422 students (Jackson n = 117, Oak Hill n = 49, Shenandoah n = 151, Trivalley n = 105), or 67.20% of the originally available sample. The students in the eligible sample were 14 – 19 years old (μ = 15.45 years, s = 1.00 years). There were n = 185 (43.8%) students enrolled in the 9th grade, n = 183 (43.4%) students enrolled in the 10th grade, n = 32 (7.6%) students enrolled in the 11th grade, and n = 21 (5.0%) students enrolled in the 12th grade. 44.3% (n = 187) of the sample was male and 55.7% (n = 235) of the sample was female. The final eligible sample was primarily white (96.0%, n = 405), with very few students reporting being of African American (0.5%, n = 2), Hispanic (0.9%, n = 4), or of another (1.4%, n = 6) racial background.

Subject Mortality

Of the n = 422 students in the eligible sample, the evaluation of the intervention included n = 211 students; there was a 50% subject mortality rate across all schools over the course of the study. Subjects were lost either at pretest or at post-test due to inadequate completion of the SCT construct instruments and due to inadequate completion of the PDPAR logs. A description of subject mortality, by school, is provided in Table 4.2. If a student completed less than 80% of the questions on any one or more of the SCT instruments, they were considered lost due to inadequate completion of the SCT instruments. If a student completed less than five days of PDPAR logs, they were considered lost due to inadequate completion of the PDPAR logs. By school, the mortality rates were 71.79% at Jackson High School, 48.98% at Oak Hill High School, 47.02% at Shenandoah High School, and 30.48% at Trivalley High School. A series of 2X2 Chi-Square tables revealed significant differences in mortality rates between Jackson High School and Shenandoah High School (χ^2 (1) = 6.96, p <0.01), and between Jackson High School and Trivalley High School (χ^2 (1) = 13.45, p <0.01).

School	Eligible Students	Final Sample	Lost at Pretest		Lost at Post-Test	
			SCT Instrument	PDPAR Logs	SCT Instrument	PDPAR Logs
Jackson HS	117	33	12 (10.30%)	44 (37.60%)	10 (8.50%)	18 (15.40%)
Oak Hill HS	49	25	3 (6.10%)	5 (10.20%)	9 (18.30%)	7 (14.30%)
Shenandoah HS	151	80	6 (4.00%)	16 (10.60%)	20 (13.20%)	29 (19.20%)
Trivalley HS	105	73	0	5 (4.80%)	15 (14.30%)	12 (11.40%)
Total	**422**	**211**	**21 (5.98%)**	**70 (16.59%)**	**54 (12.80%)**	**66 (15.64%)**

Table 4.2: Subject Mortality, by School

It is important to note that a total of 26 eligible students dropped out of the study due to teacher non-compliance. At Shenandoah High School, one teacher failed to return the entire 3rd period class' pretest PDPAR logs; this resulted in a loss of 11 eligible subjects at pretest. The teacher participating at Oak Hill High School failed to provide post-test data from her entire 8th period class; this included 5 eligible students. At Shenandoah High School, one teacher decided to withdraw her 8th period class from the intervention after the pre-test; this resulted in a loss of 10 eligible subjects at post-test. The remainder subject attrition occurred as a result of the student failing to complete at least 80% of the SCT instruments at pretest and post-test or as a result of the student failing to complete at least five PDPAR logs at pretest and post-test.

Differential mortality can lead to problems with the internal validity of the study; therefore, an examination of mortality was warranted. Subject mortality was first examined at each school by gender, grade, and type of class. Distributions for gender, grade enrollment, and course enrollment for the students who were included in the pretest analysis, who were included in the final analysis, and the resulting distributions of the subjects who were lost over the course of the study is presented in Table 4.3. The only significant difference in mortality by gender was at Shenandoah High School, (χ^2 (1) = 6.34, p <0.05), where 73.24% of the subjects lost were male and 26.76% were female. The only significant differences in mortality by grade was at Jackson High School (χ^2 (1) = 7.06, p <0.01), where 36.14% of the subjects lost were in the 9th grade and 63.86% of the subjects lost were in the 10th grade. The only school that had both health and physical education classes participating in the intervention was Shenandoah High School; there were no significant differences in mortality by class type.

		Male	Female	9th Grade	10th Grade	11th Grade	12th Grade	PE	Health	Life Skills
Jackson HS	Pretest	54 (46.2%)	63 (53.8%)	54 (46.2%)	62 (53.0%)	0	0	117 (100%)	0	0
	Final Sample	15 (45.5%)	18 (54.5%)	24 (72.7%)	9 (27.3%)	0	0	33 (100%)	0	0
	Lost	39 (46.43%)	45 (53.57%)	30 (36.14%)	53 (63.86%)	0	0	84 (100%)	0	0
Oak Hill HS	Pretest	4 (8.2%)	45 (91.8%)	18 (36.7%)	12 (24.5%)	9 (18.4%)	10 (20.4%)	0	0	49 (100%)
	Final Sample	3 (12.0%)	22 (88.0%)	10 (40.0%)	10 (40.0%)	2 (8.0%)	3 (12.0%)	0	0	25 (100%)
	Lost	1 (4.17%)	23 (95.83%)	8 (33.33%)	2 (8.33%)	7 (29.17%)	7 (29.17%)	0	0	24 (100%)
Shenandoah HS	Pretest	81 (53.6%)	70 (46.4%)	77 (51.4%)	45 (29.8%)	20 (13.2%)	9 (6.0%)	118 (78.1%)	33 (21.9%)	0
	Post-Test	29 (36.3%)	51 (63.8%)	52 (65.0%)	22 (27.5%)	4 (5.0%)	2 (2.5%)	59 (73.8%)	21 (26.3%)	0
	Lost	52 (73.24%)	19 (26.76%)	25 (35.21%)	23 (32.39%)	16 (22.54%)	7 (9.86%)	59 (83.10%)	12 (16.90%)	0
Trivalley HS	Pretest	48 (45.7%)	57 (65.3%)	36 (34.3%)	64 (61.0%)	3 (2.9%)	2 (1.9%)	105 (100%)	0	0
	Post-Test	29 (39.7%)	44 (60.3%)	27 (37.0%)	43 (58.95)	2 (2.7%)	1 (1.4%)	73 (100%)	0	0
	Lost	19 (59.38%)	13 (40.63%)	9 (28.13%)	21 (65.63%)	1 (3.13%)	1 (3.13%)	32 (100%)	0	0

Table 4.3: Subject Mortality by Gender, Grade, and Type of Class

Subject mortality was also examined to determine whether there were differences between subjects who were included in the final sample and subjects who were lost over the course of the study on measures of the independent and dependent variables at pretest and post-test. The results comparing subjects in the final sample to subjects lost at pretest due to a failure to complete at least 80% of each SCT instrument, subjects lost at pretest due to a failure to complete at least five PDPAR logs, subjects lost at post-test due a failure to complete at least 80% of each SCT instrument, and subjects lost at post-test due to a failure to complete at least five PDPAR logs are presented in Tables 4.4 – 4.7. In each table, the means (M) and standard deviations (SD) of the final sample and the subjects lost over the course of the study are presented for all appropriate measures. The t-statistic comparing the final sample to the subjects lost is also presented, followed by the p-value indicating statistical significance.

Examining Table 4.4, there appear to be differences between those students who were lost at pretest due to inadequate completion of the SCT instruments and those students who were included in the final sample. Jackson High School students in the final sample scored significantly lower than those lost at pretest on self-regulation ($t\ (35) = 2.79$, $p<0.01$). There was only one student at Jackson High School who failed to complete the pretest SCT instruments but completed the post-test PDPAR logs; this individual reported participating in more days of moderate physical activity at pretest ($t(32) = 2.29$, $p<0.05$) than the final sample. Oak Hill High School students in the final sample reported participating in fewer days of moderate physical activity at the pretest than students who were lost at pretest ($t\ (26) = 2.20$, $p<0.05$). Shenandoah students in the final sample scored significantly higher on self-efficacy for overcoming barriers to physical activity at post-test ($t\ (82) = -2.35$, $p<0.05$) and on social support for physical activity ($t\ (82) = -2.14$, $p<0.05$) at post-test than students who failed to complete the pretest SCT instruments. There were no Trivalley High School students lost at pretest due to inadequate completion of the SCT instruments.

School	Measure	M Final	SD Final	M Lost	SD Lost	T	sig
Jackson HS	Pretest Mod PA	1.18	1.72	0.60	1.34	-0.72	0.48
	Pretest Vig PA	0.27	1.01	0.00	0.00	-0.60	0.55
	Post-Test SE	26.67	10.44	31.75	10.18	0.92	0.36
	Post-Test SR	60.58	30.67	104.75	19.70	2.79	0.01**
	Post-Test SS	19.94	10.90	29.00	11.31	1.57	0.13
	Post-Test OE	356.64	184.07	454.00	292.72	0.84	0.41
	Post-Test Mod PA	0.94	1.75	5.00	0.00	2.29	0.03*
	Post-Test Vig PA	0.30	1.05	1.00	0.00	0.66	0.52
Oak Hill HS	Pretest Mod PA	1.88	1.62	4.00	1.00	2.20	0.04*
	Pretest Vig PA	0.32	0.75	1.33	2.31	0.76	0.56
	Post-Test SE	33.64	7.03	31.50	13.44	-0.39	0.70
	Post-Test SR	90368	32.02	52.50	6.36	-1.65	0.11
	Post-Test SS	28.48	11.35	14.00	4.24	-1.77	0.09
	Post-Test OE	472.44	171.41	581.00	323.85	0.82	0.42
	Post-Test Mod PA	1.88	1.69	5.00	0.00	1.81	0.08
	Post-Test Vig PA	0.24	0.88	0.00	0.00	-0.27	0.79
Shenandoah HS	Pretest Mod PA	1.33	1.62	1.50	1.76	0.25	0.80
	Pretest Vig PA	0.20	0.74	1.00	2.00	0.96	0.37
	Post-Test SE	30.93	5.61	24.25	2.99	-2.35	0.02*
	Post-Test SR	80.50	23.61	69.00	20.02	-0.96	0.34
	Post-Test SS	28.66	8.42	19.50	6.40	-2.14	0.04*
	Post-Test OE	460.35	160.06	417.25	222.32	-0.52	0.61
	Post-Test Mod PA	1.49	1.93	0.50	0.71	-0.72	0.47
	Post-Test Vig PA	0.15	0.62	0.00	0.00	-0.34	0.73

Final = Final Sample; Lost = Subjects Lost; M = Mean; SD = Standard Deviation
* $p<0.05$; ** $p<0.01$

Table 4.4: Comparison of Subjects Lost at Pretest due to Non-Completion of the SCT Instruments to the Final Sample

Examining Table 4.5, there appear to be differences between those subjects who were lost at pretest due to inadequate completion of the PDPAR exercise logs and those subjects who were included in the finals sample, particularly among students at Shenandoah High School. At Jackson High School, students in the final sample scored lower on the social support for physical activity at pretest ($t\ (75) = 2.39$, $p<0.05$) and at post-test ($t\ (66) = 2.16$, $p<0.05$) than students who inadequately completed the PDPAR logs at pretest. At Oak Hill High School, students in the final sample reported participating in fewer days of moderate physical activity ($t\ (25) = 2.14$, $p<0.05$) than students who inadequately completed the PDPAR logs at pretest. At Shenandoah High School, students in the final sample scored lower on all of the pretest SCT construct variables ($t_{SE}\ (94) = 2.97$, $p<0.01$; $t_{SR}\ (94) = 2.54$, $p = 0.01$; $t_{SS}\ (94) = 5.94$, $p<0.01$; $t_{OE}\ (94) = 2.65$, $p = 0.01$) than students who were lost at pretest due to inadequate completion of the PDPAR logs; students in the final sample also scored lower on post-test self-regulation ($t\ (89) = 2.10$, $p<0.05$) and post-test social support ($t\ (90) = 3.56$, $p<0.01$). Students in the final sample from Trivalley High School scored significantly lower at pretest on self-regulation ($t\ (76) = 2.81$, $p = 0.01$) and on social support ($t\ (76) = 4.66$, $p<0.05$) and significantly lower at post-test on social support ($t\ (76) = 2.19$, $p<0.05$) than students who were lost at pretest due to inadequate completion of the PDPAR logs.

School	Measure	M Final	SD Final	M Lost	SD Lost	T	sig
Jackson HS	Pretest SE	27.48	8.75	27.20	8.32	-0.14	0.89
	Pretest SR	59.64	27.89	68.75	10.30	1.35	0.18
	Pretest SS	22.21	9.72	27.75	8.32	2.39	0.02*
	Pretest OE	417.61	173.38	432.41	178.46	0.37	0.72
	Post-Test SE	26.67	10.44	24.94	9.37	-0.72	0.48
	Post-Test SR	60.58	30.37	64.44	26.47	0.55	0.58
	Post-Test SS	19.94	10.90	25.20	9.99	2.16	0.04*
	Post-Test OE	356.64	184.07	364.15	200.13	0.16	0.87
	Post-Test Mod PA	0.94	1.75	0.77	1.43	-0.41	0.68
	Post-Test Vig PA	0.30	1.05	0.00	0.00	-1.67	0.11
Oak Hill HS	Pretest SE	30.76	5.58	30.40	8.99	-0.12	0.91
	Pretest SR	71.92	20.61	59.80	18.87	-1.21	0.24
	Pretest SS	24.72	9.98	20.80	8.07	-0.82	0.42
	Pretest OE	479.44	128.04	449.80	127.12	-0.47	0.64
	Post-Test SE	33.64	7.03	34.33	5.51	0.16	0.87
	Post-Test SR	90.68	32.02	87.33	8.33	-0.42	0.68
	Post-Test SS	28.48	11.35	30.33	3.06	0.28	0.78
	Post-Test OE	472.44	171.41	499.50	178.90	0.21	0.83
	Post-Test Mod PA	1.88	1.69	4.50	0.71	2.14	0.04*
	Post-Test Vig PA	0.24	0.88	1.00	1.41	1.14	0.27
Shenandoah HS	Pretest SE	29.11	6.79	34.44	5.16	2.97	<0.01**
	Pretest SR	53.16	18.83	84.25	19.56	2.54	0.01**
	Pretest SS	21.51	8.15	27.31	9.20	5.99	<0.01**
	Pretest OE	432.50	152.81	545.31	169.74	2.65	0.01**
	Post-Test SE	30.93	5.61	34.08	6.33	1.79	0.08
	Post-Test SR	80.50	23.61	107.18	20.81	2.10	0.04*
	Post-Test SS	28.66	8.42	34.08	7.57	3.56	<0.01**
	Post-Test OE	460.35	160.06	528.80	181.33	1.26	0.21
	Post-Test Mod PA	1.49	1.93	1.64	2.01	0.24	0.81
	Post-Test Vig PA	0.15	0.62	0.55	1.29	0.99	0.34
Trivalley HS	Pretest SE	29.26	6.96	33.00	3.32	1.19	0.24
	Pretest SR	58.93	22.40	87.40	8.56	2.81	0.01*
	Pretest SS	24.59	9.91	35.80	4.66	2.50	0.02**
	Pretest OE	431.93	166.71	545.80	88.62	1.51	0.14
	Post-Test SE	28.64	8.24	34.20	6.72	1.47	0.15
	Post-Test SR	75.25	28.22	97.20	23.06	1.70	0.09
	Post-Test SS	26.71	11.15	38.00	11.11	2.19	0.03*
	Post-Test OE	440.73	175.58	584.00	128.83	1.79	0.08
	Post-Test Mod PA	1.04	1.37	2.00	2.45	0.78	0.49
	Post-Test Vig PA	0.05	0.23	0.50	1.00	0.89	0.44

Final = Final Sample; Lost = Subjects Lost; M = Mean; SD = Standard Deviation

Table 4.5: Comparison of Subjects Lost at Pretest due to Non-Completion of the PDPAR Logs to the Final Sample

Examining Table 4.6, there are few differences between those subjects included in the final sample and those subjects who were lost at post-test due to a failure to complete one or more of the SCT instruments. There were no differences between students in the final sample and students lost at post-test due to a failure to complete the SCT instruments from Oak Hill High School or Shenandoah High School. Students in the final sample from Jackson High School reported participating in more days of moderate physical activity at post-test ($t(37) = -.309$, $p<0.01$) than students who failed to adequately complete the SCT instruments at post-test. Students in the final sample from Trivalley High School scored significantly higher on social support at pretest ($t(86) = -2.22$, $p<0.05$) than students who inadequately completed the SCT instruments at post-test

School	Measure	M Final	SD Final	M Lost	SD Lost	T	sig
Jackson HS	Pretest SE	27.48	8.75	27.90	7.96	0.13	0.89
	Pretest SR	59.64	27.89	64.20	19.29	0.48	0.63
	Pretest SS	22.21	9.72	24.30	10.15	0.59	0.56
	Pretest OE	417.61	173.38	456.00	180.95	0.61	0.55
	Pretest Mod PA	1.18	1.72	0.78	1.64	-0.63	0.53
	Pretest Vig PA	0.27	1.01	0.00	0.00	-0.80	0.43
	Post-Test Mod PA	0.94	1.74	0.00	0.00	-3.09	<0.01**
	Post-Test Vig PA	0.30	1.05	0.00	0.00	-0.70	0.49
Oak Hill HS	Pretest SE	30.76	5.58	31.67	3.12	0.46	0.65
	Pretest SR	71.92	20.61	57.33	19.10	-1.85	0.07
	Pretest SS	24.72	9.98	22.44	10.33	-0.58	0.57
	Pretest OE	479.44	128.04	393.33	99.87	-1.82	0.08
	Pretest Mod PA	1.88	1.62	1.22	1.39	-1.08	0.29
	Pretest Vig PA	0.32	0.75	0.11	0.33	-0.80	0.43
	Post-Test Mod PA	1.88	1.69	1.67	2.89	-0.19	0.85
	Post-Test Vig PA	0.24	0.88	0.00	0.00	-0.47	0.65
Shenandoah HS	Pretest SE	29.11	6.79	29.45	4.87	0.21	0.84
	Pretest SR	53.16	18.83	58.65	16.74	1.19	0.24
	Pretest SS	21.51	8.15	23.80	10.40	1.06	0.29
	Pretest OE	432.50	152.81	463.50	157.15	0.81	0.42
	Pretest Mod PA	1.33	1.62	1.35	1.84	0.06	0.95
	Pretest Vig PA	0.20	0.74	0.25	0.72	0.27	0.79
	Post-Test Mod PA	1.49	1.93	0.75	0.96	-1.41	0.23
	Post-Test Vig PA	0.15	0.62	0.00	0.00	-0.48	0.61
Trivalley HS	Pretest SE	29.26	6.96	28.27	7.86	-0.49	0.62
	Pretest SR	58.93	22.40	59.13	22.17	0.03	0.98
	Pretest SS	24.59	9.91	18.53	8.14	-2.22	0.03*
	Pretest OE	431.93	166.71	412.40	147.55	-0.42	0.68
	Pretest Mod PA	1.04	1.37	1.53	1.60	1.23	0.22
	Pretest Vig PA	0.27	0.80	0.27	0.59	-0.03	0.97
	Post-Test Mod PA	1.04	1.37	1.60	2.19	0.56	0.60
	Post-Test Vig PA	0.05	0.23	0.00	0.00	-0.53	0.58

Final = Final Sample; Lost = Subjects Lost; M = Mean; SD = Standard Deviation

Table 4.6: Comparison of Subjects Lost at Post-Test due to Non-Completion of the SCT Instruments to the Final Sample

Examining Table 4.7, there appear to be differences between students in the final sample and students who dropped out of the study due to inadequate completion of the PDPAR logs at post-test. At Jackson High School, students in the final sample scored lower than students who failed to complete the post-test PDPAR logs on social support (t_{SS} (49) = 2.11, $p<0.05$) and outcome expectancy-values (t_{OE} (49) = 2.52, $p<0.05$) at pretest and on self-efficacy (t_{SE} (49) = 2.05, p = 0.05) and outcome expectancy-values; (t_{OE} (49) = 2.01, p = 0.05) at post-test. Students in the final sample from Oak Hill High School reported participating in more days of vigorous physical activity at pretest than students who failed to complete the post-test PDPAR logs (t (30) = -2.14, $p<0.05$). Students in the final sample from Shenandoah High School scored significantly lower on self-regulation and social support at pretest than students who dropped out of the study due to a failure to complete the post-test PDPAR logs (t_{SR} (107) = 2.56, p = 0.05; t_{SS} (107) = 2.02, $p<0.05$). Finally, students in the final sample from Trivalley High School reported participating in significantly more days of vigorous physical activity at pretest than students who dropped out of the study at post-test due to a failure to complete the PDPAR logs (t (83) = -2.91, p = 0.01).

School	Measure	M Final	SD Final	M Lost	SD Lost	T	sig
Jackson HS	Pretest SE	27.48	8.75	29.67	7.85	0.88	0.38
	Pretest SR	59.64	27.89	73.06	30.28	1.59	0.12
	Pretest SS	22.21	9.72	28.50	10.97	2.11	0.04*
	Pretest OE	417.61	173.38	548.06	183.73	2.52	0.02*
	Pretest Mod PA	1.18	1.72	1.67	1.78	0.95	0.35
	Pretest Vig PA	0.27	10.1	0.17	0.38	-0.43	0.67
	Post-Test SE	26.67	10.44	28.06	9.86	2.05	0.05*
	Post-Test SR	60.58	30.67	79.00	30.68	0.61	0.55
	Post-Test SS	19.94	10.90	26.11	9.68	0.46	0.65
	Post-Test OE	356.34	184.07	392.50	230.53	2.01	0.05*
Oak Hill HS	Pretest SE	30.76	5.58	33.00	4.08	0.99	0.33
	Pretest SR	71.92	20.61	59.29	20.58	-0.77	0.45
	Pretest SS	24.72	9.98	21.43	10.29	-1.43	0.16
	Pretest OE	479.44	128.04	408.86	118.32	-1.31	0.20
	Pretest Mod PA	1.88	1.62	1.57	1.72	-0.44	0.66
	Pretest Vig PA	0.32	0.75	0.00	0.00	-2.14	0.04*
	Post-Test SE	33.64	7.03	32.14	5.40	-1.32	0.20
	Post-Test SR	90.68	32.02	72.71	31.00	-0.57	0.58
	Post-Test SS	28.48	11.35	25.00	11.34	-0.52	0.61
	Post-Test OE	472.44	171.41	433.71	110.35	-0.07	0.48
Shenandoah HS	Pretest SE	29.11	6.79	29.66	9.30	0.29	0.78
	Pretest SR	53.16	18.83	69.45	32.40	2.56	0.05*
	Pretest SS	21.51	8.15	26.10	11.23	2.02	0.02*
	Pretest OE	432.50	152.81	444.76	190.96	0.31	0.56
	Pretest Mod PA	1.33	1.62	2.00	2.20	1.51	0.14
	Pretest Vig PA	0.22	0.74	0.31	1.07	0.61	0.54
	Post-Test SE	30.93	5.61	29.21	7.11	1.55	0.13
	Post-Test SR	80.50	23.61	89.97	29.76	-0.75	0.45
	Post-Test SS	28.66	8.42	30.83	9.23	-1.18	0.25
	Post-Test OE	460.35	160.06	434.59	151.39	1.11	0.25
Trivalley HS	Pretest SE	29.26	6.96	29.17	6.31	-0.44	0.97
	Pretest SR	58.93	22.40	64.17	22.36	0.75	0.46
	Pretest SS	24.59	9.91	22.42	9.25	-0.71	0.48
	Pretest OE	431.93	166.71	453.75	217.40	0.40	0.69
	Pretest Mod PA	1.04	1.37	0.83	1.03	-0.52	0.62
	Pretest Vig PA	0.27	0.80	0.00	0.00	-2.91	0.01**
	Post-Test SE	28.64	8.24	27.25	6.73	0.56	0.58
	Post-Test SR	75.25	28.22	80.08	23.39	-0.68	0.50
	Post-Test SS	26.71	11.15	22.58	6.96	-0.56	0.58
	Post-Test OE	440.73	175.58	403.33	186.52	-1.72	0.10

Final = Final Sample; Lost = Subjects Lost; M = Mean; SD = Standard Deviation

Table 4.7: Comparison of Subjects Lost at Post-Test due to Non-Completion of the PDPAR Logs to the Final Sample

In summary, there did appear to be differential mortality across the schools which could influence the internal validity of the study. The differences in mortality primarily occurred among students who dropped out of the study at pretest and students who were included in the final sample. Students in the final sample tended to score lower on the SCT variables than students who dropped out of the study. Students in the final sample tended to report more days of vigorous physical activity than students who dropped out of the study. Mortality poses a threat to internal validity because it can result in the final groups being unequal; inequality of the groups can lead to a bias in the results of the study. Because there was differential mortality, the students in the final sample were compared at pretest on each of the SCT and physical activity variables to determine whether between group pretest differences resulted from the differential mortality.

Description of the Final Sample

The data was first examined on the basis of demographic variables in order to describe the students included in the final sample and to determine whether age, gender, athletic, or racial differences existed between students participating in the intervention evaluation at each of the schools. Descriptive statistics for the age of the students at each school is presented in Table 4.8. A one-way ANOVA revealed no pretest differences in the age between the participating students at each school ($F(3, 207) = 1.94$, $p = 0.12$). The distribution of the grade in which participating students were enrolled at each school was presented in Table 4.3. The majority of the students participating in the intervention evaluation were in the 9^{th} and 10^{th} grade. No students at Jackson High School were enrolled in 11^{th} or 12^{th} grades. 80% of participating students from Oak Hill, 92.5% of participating students from Shenandoah, and 95.9% of participating students from Trivalley were in the 9^{th} or 10^{th} grades.

School	Min	Max	SD	Mean
Jackson HS (n = 33)	14.00	17.00	0.68	14.97
Oak Hill HS (n = 25)	14.00	18.00	1.16	15.56
Shenandoah HS (n = 80)	14.00	19.00	1.02	15.21
Trivalley HS (n = 73)	14.00	18.00	0.82	15.21

Table 4.8: Descriptive Statistics for Age of the Final Sample at Pretest

The frequency distributions for gender and athletic status for the students in the final sample at each school is presented in Table 4.9. There were significant differences in the gender distribution among students in the final sample between Jackson High School and Oak Hill High School (χ^2 (1) = 27.39, p <0.01), Oak Hill High School and Shenandoah High School (χ^2 (1) = 16.08, p <0.01), and Oak Hill High School and Trivalley High School (χ^2 (1) = 20.01, p <0.01). There were no significant differences in the distribution of athletes and non-athletes between any of the schools.

School		Male	Female	Sample
Jackson HS (n = 33)	Athlete	12 (60%)	8 (40%)	**20 (60.6%)**
	Non-Athlete	3 (23.1%)	10 (76.9%)	**13 (39.4%)**
	Sample	**15 (45.5%)**	**18 (54.5%)**	
Oak Hill HS (n = 25)	Athlete	1 (8.3%)	11 (91.7%)	**12 (48%)**
	Non-Athlete	2 (15.4%)	11 (84.6%)	**13 (52%)**
	Sample	**3 (12.0%)**	**22 (88%)**	
Shenandoah HS (n = 80)	Athlete	19 (38.8%)	30 (61.2%)	**49 (61.2%)**
	Non-Athlete	10 (32.3%)	21 (67.7%)	**31 (38.8%)**
	Sample	**29 (36.3%)**	**51 (63.8%)**	
Trivalley HS (n = 73)	Athlete	18 (43.9%)	23 (56.1%)	**41 (56.2%)**
	Non-Athlete	11 (34.4%)	21 (65.6%)	**32 (43.8%)**
	Sample	**29 (39.7%)**	**44 (60.3%)**	

Table 4.9: Frequency Distribution for Gender and Athletic Status of the Final Sample at Pretest, by School

Table 4.10 presents the number of students at each school who reported participating in fall, winter, spring, and summer athletics. The *Plan for Exercise, Plan for Health* intervention was delivered from March, 2006 through May, 2006. Once a student volunteers to participate in an organized school sport, he or she is required to attend daily practices and competitions. Student athletes typically spend 1 – 2 hours practicing or competing in their sport on 4 – 6 days per week; as a result, student athletes typically meet the recommended guidelines for physical activity during the months they are participating in organized athletics. While a student's participation in any organized sport is volitional, the time he or she spends being physically active at practice or as part of competitions is driven by the sport. Therefore, the physical activity of students who reported participating in a spring organized sport may have been affected by their athletic participation. This pertains to 24% - 34% of the students from each school.

School		Fall Sport	Winter Sport	Spring Sport	Summer Sport
Jackson HS (n =20)	Male	8 (53.3%)	7 (46.7%)	5 (33.3%)	3 (20.0%)
	Female	4 (22.2%)	6 (33.3%)	4 (22.2%)	4 (22.2%)
	Sample	**12 (36.4%)**	**13 (39.4%)**	**9 (27.3%)**	**7 (21.2%)**
Oak Hill HS (n =12)	Male	0	0	1 (33.3%)	0
	Female	2 (9.1%)	3 (13.6%)	5 (22.7%)	4 (18.2%)
	Sample	**2 (8.0%)**	**3 (12.0%)**	**6 (24.0%)**	**4 (16.0%)**
Shenandoah HS (n =49)	Male	14 (48.3%)	8 (27.6%)	6 (20.7%)	4 (13.8%)
	Female	16 (31.4%)	10 (19.6%)	20 (39.2%)	10 (19.6%)
	Sample	**30 (37.5%)**	**18 (22.5%)**	**26 (32.5%)**	**14 (17.5%)**
Trivalley HS (n =41)	Male	14 (48.3%)	5 (17.2%)	9 (31.0%)	4 (13.8%)
	Female	14 (31.8%)	14 (31.8%)	16 (36.4%)	11 (25.0%)
	Sample	**28 (38.4%)**	**19 (26.0%)**	**25 (34.2%)**	**15 (20.5%)**

Table 4.10: Frequency Distribution for Sport Participation Seasons, Final Sample at Pretest by School

Table 4.11 presents the frequency distribution for the number of seasons student athletes reported participating in organized athletics. The percentage of students who reported participating in one or more seasons of organized athletics reflects national data. Nationally, 56.0% of high school students report participating in at least one organized sport (CDC, *YRBS*, 2006). The majority of students participating in organized athletics are participating in one or two sports. No students at Oak Hill High School reported participating in more than two school sports. In the other schools, five students at Jackson High School, nine Students at Shenandoah High School, and twelve students at Trivalley High School reported participating in three or four organized sports. This means that most students are spending less than half of the year participating in an organized school sport; this leaves at least half of the year for students to engage in volitional physical activity.

School		1 Sport	2 Sports	3 Sports	4 Sports
Jackson HS (n =20)	Male	5 (33.3%)	5 (33.5%)	0	2 (13.3%)
	Female	4 (22.2%)	1 (5.6%)	0	3 (16.7%)
	Sample	**9 (29.7%)**	**6 (18.2%)**	**0**	**5 (15.2%)**
Oak Hill HS (n =12)	Male	1 (33.3%)	0	0	0
	Female	8 (36.4%)	3 (13.6%)	0	0
	Sample	**9 (36.0%)**	**3 (12.0%)**	**0**	**0**
Shenandoah HS (n =49)	Male	8 (27.6%)	9 (31.0%)	2 (6.9%)	0
	Female	14 (27.5%)	9 (17.6%)	4 (7.8%)	3 (5.9%)
	Sample	**22 (27.5%)**	**18 (22.5%)**	**6 (7.5%)**	**3 (3.8%)**
Trivalley HS (n =41)	Male	10 (34.5%)	5 (17.2%)	0	3 (10.3%)
	Female	4 (9.1%)	10 (22.7%)	5 (11.4%)	4 (9.1%)
	Sample	**14 (19.2%)**	**15 (20.5%)**	**5 (6.8%)**	**7 (9.6%)**

Table 4.11: Frequency Distribution for Number of Sports Participation, Final Sample at Pretest, by School

The racial distribution of students in the final sample is presented in Table 4.12. The final sample was homogenous, with only 4 students from any school reporting having a racial background other than white. This homogeneity was expected based on information gathered from the Ohio Department of Education, presented in Table 4.1. Because of the racial homogeneity of the final sample, no further analysis was conducted by race.

School		White	African American	Hispanic	Other
Jackson HS (n = 33)	Male	14 (93.3%)	0	0	1 (6.7%)
	Female	17 (94.4%)	0	0	1 (5.6%)
	Sample	**31 (93.9%)**	**0**	**0**	**2 (6.1%)**
Oak Hill HS (n = 25)	Male	3 (100%)	0	0	0
	Female	22 (100%)	0	0	0
	Sample	**25 (100%)**	**0**	**0**	**0**
Shenandoah HS (n = 80)	Male	28 (96.6%)	1 (3.4%)	0	0
	Female	50 (98.0%)	0	1 (2.0%)	0
	Sample	**78 (97.5%)**	**1 (1.3%)**	**1 (1.3%)**	**0**
Trivalley HS (n = 73)	Male	29 (100%)	0	0	0
	Female	42 (95.5%)	0	0	0
	Sample	**71 (97.3%)**	**0**	**0**	**0**

Table 4.12: Frequency Distribution of Race for the Final Sample at Pretest, by School

Descriptive statistics for weight and BMI of the subjects in the final sample are presented in Table 4.13. BMI was calculated through the following equation: [weight (lbs) / (height (in))^2] * 703. It is important to note that the information on height and weight was collected through self-report measures. According to the CDC, 15-year old adolescent males are: underweight if they have a BMI < 16, healthy weight if they have a BMI of 16 – 23, at risk for becoming overweight if they have a BMI of 23 – 26, and overweight if they have a BMI > 26; 15-year old adolescent girls are: underweight if they have a BMI < 17, healthy weight if they have a BMI of 17 – 24, at risk for becoming overweight if they have a BMI of 24 – 27, and overweight if they have a BMI > 27 (CDC, *Overweight and Obesity*, 2006). According to the descriptive statistics presented in Table 4.13, on average, the students in the final sample were of a healthy weight.

Indicators of Health		**Weight (lbs)**				**BMI**			
		Min	**Max**	**SD**	**Mean**	**Min**	**Max**	**SD**	**Mean**
Jackson HS (n = 33)	Male	118.00	270.00	37.02	156.29	17.94	36.61	4.75	22.44
	Female	90.00	215.00	35.56	135.00	17.58	33.67	4.78	23.19
	Sample	**90.00**	**270.00**	**37.23**	**145.64**	**17.58**	**36.61**	**4.69**	**22.81**
Oak Hill HS (n = 25)	Male	130.00	205.00	37.90	164.33	19.76	29.41	4.88	24.17
	Female	97.00	245.00	38.60	153.05	17.18	39.54	5.88	25.92
	Sample	**97.00**	**245.00**	**37.85**	**154.52**	**17.18**	**39.54**	**5.69**	**25.69**
Shenandoah HS (n = 80)	Male	101.00	267.00	39.99	159.26	13.85	37.23	4.83	23.74
	Female	86.00	180.00	21.56	129.05	15.73	47.90	4.92	22.24
	Sample	**86.00**	**267.00**	**31.45**	**139.93**	**13.85**	**47.90**	**4.91**	**22.77**
Trivalley HS (n = 73)	Male	97.00	200.00	22.85	143.90	16.69	28.89	3.01	21.15
	Female	94.00	190.00	19.32	124.88	16.98	33.65	3.24	21.02
	Sample	**94.00**	**200.00**	**22.74**	**132.76**	**16.69**	**30.89**	**3.06**	**21.12**

Table 4.13: Descriptive Statistics for Weight and BMI, Final Sample at Pretest

The distribution of students as underweight, healthy weight, at risk for becoming overweight, and overweight according to BMI for each school are presented in Table 4.14. Examination of this table indicates a high prevalence of students who were at risk of becoming overweight or who were overweight. At Jackson High School, 35.5% of the males and 35.5% of the females reported being either at risk of becoming overweight or overweight. At Oak Hill High School, 60% of the males and 66.6% of the females reported being either at risk of becoming overweight or overweight. At Shenandoah High School, 38% of the males and 21% of the females reported being either at risk of becoming overweight or overweight. At Trivalley High School, 23.8% of the males and 9.6% of the females reported being either at risk of becoming overweight or overweight. These rates are higher than national averages. Nationally, 15.5% of high school females and 15.8% of high school males are at risk of being overweight; 10% of high school females and 16% of high school males are overweight (CDC, *YRBS*, 2006).

BMI Categorizations		**Underweight** Male: <16 Female: <17	**Healthy Weight:** Male: 16-23 Female: 17-24	**At-Risk for Overweight** Male: 23-26 Female: 24-27	**Overweight** Male: >26 Female: >27
Jackson HS (n = 33)	Male	0	9 (63.9%)	4 (28.4%)	1 (7.1%)
	Female	0	9 (63.9%)	3 (21.3%)	2 (14.2%)
Oak Hill HS (n = 25)	Male	0	8 (40.0%)	6 (30.0%)	6 (30.0%)
	Female	0	1 (33.3%0	1 (33.3%)	1 (33.3%)
Shenandoah HS (n = 80)	Male	1 (3.8%)	16 (61.5%)	2 (7.6%)	8 (30.4%)
	Female	3 (6.3%)	33 (72.7%)	6 (14.7%)	6 (6.3%)
Trivalley HS (n = 73)	Male	0	22 (75.9%)	5 (17.0%)	2 (6.8%)
	Female	1 (2.4%)	37 (90.3%)	1 (2.4%)	3 (7.2%)

Table 4.14: Frequency Distributions for BMI Categorizations, Final Sample at Pretest

<u>Physical Activity Descriptive Statistics</u>

The physical activity data for the final sample was examined at pretest and post-test to determine the distributions and central tendencies of the data and to guide the development of the regression models. Data for the frequency of moderate and vigorous physical activity was examined separately. The data was first analyzed to determine whether pretest differences existed between the schools. Data was then analyzed to determine whether there were differences in the pretest or the post-test data at each school based on gender and athletic status. Such differences would warrant adding gender and/or athletic status to the regression models predicting physical activity.

Descriptive statistics for the frequency of moderate physical activity for the final sample, both at pretest and at post-test, are presented in Table 4.15. There were no pretest differences in the days of moderate physical activity between the schools (F (3, 207) = 1.88, p = 0.13). By looking at the data, it appears that the frequency of moderate physical activity decreased over the course of 9 weeks at Jackson High School, particularly among females (from 0.89 days to 0.37 days) and non-athletes (from 0.61 – 0.23 days). Overall, the frequency of moderate physical activity stayed the same at Oak Hill High School; it appears to have decreased among males (0.67 – 0.33 days), increased among athletes (1.67 – 1.93 days) and decreased among non-athletes (2.08 – 1.80 days). The frequency of moderate physical activity appears to have increased among students at Shenandoah High School, particularly among males (1.28 – 1.64 days) and non-athletes (1.06 – 1.48 days). Overall, moderate physical activity appeared to have stayed the same at Trivalley High School; it appears to have increased among males (1.24 – 1.86 days), decreased among females (0.90 – 0.53 days), and decreased among non-athletes (0.66 – 0.41 days).

Moderate Physical Activity		Pretest				Post-Test			
		Min	Max	SD	Mean	Min	Max	SD	Mean
Jackson HS (Comparison) N = 33	Male	0.00	4.00	1.77	1.53	0.00	5.00	2.09	1.71
	Female	0.00	5.00	1.68	0.89	0.00	5.00	1.21	0.37
	Athletes	0.00	5.00	1.88	1.55	0.00	5.00	2.04	1.40
	Non-Athletes	0.00	4.00	1.33	0.61	0.00	3.00	0.83	0.23
	Sample	**0.00**	**5.00**	**1.72**	**1.18**	**0.00**	**5.00**	**1.75**	**0.94**
Oak Hill HS (Intervention) N = 25	Male	0.00	2.00	1.15	0.67	0.00	1.00	0.58	0.33
	Female	0.00	5.00	1.62	2.05	0.00	5.00	1.69	2.09
	Athletes	0.00	5.00	1.72	1.67	0.00	5.00	1.67	1.93
	Non-Athletes	0.00	5.00	1.55	2.08	0.00	5.00	1.81	1.80
	Sample	**0.00**	**5.00**	**1.62**	**1.88**	**0.00**	**5.00**	**1.69**	**1.88**
Shenandoah HS (Intervention) N = 80	Male	0.00	5.00	1.69	1.28	0.00	5.00	2.16	1.64
	Female	0.00	5.00	1.60	1.35	0.00	5.00	1.81	1.40
	Athletes	0.00	5.00	1.72	1.49	0.00	5.00	2.04	1.49
	Non-Athletes	0.00	5.00	1.44	1.06	0.00	5.00	1.77	1.48
	Sample	**0.00**	**5.00**	**1.62**	**1.33**	**0.00**	**5.00**	**1.93**	**1.49**
Trivalley HS (Intervention) N = 73	Male	0.00	5.00	1.55	1.24	0.00	5.00	1.58	1.86
	Female	0.00	5.00	1.24	0.90	0.00	4.00	0.92	0.53
	Athletes	0.00	5.00	1.53	1.34	0.00	5.00	1.48	1.31
	Non-Athletes	0.00	4.00	1.04	0.66	0.00	3.00	0.80	0.41
	Sample	**0.00**	**5.00**	**1.37**	**1.04**	**0.00**	**5.00**	**1.37**	**1.04**

Table 4.15: Descriptive Statistics for Days of Moderate Physical Activity

Gender should be included in the regression models predicting moderate physical activity, as there were gender differences in moderate physical activity at post-test. There were no gender differences in the frequency of moderate physical activity at pretest at any of the participating schools: Jackson ($t(31) = 1.07$, $p = 0.29$); Oak Hill ($t(23) = -1.42$, $p = 0.17$); Shenandoah ($t(78) = -0.20$, $p = 0.84$); Trivalley ($t(71) = 1.02$, $p = 0.31$). There were gender differences in the frequency of moderate physical activity at post-test at Jackson High School ($t(31) = 2.16$, $p<0.05$) and at Trivalley High School ($t(38.52) = 4.03$, $p <0.01$). There were no gender differences in the frequency of moderate physical activity at post-test at Oak Hill High School ($t(23) = -1.76$, $p = 0.09$) or at Shenandoah High School ($t(78) = 0.53$, $p = 0.60$).

Based on an analysis of athletic status at pretest and post-test, athletic status should be included in the regression models predicting moderate physical activity for Jackson High School and Trivalley High School. Athletes at Trivalley High School reported participating in significantly more days of moderate physical activity at pretest than non-athletes ($t(71) = -2.28$, $p <0.05$). There were no pretest differences in moderate physical activity by athletic status at the remaining three schools: Jackson ($t(31) = -1.68$, $p = 0.10$); Oak Hill ($t(23) = 0.63$, $p = 0.54$); Shenandoah ($t(78) = -1.15$, $p = 0.26$). There were post-test differences in the frequency of moderate physical activity by athletic status at Jackson High School and at Trivalley High School. Athletes at Jackson High School reported participating in more days of moderate physical activity at post-test than non-athletes ($t(27.17) = -2.29$, $p <0.05$). Athletes at Trivalley High School reported participating in more days of moderate physical activity than non-athletes at post-test ($t(67.30) = -3.38$, $p <0.01$). The post-test frequency of moderate physical activity between athletes and non-athletes was the same at Oak Hill High School ($t(23) = -0.19$, $p = 0.85$) and at Shenandoah High School ($t(78) = -0.01$, $p = 0.99$).

The frequency distributions for rates of moderate physical activity at pretest and at post-test are presented in Table 4.16. Rates of physical activity among students in this sample are low. Based on the descriptive statistics, no subgroup reported more than 2 days of moderate physical activity at either pretest or post-test. Based on the frequency distributions, the majority of the sample participated in no moderate physical activity during the previous 5 days. At Jackson High School 60.6% of the sample at pretest and 72.7% of the sample at post-test reported no physical activity. At Oak Hill High School, 24.0% of the sample at pretest and 28.0% of the sample at post-test reported no physical activity. At Shenandoah High School, 47.5% of the sample at pretest and 55.0% of the sample at post-test reported no physical activity. At Trivalley High School, 49.3% of the sample at pretest and post-test reported no physical activity. However, when examining the frequency distributions, the number of students who reported participating in at least 30 minutes of moderate physical activity on 5 days in the previous week also increased at three of the participating schools: Jackson High School (from 3.0 – 12.1%), Oak Hill High School (from 8.0 – 12.0%), and Shenandoah High School (from 8.8 – 13.8%).

Moderate Physical Activity		Pretest						Post-Test					
		0 Days	1 Days	2 Days	3 Days	4 Days	5 Days	0 Days	1 Day	2 Days	3 Days	4 Days	5 Days
Jackson HS (Comparison) N = 33	Male	46.7%	13.3%	6.7%	6.7%	26.7%	0	50.0%	7.1%	7.1%	14.3%	0	21.4%
	Female	72.2%	5.6%	5.6%	0	11.1%	5.6%	89.5%	0	5.3%	0	0	5.3%
	Athletes	50.0%	10.0%	10.0%	0	25.0%	5.0%	60.0%	5.0%	10.0%	5.0%	0	20.0%
	Non-Athletes	76.9%	7.7%	0	7.7%	7.7%	0	92.3%	0	0	7.3%	0	0
	Sample	**60.6%**	**9.1%**	**6.1%**	**3.0%**	**18.2%**	**3.0%**	**72.7%**	**3.0%**	**6.1%**	**6.1%**	**0**	**12.1%**
Oak Hill HS (Intervention) N = 25	Male	66.7%	0	33.3%	0	0	0	66.7%	33.3%	0	0	0	0
	Female	18.2%	27.3%	18.2%	13.6%	13.6%	9.1%	22.7%	13.6%	31.8%	9.1%	9.1%	13.6%
	Athletes	33.3%	25.0%	8.3%	16.7%	8.3%	8.3%	26.7%	6.7%	46.7%	0	6.7%	13.3%
	Non-Athletes	15.4%	23.1%	30.8%	7.7%	15.4%	7.7%	30.0%	30.0%	0	20.0%	20.0%	10.0%
	Sample	**24.0%**	**24.0%**	**20.0%**	**12.0%**	**12.0%**	**8.0%**	**28.0%**	**16.0%**	**28.0%**	**8.0%**	**8.0%**	**12.0%**
Shenandoah HS (Intervention) N = 80	Male	51.7%	13.8%	10.3%	13.8%	0	10.3%	57.1%	3.6%	7.1%	7.1%	0	25.0%
	Female	45.1%	15.7%	17.6%	9.8%	3.9%	7.8%	53.8%	9.6%	7.7%	7.7%	13.5%	7.7%
	Athletes	44.9%	14.3%	2.2%	14.3%	4.1%	10.2%	57.1%	8.2%	6.1%	6.1%	2.0%	24.0%
	Non-Athletes	51.6%	16.1%	19.4%	6.5%	0	6.5%	51.6%	6.5%	9.7%	9.7%	19.4%	3.2%
	Sample	**47.5%**	**15.0%**	**15.0%**	**11.3%**	**2.5%**	**8.8%**	**55.0%**	**7.5%**	**7.5%**	**7.5%**	**8.8%**	**13.8%**
Trivalley HS (Intervention) N = 73	Male	44.8%	20.7%	20.7%	0	6.9%	6.9%	21.4%	26.8%	17.9%	17.9%	3.6%	10.7%
	Female	52.3%	22.7%	13.6%	6.8%	2.3%	2.3%	66.7%	20.0%	8.9%	2.2%	2.2%	0
	Athletes	39.0%	24.0%	19.5%	4.9%	4.9%	7.3%	39.2%	25.5%	15.7%	9.8%	3.9%	5.9%
	Non-Athletes	62.5%	18.8%	2.5%	3.1%	3.1%	0	72.7%	18.2%	4.5%	4.5%	0	0
	Sample	**49.3%**	**21.9%**	**16.4%**	**4.1%**	**4.1%**	**4.1%**	**49.3%**	**23.3%**	**12.3%**	**8.2%**	**2.7%**	**4.1%**

Table 4.16: Frequency Distribution for Days of Moderate Physical Activity

Descriptive statistics for the frequency of vigorous physical activity are presented in Table 4.17. There were no pretest differences in the frequency of vigorous physical activity by school at pretest (F (3, 207) = 0.19, p = 0.90). By looking at the data, the frequency of vigorous physical activity appears to have stayed the same overall at Jackson High School (0.27 – 0.30 days); it increased among athletes (from 0.40 – 0.50 days) and decreased among all other sub-groups. The frequency of vigorous physical activity appears to have decreased among students in each of the intervention schools: from 0.75 – 0.24 days among students at Oak Hill, from 0.20 – 0.15 days among students at Shenandoah, and from 0.27 – 0.05 days among students at Trivalley High School. Overall, the rates of vigorous physical activity appear to be low, with no subgroup reporting an average of more than 1.00 day of vigorous physical activity in the previous 5 days. Several groups reported no vigorous physical activity, including: non-athletes at Trivalley at pretest and post-test, non-athletes at Jackson at post-test, and non-athletes at post-test at Oak Hill.

Vigorous Physical Activity		Pretest				Post-Test			
		Min	Max	SD	Mean	Min	Max	SD	Mean
Jackson HS (Comparison) N = 33	Male	0.00	3.00	0.80	0.27	0.00	5.00	1.40	0.50
	Female	0.00	5.00	1.19	0.28	0.00	3.00	0.69	0.16
	Athletes	0.00	5.00	1.27	0.40	0.00	5.00	1.32	0.50
	Non-Athletes	0.00	1.00	0.28	0.08	0.00	0.00	0.00	0.00
	Sample	**0.00**	**5.00**	**1.00**	**0.27**	**0.00**	**5.00**	**1.05**	**0.30**
Oak Hill HS (Intervention) N = 25	Male	0.00	1.00	0.58	0.33	0.00	0.00	0.00	0.00
	Female	0.00	3.00	0.78	0.32	0.00	4.00	0.94	0.27
	Athletes	0.00	3.00	1.00	0.50	0.00	4.00	1.12	0.40
	Non-Athletes	0.00	1.00	0.38	0.15	0.00	0.00	0.00	0.00
	Sample	**0.00**	**3.00**	**0.32**	**0.75**	**0.00**	**4.00**	**0.88**	**0.24**
Shenandoah HS (Intervention) N = 80	Male	0.00	2.00	0.44	0.13	0.00	1.00	0.26	0.07
	Female	0.00	5.00	0.86	0.24	0.00	5.00	0.74	0.19
	Athletes	0.00	2.00	0.37	0.10	0.00	1.00	0.24	0.06
	Non-Athletes	0.00	5.00	1.08	0.35	0.00	5.00	0.94	0.29
	Sample	**0.00**	**5.00**	**0.74**	**0.20**	**0.00**	**5.00**	**0.62**	**0.15**
Trivalley HS (Intervention) N = 73	Male	0.00	4.00	0.98	0.41	0.00	1.00	0.26	0.07
	Female	0.00	4.00	0.66	0.18	0.00	1.00	0.21	0.04
	Athletes	0.00	4.00	1.03	0.49	0.00	1.00	0.27	0.08
	Non-Athletes	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sample	**0.00**	**4.00**	**0.80**	**0.27**	**0.00**	**1.00**	**0.23**	**0.05**

Table 4.17: Descriptive Statistics for Days of Vigorous Physical Activity

Based on the analysis of gender at pretest and post-test, gender should not be included in the regression models predicting the frequency of vigorous physical activity. There were no pretest gender differences in the days of vigorous physical activity at any of the participating schools: Jackson High School $t(31) = -0.03$, $p = 0.98$; Oak Hill High School $t(23) = 0.03$, $p = 0.98$, Shenandoah High School $t(78) = -0.57$, $p = 0.57$. Trivalley High School $t(44.41) = 1.12$, $p = 0.27$. There were no post-test gender differences in the days of vigorous physical activity at any of the participating schools: Jackson High School $t(31) = 0.93$, $p = 0.36$; Oak Hill High School $t(23) = -0.50$, $p = 0.63$; Shenandoah High School $t(78) = -0.83$, $p = 0.41$; Trivalley High School $t(71) = 0.49$, $p = 0.63$.

Based on the analysis of athletic status at pretest and post-test, athletic status should be included in the regression models predicting the frequency of vigorous physical activity. Athletes at Trivalley High School reported participating in more vigorous physical activity than non-athletes at pretest ($t(40) = -3.04$, $p < 0.01$) and at post-test ($t(50) = -2.06$, $p < 0.05$); it is important to note that non-athletes from Trivalley High School reported participating in no days of vigorous physical activity at both pretest and post-test. There were no pretest differences by athletic status in the remaining high schools for vigorous physical activity: Jackson $t(31) = -0.90$, $p = 0.38$; Oak Hill $t(13.84) = -1.13$, $p = 0.28$; Shenandoah $t(34.43) = 1.26$, $p = 0.22$). There were no post-test differences by athletic status in the remaining high schools for vigorous physical activity: Jackson $t(19) = -1.70$, $p = 0.11$; Oak Hill $t(14) = -1.38$, $p = 0.19$; Shenandoah $t(32.55) = 1.33$, $p = 0.19$.

The frequency distributions for the rates of vigorous physical activity are presented in Table 4.18. Rates of vigorous physical activity among students in the final sample were very low. At Jackson High School, 90.9% of students report no vigorous physical activity at pretest and at post-test. At Oak Hill High School, 80.0% of students report no vigorous physical activity at pretest and 92.0% of students report no vigorous physical activity at post-test. At Shenandoah High School 90.0% of the sample reported no vigorous physical activity at pretest and post-test. At Trivalley High School 84.9% of the sample at pretest and 94.5% of the sample at post-test reported no vigorous physical activity. When examining the frequency distributions, the number of students who reported participating in at least 30 minutes of vigorous physical activity on 3 or more days in the previous week stayed the same at Jackson High School, remained the same at Oak Hill High School (4%, although the 4% increased from 3 – 4 days), and decreased at both Shenandoah High School (from 2.6% - 1.3%) and Trivalley High School (from 4.1% - 0%). At Oak Hill High School and Trivalley High School, the decreases in the prevalence of students participating in 3 -5 days of vigorous physical activity occurred only among athletes; this may reflect an end of the spring athletic season.

Vigorous Physical Activity		Pretest						Post-Test					
		0 Days	1 Days	2 Days	3 Days	4 Days	5 Days	0 Days	1 Day	2 Days	3 Days	4 Days	5 Days
Jackson HS (Comparison) N = 33	Male	86.7%	6.7%	0	6.7%	0	0	85.7%	0	7.1%	0	0	7.1%
	Female	94.4%	0	0	0	0	5.6%	94.7%	0	0	5.3%	0	0
	Athletes	90.0%	0	0	5.0%	0	5.0%	85.0%	0	5.0%	5.0%	0	5.0%
	Non-Athletes	92.3%	7.7%	0	0	0	0	100%	0	0	0	0	0
	Sample	**90.9%**	**3.0%**	**0**	**3.0%**	**0**	**3.0%**	**90.9%**	**0**	**3.0%**	**3.0%**	**0**	**3.0%**
Oak Hill HS (Intervention) N = 25	Male	66.7%	33.3%	0	0	0	0	100%	0	0	0	0	0
	Female	81.8%	9.1%	4.5%	4.5%	0	0	90.9%	0	4.5%	0	4.5%	0
	Athletes	75.0%	8.3%	8.3%	8.3%	0	0	86.7%	0	6.7%	0	6.7%	0
	Non-Athletes	84.6%	15.4%	0	0	0	0	100%	0	0	0	0	0
	Sample	**80.0%**	**12.0%**	**4.0%**	**4.0%**	**0**	**0**	**92.0%**	**0**	**4.0%**	**0**	**4.0%**	**0**
Shenandoah HS (Intervention) N = 80	Male	89.7%	6.9%	3.4%	0	0	0	92.9%	7.1%	0	0	0	0
	Female	90.2%	3.9%	2.0%	2.0%	0	2.0%	88.5%	9.6%	0	0	0	1.9%
	Athletes	91.8%	6.1%	2.0%	0	0	0	93.9%	6.1%	0	0	0	0
	Non-Athletes	87.1%	3.2%	3.2%	3.2%	0	3.2%	83.9%	12.9%	0	0	0	3.2%
	Sample	**90.0%**	**5.0%**	**2.5%**	**1.3%**	**0**	**1.3%**	**90.0%**	**8.8%**	**0**	**0**	**0**	**1.3%**
Trivalley HS (Intervention) N = 73	Male	79.3%	10.3%	3.4%	3.4%	3.4%	0	92.9%	7.1%	0	0	0	0
	Female	88.6%	9.1%	0	0	2.3%	0	95.6%	4.4%	0	0	0	0
	Athletes	73.2%	17.1%	2.4%	2.4%	4.9%	0	92.2%	7.8%	0	0	0	0
	Non-Athletes	100%	0	0	0	0	0	100%	0	0	0	0	0
	Sample	**84.9%**	**9.6%**	**1.4%**	**1.4%**	**2.7%**	**0**	**94.5%**	**5.5%**	**0**	**0**	**0**	**0**

Table 4.18: Frequency Distribution for Days of Vigorous Physical Activity

Social Cognitive Theory Construct Descriptive Statistics

Descriptive statistics for each of the Social Cognitive Theory variables were computed at both pretest and post-test in order to examine the central tendencies and distributions of the variables. Each of the SCT variables was examined to determine whether there were pretest differences between the schools and whether there were gender differences or differences based on athletic status within the schools at pretest and at post-test.

Descriptive statistics for the SCT construct self-efficacy for overcoming barriers to physical activity are presented in Table 4.19. There were no pretest differences in self-efficacy between the participating schools (F (3, 207) = 1.05, p = 0.37). By examining the table, it appears that self-efficacy remained relatively stable over the course of the study. The scale included seven Likert-type questions, with six possible answers for each question; therefore the scores had the potential to range from 7 – 42. Examining the overall mean values at each school, scores at Jackson High School appear to have decreased by less than one point (27.48 – 26.67). Scores at Oak Hill High School appear to have increased by almost 3 points (from 30.76 – 33.64). Scores at Shenandoah High School appear to have increased by less than one point (from 29.11 – 30.93). Scores at Trivalley High School appear to have decreased by less than one point (from 29.26 – 28.64).

Examining the data in Table 4.19, it appears that where there were gender differences in self-efficacy scores, males scored higher than females. This was confirmed for Jackson High School at pretest (t (31) = 2.92, p <0.01) and at post-test (t (31) = 2.96, p <0.01). There were no pretest gender differences in self-efficacy for overcoming barriers to physical activity at the other schools (t_{OH} (23) = -0.36, p = 0.73; t_S (78) = 1.73, p = 0.09; t_{TV} (71) = -0.05, p = 0.96). There were no post-test gender differences in self-efficacy for overcoming barriers to physical activity at the other schools either (t_{OH} (23) = 0.18, p = 0.86; t_S (78) = 0.34, p = 0.74; t_{TV} (71) = 0.03, p = 0.98).

Examining the data in Table 4.19, it appears that there were difference in self-efficacy scores on the basis of athletic status as well. Overall, it appears that athletes scored higher on the self-efficacy for overcoming barriers to physical activity instrument than non-athletes. This difference was confirmed at Jackson High School at pretest (t (31) = -2.21, p <0.05) and at Trivalley High School at pretest (t (71) = -

.318, $p < 0.01$) and at post-test ($t(71) = -3.82$, $p < 0.01$). There were no pretest differences in self-efficacy on the basis of athletic status at Oak Hill High School ($t(23) = -0.34$, $p = 0.73$) or at Shenandoah High School ($t(78) = -1.62$, $p = 0.11$). There were no post-test differences in self-efficacy on the basis of athletic status at Jackson High School ($t(31) = -1.87$, $p = 0.07$), Oak Hill High School ($t(23) = -1.72$, $p = 0.10$), or Shenandoah High School ($t(78) = -1.18$, $p = 0.24$).

Self-Efficacy for Physical Activity		Pretest				Post-Test			
		Min	Max	SD	Mean	Min	Max	SD	Mean
Jackson HS (Comparison) N = 33	Male	23.00	42.00	7.00	31.87	18.00	42.00	8.60	32.29
	Female	7.00	40.00	8.51	23.83	7.00	39.00	9.89	22.53
	Athletes	7.00	42.00	9.24	30.05	7.00	42.00	9.95	29.30
	Non-Athletes	12.00	33.00	6.40	23.54	7.00	35.00	10.24	22.62
	Sample	**7.00**	**42.00**	**8.75**	**27.48**	**7.00**	**42.00**	**10.44**	**26.67**
Oak Hill HS (Intervention) N = 25	Male	24.00	35.00	5.51	29.67	27.00	40.00	6.66	34.33
	Female	17.00	39.00	5.71	30.91	18.00	42.00	7.22	33.55
	Athletes	24.00	38.00	5.00	31.17	23.00	42.00	5.91	35.53
	Non-Athletes	17.00	39.00	30.38	6.25	18.00	40.00	7.90	30.80
	Sample	**17.00**	**39.00**	**5.58**	**30.76**	**18.00**	**42.00**	**7.03**	**33.64**
Shenandoah HS (Intervention) N = 80	Male	16.00	41.00	6.93	30.83	14.00	40.00	5.86	31.21
	Female	7.00	41.00	6.58	28.14	17.00	42.00	5.52	30.77
	Athletes	17.00	41.00	5.99	30.08	17.00	41.00	5.18	31.51
	Non-Athletes	7.00	40.00	7.74	27.58	14.00	42.00	6.21	30.00
	Sample	**7.00**	**41.00**	**6.79**	**29.11**	**14.00**	**42.00**	**5.61**	**30.93**
Trivalley HS (Intervention) N = 73	Male	12.00	42.00	7.04	29.21	7.00	40.00	8.62	28.68
	Female	7.00	41.00	6.98	29.30	7.00	42.00	8.10	28.62
	Athletes	20.00	42.00	5.74	31.41	13.00	42.00	6.61	30.86
	Non-Athletes	7.00	41.00	7.47	26.50	7.00	41.00	9.46	23.50
	Sample	**7.00**	**42.00**	**6.96**	**29.26**	**7.00**	**42.00**	**8.24**	**28.64**

Table 4.19: Descriptive Statistics for Self-Efficacy to Overcome Barriers to Physical Activity

Descriptive statistics for the SCT construct self-regulation of physical activity are presented in Table 4.20. There were pretest differences in self-regulation between the participating schools ($F(3, 207) = 1.77$, $p < 0.01$). A Boneferroni post hoc analysis revealed that students at Shenandoah scores significantly lower than students at Oak Hill High School at pretest ($p < 0.05$). By examining the table, it appears that self-regulation scores increased over the course of the study, particularly within the intervention schools. The scale included 25 Likert-type questions, with six possible answers for each question; therefore the scores had the potential to range from 25 - 150. Examining the overall mean values at each school, scores at Jackson High School appear to have increased by less than one point (59.64 – 60.58). Scores at Oak Hill High School appear to have increased (from 71.92 – 90.68). Scores at Shenandoah High School appear to have increased (from 53.16 – 80.50). Scores at Trivalley High School appear to have increased (from 58.93 – 75.25).

Examining the data in Table 4.20, there were gender differences in self-regulation at Jackson High School and Oak Hill High School. Males at Jackson High School scored higher than females on the self-regulation for physical activity scale at pretest ($t\ (31) = 3.74$, $p < 0.01$) and at post-test ($t\ (31) = 3.91$, $p < 0.01$). Females at Oak Hill High School scored significantly higher than males on self-regulation at post-test ($t\ (21) = -4.93$, $p < 0.01$). There were no pretest gender differences in self-regulation at Oak Hill High School ($t\ (23) = -0.20$, $p = 0.85$), Shenandoah High School ($t\ (78) = 0.27$, $p = 0.79$), or Trivalley High School ($t\ (71) = -0.27$, $p = 0.79$). There were no post-test gender differences in self-regulation at Shenandoah High School ($9\ (78) = -1.61$, $p = 0.11$) or at Trivalley High School ($t\ (71) = -0.72$, $p = 0.47$).

Several differences in self-regulation of physical activity were found on the basis of athletic status. Athletes at Jackson High School scored higher on the self-regulation instrument than non-athletes at pretest ($t\ (31) = -3.47$, $p < 0.01$) and at post-test ($t\ (31) = 0.31$, $p < 0.01$). Athletes at Trivalley High School scored higher on self-regulation than non-athletes at pretest ($t\ (71) = -3.86$, $p < 0.01$) and at post-test ($t\ (78) = -3.94$, $p < 0.01$). Athletes also scored higher in self-regulation than non-athletes at Oak Hill High School on the post-test ($t\ (71) = -3.94$, $p < 0.01$). There were no differences in self-regulation at pretest on the basis of athletic status at Oak Hill High School ($t\ (23) = -1.56$, $p = 0.13$) or Shenandoah High School ($t\ (78) = -1.15$, $p = 0.25$). There were no differences in self-regulation at post-test on the basis of athletic status at Shenandoah High School ($t\ (78) = 0.88$, $p = 0.38$).

Self-Regulation of Physical Activity		Pretest				Post-Test			
		Min	Max	SD	Mean	Min	Max	SD	Mean
Jackson HS (Comparison) N = 33	Male	33.00	122.00	29.05	76.40	25.00	133.00	31.36	80.79
	Female	25.00	84.00	17.75	45.67	25.00	103.00	20.25	45.68
	Athletes	25.00	122.00	27.51	71.35	25.00	133.00	31.03	72.15
	Non-Athletes	25.00	80.00	17.19	41.61	25.00	96.00	20.43	42.77
	Sample	**25.00**	**122.00**	**29.89**	**59.64**	**25.00**	**133.00**	**30.67**	**60.58**
Oak Hill HS (Intervention) N = 25	Male	57.00	89.00	17.01	69.67	61.00	61.00	0.00	61.00
	Female	26.00	110.00	21.38	72.23	33.00	141.00	32.08	94.73
	Athletes	52.00	110.00	17.93	78.42	61.00	141.00	23.90	104.53
	Non-Athletes	26.00	100.00	21.77	65.92	33.00	129.00	32.36	69.90
	Sample	**26.00**	**110.00**	**20.61**	**71.92**	**33.00**	**141.00**	**32.02**	**90.68**
Shenandoah HS (Intervention) N = 80	Male	27.00	109.00	28.81	53.93	35.00	126.00	25.00	74.75
	Female	28.00	109.00	17.81	52.73	37.00	130.00	22.47	83.60
	Athletes	27.00	109.00	19.47	55.08	35.00	122.00	22.45	78.65
	Non-Athletes	28.00	102.00	17.65	50.13	37.00	130.00	25.45	83.42
	Sample	**27.00**	**109.00**	**18.83**	**53.16**	**35.00**	**130.00**	**23.61**	**80.50**
Trivalley HS (Intervention) N = 73	Male	25.00	110.00	23.90	58.07	25.00	134.00	31.31	72.21
	Female	25.00	119.00	21.61	59.50	25.00	136.00	26.31	77.13
	Athletes	34.00	119.00	21.58	67.12	34.00	136.00	26.25	83.04
	Non-Athletes	25.00	99.00	19.02	48.44	25.00	117.00	25.50	57.18
	Sample	**25.00**	**119.00**	**22.40**	**58.93**	**25.00**	**136.00**	**25.22**	**75.25**

Table 4.20: Descriptive Statistics for Self-Regulation of Physical Activity

Descriptive statistics for the SCT construct social support from family and friends for physical activity are presented in Table 4.21. There were no pretest differences in social support between the participating schools ($F (3, 207) = 1.77$, $p < = 0.15$). The scale included eight Likert-type questions, with six possible answers for each question; therefore the scores had the potential to range from 8 – 48. Examining the overall mean values at each school, scores at Jackson High School appear to have decreased by less than 2 points (from 22.21 – 19.94); scores particularly decreased among females and non-athletes. At Oak Hill High School, scores appear to have increased by almost 4 points (from 24.72 – 28.48); scores particularly increased among females (from 24.90 – 29.23). At Shenandoah High School, scores appear to have increased (from 21.51 – 26.66); this increase occurred among all subgroups. At Trivalley High School, scores appear to have increased by more than 2 points (from 24.59 – 26.71); there was no particular subgroup that appeared to change have a change in social support over the course of the study that exceeded other subgroups.

Examining the data in Table 4.20, there were gender differences in social support for physical activity at pretest and post-test. Females at Trivalley High School scored higher than males on social support for physical activity at pretest ($t(71) = -2.08$, $p < 0.05$). Males at Jackson High School scored higher than females on social support for physical activity at post-test ($t(31) = 3.13$, $p < 0.01$). There were no pretest gender differences in social support at Jackson High School ($t(31) = 1.78$, $p = 0.09$), Oak Hill High School ($t(23) = -0.25$, $p = 0.80$), or Shenandoah High School ($t(78) = -1.11$, $p = 0.27$). There were no post-test gender differences in social support for physical activity at Oak Hill High School ($t(23) = -0.89$, $p = 0.38$), Shenandoah High School ($t(78) = -1.39$, $p = 0.17$), or Trivalley High School ($t(71) = -1.41$, $p = 0.16$).

There were differences in social support for physical activity on the basis of athletic status. Athletes at Shenandoah High School scored higher on social support for physical activity than non-athletes at pretest ($t(78) = -3.08$, $p < 0.01$). Athletes at Trivalley High School scored higher than non-athletes on social support both at pretest ($t(71) = -4.29$, $p < 0.01$) and at post-test ($t(71) = -3.37$, $p < 0.01$). Athletes at Jackson High School scored higher than non-athletes on social support at post-test ($t(31) = -2.47$, $p < 0.05$). There were no pretest differences in social support based on athletic status at Jackson High School ($t(31) = -2.03$, $p = 0.05$) or at Oak Hill High School ($t(23) = 1.32$, $p = 0.20$). There were no post-test differences in social support based on athletic status at Oak Hill High School ($t(23) = -1.08$, $p = 0.29$) or at Shenandoah High School ($t(78) = -0.94$, $p = 0.35$).

Social Support for Physical Activity		Pretest				Post-Test			
		Min	Max	SD	Mean	Min	Max	SD	Mean
Jackson HS (Comparison) N = 33	Male	8.00	45.00	10.84	25.40	8.00	43.00	11.01	26.07
	Female	8.00	36.00	8.04	19.56	8.00	40.00	8.84	15.42
	Athletes	8.00	45.00	10.19	24.85	9.00	43.00	10.35	23.45
	Non-Athletes	8.00	33.00	7.61	18.15	8.00	40.00	9.75	14.54
	Sample	**8.00**	**45.00**	**9.72**	**22.21**	**8.00**	**43.00**	**10.90**	**19.94**
Oak Hill HS (Intervention) N = 25	Male	17.00	29.00	6.03	23.33	10.00	30.00	11.27	23.00
	Female	8.00	47.00	10.49	24.90	8.00	44.00	11.42	29.23
	Athletes	11.00	47.00	11.16	27.42	8.00	44.00	10.14	30.47
	Non-Athletes	8.00	39.00	8.43	22.23	8.00	43.00	12.94	25.50
	Sample	**8.00**	**47.00**	**9.98**	**24.72**	**8.00**	**44.00**	**11.35**	**28.48**
Shenandoah HS (Intervention) N = 80	Male	8.00	46.00	9.20	20.17	9.00	48.00	9.28	26.89
	Female	8.00	40.00	7.48	22.27	9.00	44.00	7.85	29.62
	Athletes	9.00	46.00	8.59	23.63	9.00	48.00	7.83	29.37
	Non-Athletes	8.00	35.00	6.15	18.16	12.00	47.00	9.31	27.55
	Sample	**8.00**	**46.00**	**18.83**	**21.51**	**9.00**	**48.00**	**8.42**	**26.66**
Trivalley HS (Intervention) N = 73	Male	8.00	45.00	10.42	21.69	8.00	45.00	11.37	24.39
	Female	11.00	45.00	9.18	26.50	8.00	48.00	10.89	28.16
	Athletes	12.00	45.00	8.61	28.54	8.00	48.00	10.74	29.41
	Non-Athletes	8.00	45.00	9.24	19.53	8.00	38.00	9.63	20.45
	Sample	**8.00**	**45.00**	**9.91**	**24.59**	**8.00**	**48.00**	**11.15**	**26.71**

Table 4.21: Descriptive Statistics for Social Support for Physical Activity

Descriptive statistics for the SCT construct outcome expectancy-values for physical activity are presented in Table 4.22. There were no pretest differences in outcome expectancy-values between the participating schools (F (3, 207) = 0.80, p < = 0.49). The scale included 23 pairs of Likert-type questions; each pair of questions included a statement about an exercise belief and a statement about the value held on that exercise belief. There were six possible answers for each question, and the scale was summed as the products of the belief-value pairs; therefore, the scores had the potential to range from 23 - 828. Examining the overall mean values at each school, scores on outcome-expectancy-values appear to have decreased over the 9-week study at Jackson High School (from 417.61 – 356.64); this decrease occurred among all subgroups. Scores appear to have decreased slightly among students at Oak Hill High School (from 479.44 – 432.44 overall); scores for females and athletes increased, while scores for males and non-athletes decreased. Outcome expectancy-value scores appear to have increased at Shenandoah High School (from

432.50 – 460.35); an increase occurred among all sub-groups. Overall, outcome expectancy-value scores increased at Trivalley High School (from 431.93 – 440.73); when examining the subgroups, it appears that males and females had an increase in outcome expectancy-value scores over the 9-week study, but athletes and non-athletes decreased in scores.

Examining the data in Table 4.22, there were no gender differences in outcome expectancy-values for physical activity at pretest or at post-test. At pretest, the t-test values comparing gender for each school were as follows: Jackson High School ($t(31) = 0.82$, $p = 0.42$), Oak Hill High School ($t(23) = -0.61$, $p = 0.55$, Shenandoah High School ($t(78) = -1.43$, $p = 0.16$), and Trivalley High School ($t(71) = -1.57$, $p = 0.16$). At post-test, the t-test values comparing gender for each school were as follows: Jackson High School ($t(31) = 1.70$, $p = 0.10$), Oak Hill High School ($t(23) = -1.36$, $p = 0.19$), Shenandoah High School ($t(78) = -1.68$, $p = 0.10$), and Trivalley High School ($t(71) = -1.23$, $p = 0.23$).

There were differences in outcome expectancy-values for physical activity on the basis of athletic status. Athletes at Trivalley High School scored higher on outcome expectancy-values for physical activity than non-athletes at pretest ($t(70.40) = -6.43$, $p < 0.01$) and at post-test ($t(60.41) = -5.38$, $p < 0.01$). Athletes at Jackson High School scored higher than non-athletes on outcome expectancy-values at post-test ($t(31) = -3.94$, $p < 0.01$). There were no pretest differences in outcome expectancy-value based on athletic status at Jackson High School ($t(31) = -1.54$, $p = 0.13$), Oak Hill High School ($t(23) = -0.21$, $p = 0.83$), or at Shenandoah High School ($t(78) = -1.63$, $p = 0.10$). There were no post-test differences in outcome expectancy-value based on athletic status at Oak Hill High School ($t(23) = -1.52$, $p = 0.14$) or at Shenandoah High School ($t(78) = -1.39$, $p = 0.17$).

Outcome Expectancy-Values		Pretest				Post-Test			
		Min	Max	SD	Mean	Min	Max	SD	Mean
Jackson HS (Comparison) N = 33	Male	174.00	684.00	180.67	445.00	42.00	662.00	178.08	418.21
	Female	88.00	596.00	168.80	394.78	60.00	586.00	179.46	311.26
	Athletes	88.00	684.00	177.80	454.30	42.00	662.00	159.09	441.00
	Non-Athletes	130.00	584.00	156.25	361.15	60.00	587.00	141.99	226.85
	Sample	**88.00**	**684.00**	**173.38**	**417.61**	**42.00**	**662.00**	**184.07**	**356.64**
Oak Hill HS (Intervention) N = 25	Male	270.00	690.00	223.01	436.67	279.00	481.00	115.21	348.00
	Female	289.00	672.00	117.05	485.27	93.00	792.00	172.63	489.41
	Athletes	289.00	672.00	127.56	485.25	279.00	792.00	159.01	513.93
	Non-Athletes	270.00	690.00	133.44	474.08	93.00	663.00	178.44	410.20
	Sample	**270.00**	**690.00**	**128.04**	**479.44**	**93.00**	**792.00**	**171.41**	**472.44**
Shenandoah HS (Intervention) N = 80	Male	103.00	744.00	154.06	400.24	207.00	822.00	169.21	419.79
	Female	162.00	711.00	150.51	450.84	222.00	780.00	152.10	482.19
	Athletes	103.00	744.00	165.85	454.47	207.00	822.00	163.47	480.06
	Non-Athletes	159.00	665.00	124.28	397.78	207.00	738.00	151.88	429.19
	Sample	**103.00**	**744.00**	**152.81**	**432.50**	**207.00**	**822.00**	**160.06**	**460.35**
Trivalley HS (Intervention) N = 73	Male	100.00	774.00	178.21	394.66	133.00	735.00	171.60	408.93
	Female	197.00	731.00	155.88	456.50	163.00	776.00	177.01	460.51
	Athletes	201.00	774.00	152.96	518.34	159.00	776.00	171.42	495.00
	Non-Athletes	100.00	591.00	108.76	321.22	133.00	535.00	109.53	314.91
	Sample	**100.00**	**774.00**	**166.71**	**431.93**	**133.00**	**776.00**	**175.58**	**440.73**

Table 4.22: Descriptive Statistics for Outcome Expectancy-Values for Physical Activity

Correlations between Variables

The final set of descriptive statistics for the variables included in the analysis were Pearson correlations between measures of physical activity, the SCT constructs, and measures included in the process evaluation. Pearson correlations allow the researcher to assess relationships between the variables that will be included in the regression models predicting physical activity. Bivariate correlation matrices were developed for each of the participating schools and are presented in Tables 4.23 – 4.26. As theory predicts, there is evidence of intercorrelations between the SCT constructs throughout the correlation matrices.

Examining Table 4.23, there were several significant correlations among students in the final sample at Jackson High School, particularly between moderate physical activity at post-test and the SCT variables. Only self-efficacy was correlated to moderate physical activity at pretest ($r = 0.46$, $p < 0.05$). No variable significantly correlated with vigorous physical activity at pretest. Each of the SCT constructs, both at pretest and at post-test, correlated significantly with moderate physical activity at post-test (self-efficacy at pretest, $r = 0.52$, $p < 0.01$; social support at pretest, $r = 0.57$, $p < 0.01$; self-regulation at pretest $r = 0.39$, $p < 0.05$; outcome expectancy-values at pretest, $r = 0.38$, $p<0.05$; self-efficacy at post-test, $r = 0.42$, $p<0.05$; social support at post-test, $r = 0.66$, $p<0.05$; self-regulation at post-test, $r = 0.49$, $p<0.05$, and outcome expectancy-values at post-test, $r = 0.44$, $p<0.05$). The results of the knowledge final exam correlated with moderate physical activity at post-test ($r = 0.37$, $p<0.05$); this was the only process evaluation measure to correlate with any physical activity variable.

Examining Table 4.24, the only SCT variable to correlate with physical activity among students in the final sample at Oak Hill High School was self-regulation. Self-regulation correlated with moderate physical activity ($r = 0.42$, p,0.05) and with vigorous physical activity ($r = 0.41$, $p<0.05$) at post-test. None of the process evaluation variables correlated with physical activity at any point.

Examining Table 4.25, the only variables to correlate with physical activity among students at Shenandoah High School were other physical activity variables. No SCT variable significantly correlated with physical activity at pretest or post-test. No process evaluation variable significantly correlated with physical activity at pretest or post-test. Vigorous physical activity at pretest correlated with both moderate physical activity at post-test ($r = 0.23$, $p<0.05$) and with vigorous physical activity at post-test ($r = 0.80$, $p<0.05$). Moderate and vigorous physical activity at post-test correlated with each other ($r = 0.30$, $p<0.01$).

Examining Table 4.26, there were several significant correlations among students in the final sample at Trivalley High School, particularly between moderate physical activity and the SCT variables. Moderate physical activity at pretest significantly correlated with self-efficacy at pretest ($r = 0.29$, $p<0.05$), self-regulation at pretest ($r = 0.28$, $p<0.05$), and outcome expectancy-values at pretest ($r = 0.24$, $p<0.05$). Scores on the final exam knowledge test correlated with pretest vigorous physical activity ($r = 0.24$, $p<0.05$), and the rate of homework completions significantly correlated with moderate physical activity at pretest ($r = 0.24$, $p<0.05$); this means that students who were physically active at pretest were more likely to complete the intervention assignments and showed a better understanding of the program concepts at the end of the intervention.. The frequency of moderate physical activity at post-test significantly correlated with self-regulation at pretest ($r = 0.24$, $p<0.05$), self-efficacy at post-test ($r = 0.32$, $p<0.05$), social support at post-test ($r = 0.26$, $p<0.05$), self-regulation at pretest ($r = 0.30$, $p<0.05$), and the rate of homework completions ($r = 0.27$, $p <0.05$). Vigorous physical activity at post-test significantly correlated with self-regulation at post-test ($r = 0.25$, $p<0.05$) and with the student attendance rate ($r = -0.37$, $p <0.05$); apparently, students who attended fewer of the intervention classes participated in more vigorous physical activity.

	SE Pre	SS Pre	SR Pre	OE Pre	Mod Pre	Vig Pre	SE Post	SS Post	SR Post	OE Post	FE	Att	Mod Post	Vig Post
SE Pre	1.00													
SS Pre	0.56**	1.00												
SR Pre	0.66**	0.64**	1.00											
OE Pre	0.70**	0.43*	0.56**	1.00										
Mod Pre	0.46**	0.27	0.12	0.29	1.00									
Vig Pre	0.29	0.27	0.19	0.24	0.53*	1.00								
SE Post	0.78**	0.31	0.49*	0.54**	0.42*	0.29	1.00							
SS Post	0.66**	0.61**	0.63**	0.51**	0.39*	0.40*	0.59**	1.00						
SR Post	0.59**	0.55**	0.70**	0.46**	0.33	0.33	0.55**	0.64**	1.00					
OE Post	0.67**	0.43*	0.61**	0.68**	0.30	0.36*	0.64**	0.63**	0.68**	1.00				
FE	0.34*	0.23	0.29	0.11	0.16	0.12	0.30	0.42*	0.05	0.26	1.00			
Att	0.41*	0.33	0.24	0.26	0.19	0.17	0.36*	0.28	0.31	0.35*	0.12	1.00		
Mod Post	0.52**	0.57**	0.39*	0.38*	0.70**	0.61**	0.42*	0.66**	0.49**	0.44*	0.37*	0.22	1.00	
Vig Post	0.32	0.09	0.09	0.26	0.54**	0.81**	0.32	0.30	0.27	0.32	0.25	0.15	0.56**	1.00

SE =self-efficacy, SS =social support, SR =self-regulation, OE =outcome expectancy, FE =final exam (knowledge), HW =homework, Att = Attendance
Note: n = 33, *p<0.05, **p<0.01

Table 4.23: Bivariate Correlation Matrix for Jackson High School

	SE Pre	SS Pre	SR Pre	OE Pre	Mod Pre	Vig Pre	SE Post	SS Post	SR Post	OE Post	FE	HW	Att	Mod Post	Vig Post
SE Pre	1.00														
SS Pre	0.39	1.00													
SR Pre	0.75**	0.65**	1.00												
OE Pre	0.21	0.41*	0.32	1.00											
Mod Pre	0.29	0.10	0.32	0.10	1.00										
Vig Pre	0.16	0.34	0.29	0.29	0.10	1.00									
SE Post	0.45*	0.32	0.53**	0.10	0.35	0.28	1.00								
SS Post	0.14	0.35	0.34	0.11	0.39	0.33	0.78**	1.00							
SR Post	0.29	0.27	0.43*	0.03	0.52**	0.09	0.73**	0.76**	1.00						
OE Post	0.19	0.22	0.26	0.61**	0.30	0.27	0.45*	0.54**	0.56**	1.00					
FE	0.09	-0.38	-0.11	0.10	0.02	-0.24	-0.01	0.03	-0.07	0.16	1.00				
Att	0.03	0.09	0.26	0.18	0.05	-0.08	0.16	0.06	0.09	0.10	-0.13	1.00			
HW	0.09	0.17	0.21	0.46*	0.22	0.01	-0.07	0.07	0.24	0.41*	-0.02	0.17	1.00		
Mod Post	0.25	-0.02	0.20	-0.12	0.48*	0.20	0.30	0.38	0.42*	0.09	0.13	0.08	0.08	1.00	
Vig Post	0.03	0.07	0.07	0.09	0.43	-0.12	0.34	0.25	0.41*	0.17	-0.25	0.03	0.16	0.24	1.00

SE =self-efficacy, SS =social support, SR =self-regulation, OE =outcome expectancy, FE =final exam (knowledge), HW =homework, Att =Attendance
Note: n = 25, *p<0.05, **p<0.01

Table 4.24: Bivariate Correlation Matrix for Oak Hill High School

	SE Pre	SS Pre	SR Pre	OE Pre	Mod Pre	Vig Pre	SE Post	SS Post	SR Post	OE Post	FE	Att	HW	Mod Post	Vig Post
SE Pre	1.00														
SS Pre	0.16	1.00													
SR Pre	0.46**	0.59**	1.00												
OE Pre	0.39**	0.41**	0.56**	1.00											
Mod Pre	0.17	0.14	0.10	0.06	1.00										
Vig Pre	0.16	-0.07	0.14	0.20	0.07	1.00									
SE Post	0.41**	0.11	0.17	0.15	0.25*	0.22	1.00								
SS Post	0.08	0.57**	0.32**	0.23*	0.04	-0.17	0.33**	1.00							
SR Post	0.13	0.27*	0.26*	0.08	0.04	0.11	0.34**	0.54**	1.00						
OE Post	0.18	0.24*	0.26*	0.58**	0.18	0.18	0.29*	0.32**	0.32**	1.00					
FE	0.02	-0.08	-0.10	-0.01	<0.01	0.10	0.17	-0.06	-0.01	0.08	1.00				
Att	0.06	-0.03	0.11	0.11	0.12	0.10	-0.05	-0.12	-0.08	0.10	-0.10	1.00			
HW	0.02	0.22	0.13	-0.02	-0.04	0.02	0.01	0.21	0.16	-0.05	<0.01	-0.10	1.00		
Mod Post	0.12	-0.11	-0.10	-0.12	0.14	0.32**	0.20	-0.04	0.06	-0.12	0.17	0.10	0.09	1.00	
Vig Post	0.04	-0.08	0.06	0.15	-0.04	0.80**	0.16	-0.12	0.17	0.21	0.13	0.11	0.14	0.30**	1.00

SE =self-efficacy, SS =social support, SR =self-regulation, OE =outcome expectancy, FE =final exam (knowledge), HW =homework, Att =Attendance
Note: n =80,*p<0.05, **p<0.01

Table 4.25: Bivariate Correlation Matrix for Shenandoah High School

	SE Pre	SS Pre	SR Pre	OE Pre	Mod Pre	Vig Pre	SE Post	SS Post	SR Post	OE Post	FE	Att	HW	Mod Post	Vig Post
SE Pre	1.00														
SS Pre	0.56**	1.00													
SR Pre	0.52**	0.53**	1.00												
OE Pre	0.57**	0.68**	0.60**	1.00											
Mod Pre	0.29*	0.21	0.29*	0.24*	1.00										
Vig Pre	0.13	-0.10	0.14	0.21	0.12	1.00									
SE Post	0.63**	0.37**	0.47**	0.53**	0.27*	0.12	1.00								
SS Post	0.46**	0.53**	0.45**	0.64**	0.23	0.14	0.65**	1.00							
SR Post	0.43**	0.49**	0.48**	0.55**	0.35**	0.13	0.62**	0.77**	1.00						
OE Post	0.46**	0.55**	0.49**	0.78**	0.19	0.24*	0.57*	0.66**	0.65**	1.00					
FE	0.02	0.02	0.13	0.24*	-0.03	0.24*	0.28*	0.10	0.19	0.21	1.00				
Att	-0.10	-0.18	-0.08	0.06	-0.12	-0.04	-0.02	0.04	-0.01	0.06	0.13	1.00			
HW	0.17	0.06	0.13	0.20	0.43**	0.11	0.26*	0.29*	0.33**	0.29*	-0.04	-0.06	1.00		
Mod Post	0.20	0.13	0.24*	0.18	0.45**	0.09	0.32*	0.26*	0.30*	0.18	0.11	-0.07	0.27*	1.00	
Vig Post	0.03	-0.02	<0.01	-0.02	0.21	0.07	0.12	0.04	0.25*	0.04	0.08	-0.37**	0.17	0.13	1.00

SE =self-efficacy, SS =social support, SR =self-regulation, OE =outcome expectancy, FE =final exam (knowledge), HW =homework, Att =Attendance
Note: n = 73,*p<0.05, **p<0.01

Table 4.26: Bivariate Correlation Matrix for Trivalley High School

Process Evaluation

A former process evaluation for the *Plan for Exercise, Plan for Health* program was conducted and reported by Mowad (2006); because the results of a process evaluation are critical to the interpretation of the impact evaluation and the avoidance of Type III error, the results of the process evaluation will briefly be described here. The process evaluation measures that pertain to the results of the current study include measures of dose delivered, dose received, and program reach.

Dose delivered was examined through process evaluation forms completed by each teacher after the delivery of each lesson and through staff observations of two lessons. The process evaluation forms asked teachers to report the percent of lesson activities and assignments that were delivered as designed, modified or omitted. Results indicated that each teacher delivered over 88% of the lesson components as delivered; according to self-report measures, the teachers delivered the program with adequate fidelity (over 80% fidelity) (Mowad, 2006).

Differing results were found during the lesson observations, however. During the staff observations of the delivery of Lesson 3 (Goal Setting) and Lesson 8 (Exercise Intensity), it was noted that while the teachers were delivering each of the lesson components as they were written (with 100% fidelity), they were not adding instruction to the lessons. In order to deliver the lessons, each teacher read, verbatim, the student workbook to the students. No additional information was presented, no discussion was developed, and no additional examples on behalf of the teachers were added to the delivery of each lesson. The observers noted that: "the teachers did not seem prepared to deliver the lessons; they simply came into class, read the lesson to the students, and had the students follow while completing the lesson activities". Further, in the case when two teachers team taught the lessons (as was the case at Shenandoah High School and with two out of the three teachers at Trivalley High School), only one teacher delivered the lesson; the other teacher acted as a bystander and handled behavioral issues.

Dose received was evaluated through student homework completions and student attendance rates. Adequate dose received was defined as a student completing at least 80% of the program homework assignments. Because students at Jackson High School (the comparison school) were not assigned homework activities, the rate of homework completion could not be calculated for that school. No student included in the final sample at Oak Hill High School completed less than 40% of the homework assignments; 8% of the completed 40 – 60% of the homework assignments; 16% of the students completed 60 – 80% of the homework assignments; and, 76% of the students in the final sample completed 80% or more of the program homework assignments. 13.8% of the students included in the final sample at Shenandoah High School completed less than 40% of the homework assignments; 27.6% of the students completed 40 – 60% of the homework assignments; 26.3% of the students completed 60 – 80% of the homework assignments; and, 32.6% of the students in the final sample completed 80% or more of the program homework assignments. 9.6% of the students in the final sample at Trivalley High School completed less than 40% of the homework assignments; 20.5% of the students completed 40 – 60% of the homework assignments; 30.1% of the students completed 60 – 80% of the homework assignments; and, 39.8% of the students in the final sample completed 80% or more of the program homework assignments.

The second part of dose received was examined through student attendance rates; similar to homework completions, a student was considered to have received an adequate dose of the intervention if he or she attended at least 80% of the program lessons. No student included in the final sample at Jackson High School attended less than 40% or 40 – 60% of the classes during the intervention period; 3% of the students attended 60 – 80% of the classes during the intervention period; and, 97% of the students attended 80% or more of the classes during the intervention period. At Oak Hill High School, 4% of the students included in the final sample attended less than 40% of the intervention lessons; no student attended 40 – 60% of the intervention lessons; 32% of the students attended 60 – 80% of the intervention lessons; and, 64% of the student attended 80% or more of the intervention lessons. At Shenandoah High School, 1.3% of the students included in the final sample attended less than 40% of the intervention lessons; 1.3% of the students attended 40 – 60% of the intervention lessons; 8.8% of the students attended 60 – 80% of the intervention lessons; and, 88.8% of the student attended 80% or more of the intervention lessons. At Trivalley High School, no student included in the final sample attended less than 40% of the intervention lessons; 1.4% of the students attended 40 – 60% of the intervention lessons; 6.8% of the students attended 60 – 80% of the intervention lessons; and, 91.7% of the student attended 80% or more of the intervention lessons.

The final piece of the process evaluation that has particular relevance to the impact evaluation is the measure of program reach. Program reach was evaluated through a 9-item, multiple choice knowledge test; increased knowledge on the program concepts, as tested through a knowledge test, would indicate that the program reached the students, that students understood and retained the exercise concepts covered throughout the intervention. The knowledge test was administered at post-test, after the 9-week intervention. Descriptive statistics for the results of the knowledge test among students in the final sample is presented in Table 4.27. Information presented in the table is based on the percent of questions that students correctly answered on the post-test knowledge test. There were significant differences between the schools on the results of the knowledge test ($F(3, 207) = 5.22$, $p < 0.01$). Based on a post-hoc Bonferroni analysis, students at Jackson High School scored significantly lower on the knowledge test than students at Oak Hill High School ($p < 0.01$), Shenandoah High School ($p < 0.01$), and Trivalley High School ($p < 0.05$). It should be noted that Jackson High School was the comparison school and therefore students at Jackson did not receive the intervention.

School	Min	Max	SD	Mean
Jackson HS (Comparison) N = 33	0	72.73	19.29	34.16
Oak Hill HS (Intervention) N = 25	9.09	81.82	5.96	54.18
Shenandoah HS (Intervention) N = 80	0	100	22.46	48.64
Trivalley HS (Intervention) N = 73	9.09	81.82	19.95	46.08

Table 4.27: Descriptive Statistics for the Post-Test Knowledge Test, Final Sample

The frequency distributions for the results of the knowledge test are presented in Table 4.28. The first column represents the percent of students in the final sample at each school who answered less than 20% of the questions on the knowledge test correct. The second column represents the percent of students in the final sample at each school who scored 20 – 40% of the questions correct; the third column represents the percent of students who scored 40 – 60% correct; the fourth column represents the percent of students who scored 60 – 80% correct, and the fifth column represents the percent of students who answered more than 80% of the questions correct. There were no students at Jackson High School, the comparison school, who answered more than 80% of the questions correct, while 5.5 – 13.8% of the students in the intervention schools got at least 80% of the questions on the knowledge test correct. When examining the number of students who scored at least 60% on the knowledge test, this included 9.1% of the students at Jackson High School, 44.0% of the students at Oak Hill High School, 30.1% of the students at Shenandoah High School, and 28.8% of the students at Trivalley High School. This evidence is an indication that the program did, in fact, reach the students who received the intervention.

School	< 20%	20 – 40%	40 – 60%	60 – 80%	80-100%
Jackson HS (Comparison) N = 33	36.3%	30.3%	24.3%	9.1%	0
Oak Hill HS (Intervention) N = 25	8.0%	12.0%	36.0%	32.0%	12.0%
Shenandoah HS (Intervention) N = 80	8.8%	35.1%	26.3%	16.3%	13.8%
Trivalley HS (Intervention) N = 73	13.7%	30.2%	27.4%	23.3%	5.5%

Table 4.28: Frequency Distribution for the Knowledge Test Scores

Predicting Changes in Moderate Physical Activity

One primary research question and four secondary research questions were developed to assess whether the *Plan for Exercise, Plan for Health* intervention was able to account for a significant portion of the variance in changes in the frequency of adolescent moderate physical activity and whether the SCT constructs targeted by the intervention had a significant and independent contribution to predicting moderate physical activity at each of the participating schools. Multiple regression models were developed in order to assess the research questions. Hierarchical model entry was used to develop each of the regression models. The variables associated with student demographics (gender, athletic status), and the process evaluation (teacher, course, attendance rate, rate of homework completion, and percent correct on the post knowledge test) were entered into the models first in order to control for these variables and to describe the influence of rival hypotheses before examining the impact of the SCT constructs on behavior. The residualized change scores for the SCT variables were then entered into the equation. Each model was first evaluated for its ability to predict changes in the frequency of moderate physical activity, thereby answering the primary research questions. Each model was then evaluated to determine whether changes in the SCT constructs targeted independently contributed to the prediction of changes in moderate physical activity, after accounting for rival hypotheses.

An assumption check for multiple regression analysis was conducted for each multiple regression model developed. The assumption related to specification errors was not violated in any of the regression models due to the use of sound theory in the development of the study and the models. The assumption related to measurement error was not violated in any of the regression models due to the use of valid and reliable measures of the dependent and independent variables. The assumptions related to the residuals were examined by plotting the standardized residuals against the standardized predicted values, by plotting the standardized residuals against the values of the independent variables, and by plotting the residuals on a normal probability plot. The assumption of multicollinearity was examined with VIF and Tolerance statistics for each model.

Jackson High School

The following variables were entered into the regression model developed to predict changes in the frequency of moderate physical activity among students at Jackson High School: gender, athletic status, attendance, post knowledge test score, social support residualized score, outcome expectancy-values residualized score, self-efficacy residualized score, and self-regulation residualized score. The full model is presented in Figure 4.1. The rate of homework completion was not entered into this model because Jackson High School was the comparison school and the students did not have homework activities. The variable for course was not included in the model because only physical education classes participated in the study. The variable for teacher was not included in the model because only one teacher at Jackson High School participated in the study.

$$Y'_{\text{PA Residualized Change}} = a + b_1X_{\text{Gender}} + b_2X_{\text{Athletic Status}} + b_3X_{\text{Attendance Rate}} + b_4X_{\text{Knowledge}} + b_5X_{\text{Social Support Residual}} + b_6X_{\text{Outcome Expectancy-Values Residual}} + b_7X_{\text{Self-Efficacy Residual}} + b_8X_{\text{Self-Regulation Residual}}$$

Where:
Y' = the residual change score for the frequency of moderate and vigorous physical activity
a = the intercept, or value of Y when all X's are set to zero
b_k = the partial regression coefficient
X_k = the independent variables

Figure 4.1: Multiple Regression Model Predicting Moderate Physical Activity at Jackson High School

The full model predicting changes in the frequency of moderate physical activity at Jackson High School was significant ($F(8, 32) = 2.61$, $p < 0.05$). Results for the regression analysis are presented in Table 4.29. The full model predicted 28.7% of the variance in changes in the frequency of moderate physical activity (Adjusted $R^2 = 0.287$). The only variable to enter significantly into the model was the residualized change score for social support of physical activity ($b = 0.10$, $p = 0.05$). Changes in social support for physical activity independently predicted 19% of the variance in changes in the frequency of moderate physical activity (R^2change = 0.19).

Variables	**R^2**	**R^2change**	**b**	**t**	**p**
Gender	0.12	0.12	0.16	0.31	0.76
Athletic Status	0.17	0.05	0.24	0.56	0.58
Attendance	0.19	0.01	0.01	0.29	0.77
Knowledge	0.26	0.07	0.01	0.95	0.35
Social Support	0.45	0.19	0.10	2.05	0.05
Outcome Expectancy-Value	0.45	<0.01	-0.002	-0.48	0.64
Self-Efficacy	0.45	<0.01	0.01	0.16	0.88
Self-Regulation	0.47	0.01	0.02	0.76	0.45

Standard Error = 0.99
Adjusted $R^2 = 0.29$
For Model: $F = 2.61$; $p<0.05$

Table 4.29: Multiple Regression Model Predicting Changes in Moderate Physical Activity at Jackson High School (n = 33).

All of the assumptions for multiple regression analysis were met in the model predicting changes in moderate physical activity at Jackson High School. The plot of the standardized residuals against the standardized predicted values scattered about a line of x = 0, indicating homoscedasticity. The plots of the standardized residuals against each independent variable each fell about a line of x = 0, indicating that the residuals are not correlated with the independent variables. The plot of the residuals fell approximately on the line of the normal probability plot, indicating that the residuals were normally distributed. The Tolerance values for each of the independent variables were around 1.0, and the VIF values for each of the independent variables were 1.1 – 3.4; these values indicate the multicollinearity was not a problem.

Oak Hill High School

The following variables were entered into the regression model developed to predict changes in the frequency of moderate physical activity among students at Oak Hill High School: gender, athletic status, attendance, rate of homework completion, post knowledge test score, social support residualized score, outcome expectancy-values residualized score, self-efficacy residualized score, and self-regulation residualized score. The full model is presented in Figure 4.2. The variable for course was not included in the model because life skills classes participated in the study. The variable for teacher was not included in the model because only one teacher at Oak Hill High School participated in the study.

$$Y'_{\text{PA Residualized Change}} = a + b_1X_{\text{Gender}} + b_2X_{\text{Athletic Status}} + b_3X_{\text{Attendance Rate}} + b_4X_{\text{Homework Rate}} + b_5X_{\text{Knowledge}} + b_6X_{\text{Social Support Residual}} + b_7X_{\text{Outcome Expectancy-Values Residual}} + b_8X_{\text{Self-Efficacy Residual}} + b_9X_{\text{Self-Regulation Residual}}$$

Where:
Y' = the residual change score for the frequency of moderate and vigorous physical activity
a = the intercept, or value of Y when all X's are set to zero
b_k = the partial regression coefficient
X_k = the independent variables

Figure 4.2: Multiple Regression Model Predicting Moderate Physical Activity at Oak Hill High School

The full model predicting changes in the frequency of moderate physical activity at Oak Hill High School was not significant (F (9, 24) = 0.91, p =0.54). The model accounted for a non-significant 35.3% of the variance in changes in the frequency of moderate physical activity (R^2 = 0.353, p>0.05). Results for the regression analysis are presented in Table 4.30. No independent variable entered significantly into the model.

Variables	R^2	R^2change	b	t	p
Gender	0.12	0.12	1.15	1.23	0.24
Athletic Status	0.12	<0.01	-0.11	-0.21	0.84
Attendance	0.13	0.01	0.01	0.68	0.51
Homework Rate	0.15	0.02	-0.004	-0.19	0.86
Knowledge	0.18	0.02	0.01	0.98	0.35
Social Support	0.27	0.09	0.04	0.58	0.57
Outcome Expectancy-Value	0.31	0.05	-0.01	-1.19	0.25
Self-Efficacy	0.33	0.01	0.01	0.09	0.93
Self-Regulation	0.35	0.03	0.02	0.81	0.43

Standard Error = 1.56
Adjusted R^2 = -0.04
For Model: F = 0.91; p>0.05

Table 4.30: Multiple Regression Model Predicting Changes in Moderate Physical Activity at Oak Hill High School (n = 25).

All of the assumptions for multiple regression analysis were met in the model predicting changes in moderate physical activity at Oak Hill High School. The plot of the standardized residuals against the standardized predicted values scattered about a line of x = 0, indicating homoscedasticity. The plots of the standardized residuals against each independent variable each fell about a line of x = 0, indicating that the residuals are not correlated with the independent variables. The plot of the residuals fell approximately on the line of the normal probability plot, indicating that the residuals were normally distributed. The Tolerance values for each of the independent variables were around 1.0, and the VIF values for each of the independent variables were 1.1 – 3.4; these values indicate the multicollinearity was not a problem.

Shenandoah High School

The following variables were entered into the regression model developed to predict changes in the frequency of moderate physical activity among students at Shenandoah High School: gender, athletic status, course type, attendance, homework completion rate, post knowledge test score, social support residualized score, outcome expectancy-values residualized score, self-efficacy residualized score, and self-regulation residualized score. The full model is presented in Figure 4.3. The variable for course type was included in this model because one of the teachers delivering the program taught both physical education and health courses; this dummy variable was developed in order to capture any variance that may be attributed to the course setting in which the intervention was delivered. The variable for teacher was not included in the model because while two teachers participated in the delivery and evaluation of the interventions, the teachers brought the classes together to deliver the lessons and only one teacher delivered the program; the other managed the classroom and behavioral problems while the program delivery was occurring.

$$Y'_{\text{PA Residualized Change}} = a + b_1X_{\text{Gender}} + b_2X_{\text{Athletic Status}} + b_3X_{\text{Course}} + b_4X_{\text{Attendance Rate}} + b_5X_{\text{Homework Rate}} + b_6X_{\text{Knowledge}} + b_7X_{\text{Social Support Residual}} + b_8X_{\text{Outcome Expectancy-Values Residual}} + b_9X_{\text{Self-Efficacy Residual}} + b_{10}X_{\text{Self-Regulation Residual}}$$

Where:
Y' = the residual change score for the frequency of moderate and vigorous physical activity
a = the intercept, or value of Y when all X's are set to zero
b_k = the partial regression coefficient
X_k = the independent variables

Figure 4.3: Multiple Regression Model Predicting Moderate Physical Activity at Shenandoah High School

The full model predicting changes in the frequency of moderate physical activity at Shenandoah High School was not significant ($F(10, 79) = 1.09$, $p = 0.38$). The model accounted for a non-significant 13.6% of the variance in changes in the frequency of moderate physical activity ($R^2 = 0.136$, $p > 0.05$).

Results for the regression analysis are presented in Table 4.31. No independent variable entered significantly into the model.

Variables	R^2	R^2change	b	t	p
Gender	0.01	0.01	-0.29	-0.79	0.43
Athletic Status	0.01	<0.01	0.03	0.08	0.93
Course Type	0.01	<0.01	-0.03	-0.09	0.93
Attendance	0.02	0.01	0.02	1.37	0.17
Homework Completion	0.03	0.01	0.01	0.78	0.44
Knowledge	0.07	0.05	0.01	1.47	0.15
Social Support	0.07	<0.01	-0.02	-0.50	0.62
Outcome Expectancy-Value	0.09	0.02	-0.004	-1.58	0.12
Self-Efficacy	0.13	0.04	0.11	1.61	0.11
Self-Regulation	0.14	0.01	0.01	0.76	0.45

Standard Error =1.29
Adjusted R^2 = 0.01
For Model: F = 1.09; $p>0.05$

Table 4.31: Multiple Regression Model Predicting Changes in Moderate Physical Activity at Shenandoah High School (n = 80).

All of the assumptions for multiple regression analysis were met in the model predicting changes in moderate physical activity at Shenandoah High School. The plot of the standardized residuals against the standardized predicted values scattered about a line of x = 0, indicating homoscedasticity. The plots of the standardized residuals against each independent variable each fell about a line of x = 0, indicating that the residuals are not correlated with the independent variables. The plot of the residuals fell approximately on the line of the normal probability plot, indicating that the residuals were normally distributed. The Tolerance values for each of the independent variables were around 1.0, and the VIF values for each of the independent variables were 1.1 – 3.4; these values indicate the multicollinearity was not a problem.

Trivalley High School

The following variables were entered into the regression model developed to predict changes in the frequency of moderate physical activity among students at Trivalley High School: gender, athletic status, teacher, attendance, homework completion rate, post knowledge test score, social support residualized score, outcome expectancy-values residualized score, self-efficacy residualized score, and self-regulation residualized score. The full model is presented in Figure 4.4. The variable for course type was not included in this model because the intervention was only delivered in physical education classes at Trivalley. The variable for teacher was included in the model because three teachers delivered the intervention; one delivered the program separately and two teachers delivered the program as a team. This dummy variable was developed in order to capture any variance that may have been attributed to the teacher who was delivering the program.

$$Y'_{\text{PA Residualized Change}} = a + b_1X_{\text{Gender}} + b_2X_{\text{Athletic Status}} + b_3X_{\text{Teacher}} + b_4X_{\text{Attendance Rate}} + b_5X_{\text{Homework Rate}} + b_6X_{\text{Knowledge}} + b_7X_{\text{Social Support Residual}} + b_8X_{\text{Outcome Expectancy-Values Residual}} + b_9X_{\text{Self-Efficacy Residual}} + b_{10}X_{\text{Self-Regulation Residual}}$$

Where:
Y' = the residual change score for the frequency of moderate and vigorous physical activity
a = the intercept, or value of Y when all X's are set to zero
b_k = the partial regression coefficient
X_k = the independent variables

Figure 4.4: Multiple Regression Model Predicting Moderate Physical Activity at Trivalley High School

The full model predicting changes in the frequency of moderate physical activity at Trivalley High School was significant (F (10, 72) = 4.13, p <0.01). The model accounted for 40.0% of the variance in changes in the frequency of moderate physical activity (R^2 =0.40, p<0.01). Results for the regression analysis are presented in Table 4.32. The only variable to enter significantly into the model was gender (b = -0.95, p <0.01). Gender independently predicted 23.6% of the variance in changes in the frequency of moderate physical activity (R^2change = 0.236, p<0.01).

Variables	R^2	R^2change	b	t	p
Gender	0.24	0.24	-0.95	-4.85	<0.01
Athletic Status	0.24	<0.01	-0.11	-0.52	0.61
Teacher	0.24	<0.01	0.13	0.65	0.52
Attendance	0.24	<0.01	-0.01	-0.59	0.56
Homework Completion	0.30	0.06	0.01	1.42	0.16
Knowledge	0.31	0.01	0.001	0.15	0.88
Social Support	0.38	0.07	0.02	0.82	0.42
Outcome Expectancy-Value	0.38	<0.01	0.000	-0.07	0.95
Self-Efficacy	0.40	0.01	0.04	1.02	0.31
Self-Regulation	0.40	0.01	0.01	0.72	0.47

Standard Error =0.77
Adjusted R^2 = 0.30
For Model: F = 4.13; p<0.01

Table 4.32: Multiple Regression Model Predicting Changes in Moderate Physical Activity at Trivalley High School (n = 73).

All of the assumptions for multiple regression analysis were met in the model predicting changes in moderate physical activity at Trivalley High School. The plot of the standardized residuals against the standardized predicted values scattered about a line of x = 0, indicating homoscedasticity. The plots of the standardized residuals against each independent variable each fell about a line of x = 0, indicating that the residuals are not correlated with the independent variables. The plot of the residuals fell approximately on the line of the normal probability plot, indicating that the residuals were normally distributed. The Tolerance values for each of the independent variables were around 1.0, and the VIF values for each of the independent variables were 1.1 – 3.4; these values indicate the multicollinearity was not a problem.

Predicting Changes in Vigorous Physical Activity

One primary research question and four secondary research questions were also developed to assess whether the *Plan for Exercise, Plan for Health* intervention was able to account for a significant portion of the variance in changes in the frequency of adolescent vigorous physical activity and whether the SCT constructs targeted by the intervention had a significant and independent contribution to predicting vigorous physical activity at each of the participating schools. The same multiple regression models that were developed to predict changes in the frequency of moderate physical activity (depicted in Figures 4.1 –

4.4) were developed to predict changes in the frequency of vigorous physical activity. Hierarchical model entry was used to develop each of the regression models. The variables associated with student demographics (gender, athletic status), and the process evaluation (teacher, course, attendance rate, rate of homework completion, and percent correct on the post knowledge test) were entered into the models first in order to control for these variables and to describe the influence of rival hypotheses before examining the impact of the SCT constructs on behavior. The residualized change scores for the SCT variables were then entered into the equation. Each model was first evaluated for its ability to predict changes in the frequency of vigorous physical activity, thereby answering the primary research question. Each model was then evaluated to determine whether changes in the SCT constructs targeted independently contributed to the prediction of changes in vigorous physical activity, after accounting for rival hypotheses.

An assumption check for multiple regression analysis was conducted for each multiple regression model developed. The assumption related to specification errors was not violated in any of the regression models due to the use of sound theory in the development of the study and the models. The assumption related to measurement error was not violated in any of the regression models due to the use of valid and reliable measures of the dependent and independent variables. The assumptions related to the residuals were examined by plotting the standardized residuals against the standardized predicted values, by plotting the standardized residuals against the values of the independent variables, and by plotting the residuals on a normal probability plot. The assumption of multicollinearity was examined with VIF and Tolerance statistics for each model.

Jackson High School

The full model predicting changes in the frequency of vigorous physical activity at Jackson High School was not significant ($F(9, 32) = 0.61$, $p = 0.76$). The model accounted for a non-significant 17.0% of the variance in changes in the frequency of vigorous physical activity ($R^2 = 0.170$, $p > 0.05$). Results for the regression analysis are presented in Table 4.33. No independent variable entered significantly into the model.

Variables	R^2	R^2change	b	t	p
Gender	0.02	0.02	0.10	0.48	0.64
Athletic Status	0.06	0.04	0.14	0.68	0.50
Attendance	0.08	0.02	0.004	0.27	0.79
Knowledge	0.12	0.04	0.004	0.84	0.41
Social Support	0.14	0.02	0.001	0.04	0.97
Outcome Expectancy-Value	0.15	0.01	0	0.03	0.98
Self-Efficacy	0.16	0.01	0.01	0.58	0.57
Self-Regulation	0.17	0.01	0.003	0.41	0.68

Standard Error = 0.43
Adjusted R^2 = 0.11
For Model: F = 0.61; p>0.05

Table 4.33: Multiple Regression Model Predicting Changes in Vigorous Physical Activity at Jackson High School (n = 33).

All of the assumptions for multiple regression analysis were met in the model predicting changes in vigorous physical activity at Jackson High School. The plot of the standardized residuals against the standardized predicted values scattered about a line of x = 0, indicating homoscedasticity. The plots of the standardized residuals against each independent variable each fell about a line of x = 0, indicating that the residuals are not correlated with the independent variables. The plot of the residuals fell approximately on the line of the normal probability plot, indicating that the residuals were normally distributed. The Tolerance values for each of the independent variables were around 1.0, and the VIF values for each of the independent variables were 1.1 – 3.4; these values indicate the multicollinearity was not a problem.

Oak Hill High School

The full model predicting changes in the frequency of vigorous physical activity at Oak Hill High School was not significant (F (9, 24) = 0.62, p =0.77). The model accounted for a non-significant 27.0% of the variance in changes in the frequency of moderate physical activity (R^2 =0.270, p>0.05). Results for the regression analysis are presented in Table 4.34. No independent variable entered significantly into the model.

Variables	R^2	R^2change	b	t	p
Gender	0.01	0.01	-0.07	-0.23	0.83
Athletic Status	0.09	0.08	0.10	0.57	0.58
Attendance	0.09	<0.01	-0.002	-0.49	0.63
Homework Rate	0.10	0.01	0.003	-0.47	0.64
Knowledge	0.14	0.04	0.003	-0.81	0.43
Social Support	0.18	0.04	-0.01	-0.50	0.63
Outcome Expectancy-Value	0.18	<0.01	0.000	-0.16	0.87
Self-Efficacy	0.24	0.05	0.02	0.52	0.61
Self-Regulation	0.27	0.04	0.01	0.86	0.41

Standard Error = 0.37
Adjusted $R^2 = 0.17$
For Model: $F = 0.62$; $p>0.05$

Table 4.34: Multiple Regression Model Predicting Changes in Vigorous Physical Activity at Oak Hill High School (n = 25).

All of the assumptions for multiple regression analysis were met in the model predicting changes in vigorous physical activity at Oak Hill High School. The plot of the standardized residuals against the standardized predicted values scattered about a line of x = 0, indicating homoscedasticity. The plots of the standardized residuals against each independent variable each fell about a line of x = 0, indicating that the residuals are not correlated with the independent variables. The plot of the residuals fell approximately on the line of the normal probability plot, indicating that the residuals were normally distributed. The Tolerance values for each of the independent variables were around 1.0, and the VIF values for each of the independent variables were 1.1 – 3.4; these values indicate the multicollinearity was not a problem.

Shenandoah High School

The full model predicting changes in the frequency of vigorous physical activity at Shenandoah High School was significant ($F (10, 79) = 2.15$, $p <0.05$). The model accounted for 24.7% of the variance in changes in the frequency of vigorous physical activity ($R^2 =0.247$, $p<0.05$). Results for the regression analysis are presented in Table 4.35. The only variable to enter significantly into the model was the residualized change score for social support of physical activity ($b = -0.02$, $p < 0.05$). Changes in social support for physical activity independently predicted 3% of the variance in changes in the frequency of moderate physical activity (R^2change = 0.03).

Variables	R^2	R^2change	b	t	p
Gender	0.01	0.01	0.04	0.59	0.56
Athletic Status	0.04	0.03	-0.06	-1.03	0.31
Course Type	0.07	0.03	-0.07	-1.19	0.24
Attendance	0.08	0.02	0.002	0.88	0.38
Homework Completion	0.10	0.02	0.002	1.64	0.11
Knowledge	0.10	<0.01	0	-0.04	0.97
Social Support	0.11	0.01	-0.02	-2.65	0.01
Outcome Expectancy-Value	0.18	0.07	0.001	1.84	0.07
Self-Efficacy	0.22	0.04	0.02	1.51	0.14
Self-Regulation	0.24	0.02	0.003	1.21	0.23

Standard Error =0.22
Adjusted R^2 = 0.13
For Model: F = 2.15; p<0.05

Table 4.35: Multiple Regression Model Predicting Changes in Vigorous Physical Activity at Shenandoah High School (n = 80).

All of the assumptions for multiple regression analysis were met in the model predicting changes in vigorous physical activity at Shenandoah High School. The plot of the standardized residuals against the standardized predicted values scattered about a line of x = 0, indicating homoscedasticity. The plots of the standardized residuals against each independent variable each fell about a line of x = 0, indicating that the residuals are not correlated with the independent variables. The plot of the residuals fell approximately on the line of the normal probability plot, indicating that the residuals were normally distributed. The Tolerance values for each of the independent variables were around 1.0, and the VIF values for each of the independent variables were 1.1 – 3.4; these values indicate the multicollinearity was not a problem.

Trivalley High School

The full model predicting changes in the frequency of vigorous physical activity at Trivalley High School was significant (F (10, 72) = 2.35, p <0.05). The model accounted for 27.5% of the variance in changes in the frequency of vigorous physical activity (R^2 =0.275, p<0.05). Results for the regression analysis are presented in Table 4.36. Two independent variables contributed significantly to the model: percent attendance (b = -0.003, p<0.01) and the residualized change score for self-regulation (b = 0.003, p < 0.05). Percent attendance independently predicted 11.9% of the variance in changes in the frequency of vigorous physical activity (R^2change = 0.119, p<0.01). The residualized change score for self-regulation of physical activity independently predicted 7.5% of the variance in changes in the frequency of vigorous physical activity (R^2change = 0.075, p <0.05).

Variables	R^2	R^2change	b	t	p
Gender	0.003	0.003	0.000	0.01	0.99
Athletic Status	0.05	0.04	0.03	1.12	0.27
Teacher	0.05	<0.01	-0.01	-0.40	0.69
Attendance	0.17	0.12	-0.003	-2.94	<0.01
Homework Completion	0.18	0.06	0.000	0.91	0.37
Knowledge	0.19	0.01	0.000	0.69	0.49
Social Support	0.19	<0.01	-0.01	-1.46	0.15
Outcome Expectancy-Value	0.20	<0.01	0.000	-1.05	0.30
Self-Efficacy	0.20	<0.01	0.000	0.07	0.95
Self-Regulation	0.28	0.08	0.003	2.530	0.01

Standard Error =0.08
Adjusted R^2 = 0.16
For Model: F = 2.35; p<0.05

Table 4.36: Multiple Regression Model Predicting Changes in Vigorous Physical Activity at Trivalley High School (n = 73).

All of the assumptions for multiple regression analysis were met in the model predicting changes in vigorous physical activity at Trivalley High School. The plot of the standardized residuals against the standardized predicted values scattered about a line of x = 0, indicating homoscedasticity. The plots of the standardized residuals against each independent variable each fell about a line of x = 0, indicating that the residuals are not correlated with the independent variables. The plot of the residuals fell approximately on the line of the normal probability plot, indicating that the residuals were normally distributed. The Tolerance values for each of the independent variables were around 1.0, and the VIF values for each of the independent variables were 1.1 – 3.4; these values indicate the multicollinearity was not a problem.

Mediation Analysis

A 9th and final secondary research question was developed in order to test whether those SCT variables found to significantly predict changes in the frequency of moderate and vigorous physical activity mediated those changes in physical activity behavior; this was a way of statistically examining construct validity of the treatment. Through the regression models previously developed, changes in the following SCT variables were found to significantly predict adolescent physical activity behavior: changes in social support for physical activity significantly predicted changes in the frequency of moderate physical activity among students at Jackson High School; changes in social support for physical activity significantly predicted changes in the frequency of vigorous physical activity among students at Shenandoah High School; and, changes in self-regulation for physical activity significantly predicted changes in vigorous physical activity among students at Trivalley High School.

In order to assess whether these variables mediated changes in physical activity behavior, a series of 3 regression models were run, as suggested by Baron and Kenney (1986). First, the measures assessing changes in physical activity were regressed upon the model representing the *Plan for Exercise, Plan for Health* intervention (Figures 4.1 – 4.4). Second, the measures assessing changes in the relevant SCT constructs were regressed upon the model representing the *Plan for Exercise, Plan for Health* intervention (minus the SCT construct in question). Finally, the measures assessing changes in physical activity were regressed upon the model representing the *Plan for Exercise, Plan for Health* intervention, controlling for the effects of the SCT construct. As Baron and Kenny (1986) suggest, if the intervention is able to predict changes in physical activity (a significant R^2 for the first regression), the intervention is able to predict changes in the SCT construct (a significant R^2 for the second regression), and if the ability of the intervention to predict changes in behavior is attenuated when controlling for the effects of the SCT construct (R^2 is lower in the third equation than the first equation), evidence of mediation exists.

Based on a mediation analysis, changes in social support for physical activity mediated changes in the frequency of moderate physical activity at Jackson High School. As presented earlier, the intervention predicted a significant portion of the variance in changes in moderate physical activity ($R^2 = 0.287$, $p < 0.05$). The regression model developed to represent the intervention also predicted a significant portion of the variance in the changes in social support ($R^2 = 0.602$, $p<0.01$). Further, the effect of the intervention on changes in moderate physical activity was attenuated when the effect of changes in social support was controlled for. In the third equation, social support was entered into the model first to control for the variance in changes in physical activity accounted for by the changes in social support. The remainder of the intervention was then entered into the model. It accounted for a smaller portion of the variance in the changes in moderate physical activity than when the changes in social support was included in the model (R^2change = 0.04, p>0.05), and the ability of the intervention to predict moderate physical activity became non-significant when the impact of social support on behavior was controlled for.

Based on a mediation analysis, changes in social support for physical activity did not mediate changes in the frequency of vigorous physical activity among students at Shenandoah High School. As presented earlier, the intervention predicted a significant portion of the variance in changes in vigorous physical activity (R^2 = 0.247, p <0.05). The regression model developed to represent the intervention also predicted a significant portion of the variance in the changes in social support (R^2 = 0.408, p<0.01). The effect of the intervention on changes in vigorous physical activity was minimally attenuated when the effect of changes in social support was controlled for. In the third equation, social support was entered into the model first to control for the variance in changes in physical activity accounted for by the changes in social support. The remainder of the intervention was then entered into the model, and R^2 change was examined to determine whether the ability of the intervention to predict changes in behavior was attenuated when the impact of the construct was controlled for. Only 2.7% of the variance was attenuated when the changes in social support was controlled for (R^2change = 0.22, p<0.05), and the remaining intervention was still able to account for a significant portion of the variance in changes in vigorous physical activity; therefore, mediation was not supported.

Changes in self-regulation did not mediate changes in the frequency of vigorous physical activity among students at Trivalley High School. As presented earlier, the intervention predicted a significant portion of the variance in changes in vigorous physical activity (R^2 = 0.275, p <0.05). The regression model developed to represent the intervention also predicted a significant portion of the variance in the changes in self-regulation (R^2 = 0.665, p<0.01). The effect of the intervention on changes in vigorous physical activity was minimally attenuated when the effect of changes in self-regulation was controlled for. In the third equation, self-regulation was entered into the model first to control for the variance in changes in physical activity accounted for by the changes in self-regulation. The remainder of the intervention was then entered into the model; only 6.2% of the variance was attenuated when controlling for the effects of the intervention (R^2change = 0.213, p=0.05), and the intervention was still able to account for a significant portion of the variance in the changes in vigorous physical activity.

Subgroup Analysis

The use of change scores makes it difficult to distinguish, within the data, those subjects who adhered to a physical activity program (either as a result of the intervention or as a result of external factors) from those subjects whom the intervention did not reach. If a student exercised regularly at pretest, a ceiling effect would confound any impact the program had on his or her physical activity rates; if he or she remained active throughout the program and at post-test the change score would be zero, similar to a zero change score among a student who was neither active at pretest nor at post-test. Further, unless a subject who was active at pretest adhered to a physical activity program, his or her physical activity could only decrease from pretest to post-test, lending the data to negative change scores and an interpretation of the data to suggest that the intervention led to a decrease in physical activity levels.

Because of the potential problems with ceiling effects and the inability to distinguish students who adhered to a physical activity program from students who failed to adopt a physical activity program when using change scores, a subgroup analysis was conducted using only the students who were inactive at pretest. Inactivity was defined as participating in either no days or one day of moderate or vigorous physical activity during five of the seven days preceding the pretest surveys. This analysis allows the reader to gain an understanding of the effects of the intervention among previously sedentary students, for whom the intervention was particularly designed. Previous research has suggested this intervention could be particularly effective among previously sedentary adolescents (Hortz, 2005).

Descriptive statistics and regression models were produced to examine the data. Descriptive statistics were produced to examine the pretest and post-test scores on the SCT constructs and on the frequency of moderate and vigorous physical activity among students who were inactive at pretest. Regression models were developed to compare all of the students within the intervention schools to students in the comparison school; this analysis was followed by an examination of the data within each of the specific intervention schools. Using only those subjects who were physically inactive at pretest resulted in a loss of subjects to a degree that compromised statistical power. Grouping all of the subjects into one “intervention” group allowed for an examination of statistical significance with adequate statistical power; conducting a second analysis using the individual schools as the grouping level allowed the researcher to compare the effects of the program between each individual school and between each school and the intervention group as a whole.

Moderate Physical Activity

The frequency distributions for the number of days inactive students reported participating in moderate physical activity at pretest and at post-test are presented in Table 4.37. This data suggests that only one student who was inactive at the pretest in the comparison school (Jackson High School) participated in moderate physical activity on more than one day at the post-test. Descriptive statistics indicate a slight increase in moderate physical activity for Jackson High School students (pretest $\mu = 0.13$, $s = 0.34$; post-test $\mu = 0.22$, $s = 0.74$). A greater degree of change in moderate physical activity appeared to occur among students in the intervention schools. At Oak Hill High School, five of the 12 students who were inactive at pretest were participating in moderate physical activity on more than one day at post-test. Descriptive statistics indicate an increase in moderate physical activity (pretest $\mu = 0.50$, $s = 0.52$; post-test $\mu = 1.42$, $s = 1.68$). At Shenandoah High School, 12 of the 50 subjects who were inactive at pretest were participating in moderate physical activity on more than one day at post-test. Descriptive statistics indicate an increase in moderate physical activity (pretest $\mu = 0.24$, $s = 0.43$; post-test $\mu = 1.22$, $s = 1.76$). At Trivalley High School, 11 of the 52 inactive students at pretest were participating in moderate physical activity on more than one day at post-test. Descriptive statistics also indicate an increase in moderate physical activity (pretest $\mu = 0.31$, $s = 0.47$; post-test $\mu = 0.79$, $s = 1.18$)

School	Pretest		Post-Test					
	0 Days	**1 Day**	**0 Days**	**1 Day**	**2 Days**	**3 Days**	**4 Days**	**5 Days**
Jackson HS n = 23	20 (87.0%)	3 (13.0%)	21 (91.3%)	1 (4.3%)	0	1 (4.3%)	0	0
Oak Hill HS n = 12	6 (50%)	6 (50%)	5 (41.7%)	2 (16.7%)	3 (25.0%)	0	1 (8.35)	1 (8.3%)
Shenandoah HS n = 50	38 (76.0%)	12 (24.0%)	30 (60.0%)	4 (8.0%)	4 (8.0%)	3 (6.0%)	5 (10.0%)	4 (8.0%)
Trivalley HS n = 52	36 (69.2%)	16 (30.8%)	30 (57.7%)	11 (21.2%)	6 (11.5%)	3 (5.8%)	1 (1.9%)	1 (1.9%)

Table 4.37: Frequency Distribution of Moderate Physical Activity for Inactive Students

The descriptive statistics for the SCT variables at pretest and at post-test for the subjects who were inactive at pretest are presented in Table 4.38. No group was at either the extreme low or extreme high end of any of the SCT variables at pretest or at post-test. The students at Jackson High School, the comparison school, appeared to have a decrease in scores on each of the SCT constructs from pretest to post-test. The students at the interventions schools appeared to increase in score from pretest to post-test on each of the SCT constructs except two; students at Trivalley High School appeared to have a decrease in self-efficacy scores and students at Oak Hill High School appeared to have a decrease in outcome expectancy-value scores. The greatest increases in score appeared to occur for social support and self-regulation.

School	Construct	Pretest				Post-Test			
		Min	**Max**	**M**	**SD**	**Min**	**Max**	**M**	**SD**
Jackson HS n = 23	Self-Efficacy	7.00	40.00	25.35	8.66	7.00	42.00	24.22	10.90
	Social Support	8.00	36.00	20.96	9.07	8.00	43.00	17.22	9.66
	Self-Regulation	25.00	122.00	57.43	30.42	25.00	117.00	52.74	29.02
	Outcome Expectancy-Values	88.00	677.00	389.26	165.05	42.00	662.00	320.26	189.55
Oak Hill HS n = 12	Self-Efficacy	17.00	36.00	28.67	5.12	18.00	41.00	31.83	7.59
	Social Support	8.00	43.00	23.17	11.24	8.00	44.00	25.25	12.80
	Self-Regulation	26.00	89.00	64.17	17.28	33.00	129.00	80.00	30.34
	Outcome Expectancy-Values	270.00	665.00	452.67	142.87	93.00	792.00	424.58	188.83
Shenandoah HS n = 50	Self-Efficacy	7.00	41.00	28.06	6.84	14.00	39.00	30.06	5.15
	Social Support	8.00	46.00	21.14	8.03	13.00	48.00	29.06	8.55
	Self-Regulation	28.00	109.00	51.40	19.81	35.00	128.00	79.66	22.63
	Outcome Expectancy-Values	159.00	744.00	423.50	142.77	207.00	773.00	439.38	149.23
Trivalley HS n = 52	Self-Efficacy	7.00	40.00	28.37	7.11	7.00	42.00	27.65	8.70
	Social Support	8.00	45.00	23.33	9.75	8.00	48.00	25.90	11.11
	Self-Regulation	25.00	119.00	55.48	21.07	25.00	136.00	70.77	27.12
	Outcome Expectancy-Values	100.00	731.00	411.48	159.47	133.00	776.00	420.98	173.80

Table 4.38: Descriptive Statistics for the SCT Constructs, Inactive Students

The multiple regression models developed to predict changes in the frequency of moderate physical activity using variables associated with the *Plan for Exercise, Plan for Health* intervention were significant for the intervention schools and non-significant for the comparison school. While the model predicting changes in moderate physical activity for Jackson High School was non-significant ($F(8, 22) = 2.46$, $p = 0.07$), the model was able to predict a practically significant portion of the variance in changes in moderate physical activity ($R^2 = 0.585$); the lack of statistical significance was likely due to inadequate statistical power associated with a small sample size. Self-regulation significantly contributed to the model; changes in self-regulation were able to predict 21.7% ($p<0.05$) of the variance in changes in moderate physical activity among students at Jackson High School. It should be noted self-regulation scores decreased from pretest to post-test among Jackson High School students, however. The model predicting changes in moderate physical activity among the inactive intervention students was statistically significant ($F(8, 113) = 2.42$, $p <0.05$); the model was able to predict 16% of the variance in the changes in moderate physical activity. The changes in social support and the changes in self-regulation significantly contributed to the regression models predicting changes in moderate physical activity among the inactive intervention students; the changes in social support contributed to 4.1% ($p<0.05$) of the variance in the changes in moderate physical activity and the changes in self-regulation contributed to 3.8% ($p<0.05$) of the variance in the changes in moderate physical activity.

Because the model predicting changes in moderate physical activity among the intervention students was significant, further analysis was conducted to examine the models within each intervention school. The results of the regression analysis, by school, are presented in Table 4.39. As predicted, two of the models were statistically non-significant; this was likely attributable to low statistical power due to the small sample sizes. When examining the effect sizes, the models were able to predict a practically significant portion of the variance in the changes in moderate physical activity. As suggested by the model predicting changes in moderate physical activity among all of the intervention students, self-regulation and social support were the two constructs which primarily contributed to the models. Social support contributed to a practically significant portion of the variance in the changes in moderate physical activity at Oak Hill and Trivalley. Analysis supported the mediating effect of social support on moderate physical activity, particularly among Oak Hill students (OH R^2 for PA = 0.78, R^2 for SS = 0.78, R^2 = 0.41 for PA controlling for SS; TV R^2 for PA = 0.31, R^2 for SS = 0.68, R^2 = 0.27 for PA controlling for SS). Self-regulation contributed to a practically significant portion of the variance in the changes in moderate physical activity at Oak Hill and Shenandoah. Analysis supported the mediating effect of self-regulation, particularly among Oak Hill students (OH R^2 for PA=0.78, R^2 for SR = 0.64, R^2 = 0.32 for PA controlling for SR; Shen R^2 for PA = 0.24, R^2 for SR = 0.36, R^2 = 0.21 for PA controlling for SR). Self-efficacy contributed to the model predicting changes in physical activity among inactive students at Shenandoah High School. Analysis did not support the mediating effect of self-efficacy (R^2 for PA = 0.24, R^2 for self-efficacy = 0.28, R^2= 0.22 for physical activity controlling for SE), as only 2% of the variance was attenuated when controlling for the impact of self-efficacy.

School	ANOVA Results	R^2	Significant Contributors	R^2 Change
Jackson HS n = 23	F (8, 22) = 2.46, p = 0.07	0.59	Self-Regulation	0.22, p<0.05
Oak Hill HS n = 12	F (8, 11) = 1.31, p = 0.45	0.78	Social Support	0.329, p = 0.44
			Self-Regulation	0.251, p = 0.16
Shenandoah HS n = 50	F (8, 49) = 1.58, p = 0.16	0.24	Self-Efficacy	0.081, p = 0.05
			Self-Regulation	0.066, p = 0.07
Trivalley HS n = 52	F (8, 51) = 2.43, p<0.05	0.31	Social support	0.10 (p<0.05)

Table 4.39: Multiple Regression Predicting Moderate Physical Activity among Inactive Students

Vigorous Physical Activity

Frequency distributions and descriptive statistics for the frequency of vigorous physical activity were produced to compare the students in the intervention schools to the students in the comparison school. The frequency distributions for the number of days inactive students reported participating in vigorous physical activity at pretest and at post-test are presented in Table 4.40. The data suggests very little change in the frequency of adolescent vigorous physical activity from pretest to post-test within any of the participating schools. Only three students who were inactive at pretest (defined as having participated in zero or one day of vigorous physical activity) participated in more than one day of vigorous physical activity at post-test. One student in the comparison school who was inactive at the pretest participated in two days of vigorous physical activity at the post-test. Two students at Oak Hill High School who were inactive at pretest participated in more than one day of vigorous physical activity at post-test; one student participated in two days at post-test and the other participated in four days at post-test. Examining the descriptive statistics, students in the intervention schools showed no change in the frequency of vigorous physical activity (pretest $\mu = 0.08$, $s = 0.28$; post-test $\mu = 0.08$, $s = 0.40$). Students in the comparison school showed almost no change in the frequency of vigorous physical activity (pretest $\mu = 0.03$, $s = 0.18$; post-test $\mu = 0.06$, $s = 0.36$). Examining the intervention data by school, the results are similar. The greatest changes in vigorous physical activity occurred among students at Oak Hill High School (pretest $\mu = 0.13$, $s = 0.34$; post-test $\mu = 0.26$, $s = 0.92$). There was almost no change in the frequency of vigorous physical activity within Shenandoah High School (pretest $\mu = 0.05$, $s = 0.22$; post-test $\mu = 0.07$, $s = 0.25$). There was a slight decrease in the frequency of vigorous physical activity within Trivalley High School (pretest $\mu = 0.10$, $s = 0.30$; post-test $\mu = 0.04$, $s = 0.21$). Due to the lack of changes in vigorous physical activity apparent in the descriptive statistics and the frequency distributions, no further analysis was conducted to examine the data by school.

School	**Pretest**		**Post-Test**					
	0 Days	**1 Day**	**0 Days**	**1 Day**	**2 Days**	**3 Days**	**4 Days**	**5 Days**
Jackson HS n = 31	30 (96.8%)	1 (3.2%)	30 (96.8%)	0	1 (3.2%)	0	0	0
Oak Hill HS n = 23	20 (87.0%)	3 (13.0%)	21 (91.3%)	0	1 (4.3%)	0	1 (4.3%)	0
Shenandoah HS n = 76	72 (94.7%)	4 (5.3%)	71 (93.4%)	5 (6.6%)	0	0	0	0
Trivalley HS n = 69	62 (89.9%)	7 (10.1%)	66 (95.7%)	3 (4.3%)	0	0	0	0

Table 4.40: Frequency Distribution of Vigorous Physical Activity for Inactive Students

CHAPTER 5

CONCLUSIONS AND DISCUSSION

Introduction

The purpose of this study was to conduct an impact evaluation of the *Plan for Exercise, Plan for Health* intervention. The primary purpose was to evaluate the efficacy of the *Plan for Exercise, Plan for Health* intervention at changing the frequency of adolescent moderate and vigorous physical activity. There were two secondary purposes to this study. First, the study sought to examine whether changes in following four Social Cognitive Theory (SCT) constructs were able to predict changes in the frequency of adolescent moderate and vigorous physical activity: self-efficacy for overcoming barriers to physical activity, self-regulation of physical activity, social support from family and friends for physical activity, and outcome expectancy-values for physical activity. Second, the study sought to test whether changes in the targeted SCT constructs mediated changes in adolescent moderate and vigorous physical activity, thereby testing the utility of the theory in the development of physical activity interventions.

The conclusions of this study are presented in seven sections. First, the study design and threats to internal and external validity are discussed; this provides the reader with information regarding the ability to generalize the results of this study to a greater population and the ability to attribute any changes to variables targeted by the intervention to the intervention itself. The second section provides a discussion of results of the process evaluation pertaining to the final sample from which conclusions were drawn; this discussion lends itself to the avoidance of making a Type III error in the interpretation of the results. The third section provides a discussion of the behavioral impact evaluation; this section includes a discussion of the rates of physical activity among students in the final sample compared to national rates as well as a discussion of the primary research questions. The fourth section provides a discussion of the educational impact evaluation; this includes an interpretation of the impact that the intervention had on the SCT constructs targeted, a discussion of the secondary research questions, an interpretation of construct validity of the treatment, and a discussion of the mediation analysis conducted to answer the ninth secondary research question. The fifth section provides a discussion of the results of this study in the context of previous literature. The sixth and seventh sections provide a discussion of the study limitation and suggestions for future research.

Study Design and Threats to Internal and External Validity

This study used an ex post facto design with non-equivalent groups. The physical education, health, and/or life skills teachers within three Appalachian High Schools volunteered to deliver and participate in the evaluation of the *Plan for Exercise, Plan for Health* program. One teacher from one Appalachian High School did not want to deliver the intervention but volunteered to allow the research staff to visit his classes for measurement on two occasions, thereby serving as a comparison school. Because both participation in the study and the receipt of the intervention treatment was voluntary, there was neither random selection nor random assignment used in this study. The researcher cannot assume that the schools participating in the study were equivalent from the start. This design poses a few threats to internal and external validity that should be addressed before making conclusions based on the results of the study.

The threats to internal validity associated with using non-equivalent groups, as discussed in the Methods, are regression and the interaction between selection and other sources of invalidity (history, maturation, testing, etc). Regression could pose a problem if the schools recruited to participate in the study were recruited based on their extreme scores on any of the independent or dependent variables. The interaction between selection and other sources of invalidity could pose a problem because the groups cannot be assumed to be equivalent from the start; gains and losses seen over the course of the study could be due to between groups differences present at the start rather than from the effect of the intervention.

The threats to internal validity associated with regression and selection were addressed. Information about the schools collected from the Ohio Department of Education (Table 4.1) suggested that the schools were similar from the start. Analysis was conducted to compare the students within the participating schools at pretest on each of the physical activity and SCT variables; based on this analysis, there were pretest differences between the schools on self-regulation of physical activity but on no other SCT or physical activity variables. A post hoc analysis revealed that students at Oak Hill High School scored significantly higher than students at Shenandoah High School on the self-regulation construct. Because there were only pretest differences between two schools on one of six major variables, the threat to internal validity associated with selection and regression were not of concern. A lack of pretest differences provides evidence that none of the groups were extreme on any of the measures in comparison to other schools and that there was no selection bias. Further, residualized change scores were used in the regression analysis; using residualized change scores allows the researcher to partial out pretest scores from the post-test scores, providing further confidence in our ability to draw conclusions regarding the efficacy of the intervention at changing physical activity behavior.

The threats to external validity associated with using non-equivalent groups include the interaction between testing and the treatment, the interaction between selection and the treatment, and reactive arrangements. The interaction between testing and the treatment may pose a problem in this study because both a pretest and a post-test were used. Subjects involved in the study may have changed particularly in the SCT constructs due to a practicing effect of completing the instrument at pretest and then again at post-test. Such changes would not occur in the general population. Because the pretest was necessary to the internal validity of the study, this threat to external validity could not be avoided. The threat to external validity due to the interaction between selection and the treatment should not pose a problem within this study. The schools were recruited from the same region of the state and information collected from the Ohio Department of Education suggested that the schools were similar; therefore, the students participating in the intervention should be similar to the students from which the sample was drawn (Appalachia Ohio). The threat to external validity due to reactive arrangements could pose a problem to this study as the subjects were aware that they were participating in a study; therefore, they may have acted differently than students in the general population who would receive the intervention while not in a study. This threat to external validity was minimized by delivering the intervention within the school setting and by having the regular physical education, health, and/or life skills teacher to deliver the intervention rather than an outside implementer. Minimizing changes in the school environment should have minimized the reactivity of the students participating in the study.

A threat to both internal validity and external validity that became a problem within this study was the threat associated with differential mortality. There was a 50% overall mortality rate and the individual schools had up to a 70% mortality rate (Jackson High School) over the course of this study. The high subject mortality rate resulted in very low sample sizes in each of the participating schools. An in depth analysis of this mortality suggested that those subjects who dropped out over the course of the study differed from those subjects who remained in the study, particularly on the SCT variables. Because there was such a high mortality rate, the ability to draw inferences about the effectiveness of the intervention and the ability to generalize the results of the study beyond the students included in the analysis was compromised. The study should be examined based on the magnitude of effect sizes rather than through tests of statistical significance. The results of the study cannot be generalized beyond the students included in the analysis. An effort should be made in the future to replicate this study in an effort to retain enough students to have adequate statistical power in order to draw inferences from tests of statistical significance and in order to generalize the results to a larger population.

Process Evaluation

The process evaluation examined the implementation fidelity of the *Plan for Exercise, Plan for Health* intervention and was conducted in order to avoid the possibility of making a Type III error in the interpretation of the study results. Type III error occurs when conclusions are drawn about an intervention that was not delivered with adequate fidelity. Measures used to asses the implementation fidelity that were of concern in this study included dose delivered, dose received, and programmatic reach.

Dose delivered was evaluated to determine whether the teachers delivered the intervention lessons with adequate fidelity, defined as implementing 80% or more of the lesson components as written. Based on the results of the study, each of the teachers participating in the delivery of the *Plan for Exercise, Plan for Health* intervention delivered more than 80% of the lesson components as they were written (Mowad, 2006). Based on the observation of two intervention lessons at each of the schools, the teachers delivered the lessons as written. Based on measures of dose delivered, Type III error will not be a problem in the interpretation of the results of this study.

Dose received was measured to determine whether the students received an adequate dose of the intervention, as evaluated through student attendance and homework completion rates. Students were considered to have received an adequate dose of the intervention if they completed at least 80% of the homework assignments and attended at least 80% of the intervention lessons (Mowad, 2006). Similar criteria have been used in past studies (Hortz, 2005). Descriptive statistics for the final sample revealed that 76% of students at Oak Hill High School, 32.6% of the students at Shenandoah High School, and 29.8% of the students at Trivalley High School completed at least 80% of the homework assignments. It is interesting to note that the Oak Hill students were participating in the intervention as part of a life-skills course, while the Shenandoah students were participating in the intervention as part of either a health course or a physical education course (both taught by physical education teachers), and the Trivalley students were participating in the intervention as part of a physical education course. Homework is not a typical component of physical education classes; this is reflected by the low homework return rate of students at Shenandoah and Trivalley in comparison to Oak Hill. Examining attendance rates, 64% of the students at Oak Hill High School, 88.8% of the students at Shenandoah High School, and 91.7% of the students at Trivalley High School attended at least 80% of the intervention lessons. Attendance is one of the main criteria for passing physical education at Shenandoah and Trivalley; this is reflected in the attendance rates. These measures of dose received were added into the regression equations predicting changes in physical activity before the SCT variables targeted by the intervention; in this way, any variation in the dose received by the student was statistically controlled for and Type III error associated with dose received should not be a problem.

Programmatic reach was evaluated through a knowledge test, delivered at post-test, which assessed the understanding of exercise concepts targeted by the intervention. Results were low, with more than 50% of the students at each school answering less than 50% of the conceptual knowledge questions correctly. The low scores reflect a low degree of programmatic reach. Students in the intervention schools scored significantly higher than students in the control school, however. A one-way ANOVA revealed significant between groups differences on the post knowledge test ($F(3, 207) = 5.22$, $p<0.01$), and a post-hoc Boneferroni analysis revealed that students at Jackson High School (the comparison school) scored significantly lower than students at Oak Hill High School ($p<0.01$), Shenandoah High School ($p<0.01$) and Trivalley High School ($p<0.05$); there were no differences in the scores between the three intervention schools. Based on this analysis, the intervention did reach the students at the intervention schools when compared to students who did not receive the intervention. As a measure of implementation fidelity, the variable was added into the regression equations predicting changes in the frequency of moderate and vigorous physical activity before any of the SCT variables. Similar to the dose received variables, this model building procedure controlled for any effects of program reach as a measure of implementation fidelity and should help avoid Type III error.

Behavioral Impact Evaluation

The primary purpose of the study was to conduct an impact evaluation of the *Plan for Exercise, Plan for Health* intervention. The study sought to evaluate the efficacy of the intervention at changing the frequency of moderate and vigorous physical activity. Multiple regression analysis was conducted to statistically determine whether the *Plan for Exercise, Plan for Health* intervention (including variables associated with the process evaluation, variables associated with the students thought to impact physical activity, and the residualized change scores for the targeted SCT variables) could predict changes in the frequency of moderate and vigorous physical activity. A measure of effect size in multiple regression (R^2) was used to compare the effects of the intervention in the three intervention schools and a comparison school. Based on the process evaluation, Type III error should not be a problem in drawing conclusions from the results of the impact evaluation. Based on an evaluation of the threats to internal and external validity inherent to the design of the study, conclusions should be drawn in light of the effect sizes drawn from this study rather than from tests of statistical significance. The results of this study should not be generalized beyond the students included in the final analysis.

Adolescent Physical Activity Rates

Before examining the statistical analysis conducted to evaluate the efficacy of the intervention, it is important to examine any changes in the frequency distributions of physical activity from pretest to post-test. Laying out where changes in physical activity occurred over the course of the study can help to guide the conclusions drawn from the statistical analyses. Although the current recommended guidelines for physical activity suggest that adolescents participate in moderate or vigorous physical activity for at least 60 minutes per day on five or more days per week, the intervention was developed under past recommendations. Past recommendations suggested that adolescents participate in at least 20 minutes of vigorous physical activity per day on three or more days per week, or that they participate in at least 30 minutes of moderate physical activity per day on five or more days per week (CDC, *YRBS*, 2006). Because the intervention taught students the frequency and duration with which they should exercise based on the intensity of the activities that they chose to participate in, reflecting the recommended guidelines of the past, the data was analyzed based on past recommended guidelines. Therefore, comparisons between national rates of physical activity and rates of physical activity among students in the final sample are based on the recommended guidelines from the past.

Rates of Moderate Physical Activity

Rates of moderate physical activity among students participating in the final sample were low at pretest. According to the latest Youth Risk Behavior Surveillance survey, conducted in 2005, 68.7% of high school students, nation-wide, were meeting the previously recommended levels of physical activity; this included 61.5% of females and 75.8% of males (CDC, *YRBS*, 2006). Students participating in the current study reported meeting the recommended guidelines for moderate physical activity at much lower rates at pretest; 3% of students (0% of males and 5.6% of females) at Jackson High School, 8% of students (0% of males and 9.1% of females) at Oak Hill High School, 8.8% of students (10.3% of males and 7.8% of females) at Shenandoah High School, and 4.1% of students (6.9% of males and 2.3% of females) at Trivalley High School reported participating in at least 30 minutes of moderate physical activity on 5 days at pretest.

When taking into account that only five days of physical activity data was analyzed, potential rates of physical activity were still low. Assuming that the students who reported three or four days of moderate physical activity had the potential to exercise on one or two of the days not captured in this study, 24.2% of students at Jackson High School (33.4% of males and 16.7% of females), 32% of students at Oak Hill High School (0% of males and 36.3% of females), 22.6% of students at Shenandoah High School (24.1% of males and 21.5% of females), and 12.3% of students at Trivalley High School (13.8% of males and 11.4% of females) could have potentially met the past recommended guidelines for moderate physical activity at the pretest. Even when allowing the students who reported three or four days of physical activity to potentially exercise on the remaining two days of the week that were not captured, rates of students in the sample meeting guidelines for moderate physical activity are almost half of national rates, as reported by the YRBS.

While the rates of adolescents meeting the guidelines for moderate physical activity at post-test were still low, rates did appear to increase from pretest. At post-test, 12.1% of the students at Jackson High School (21.4% of males and 5.3% of females) reported participating in five days of moderate physical activity, representing a 9% increase overall. At Oak Hill High School, 12.0% of the students (0% of males and 13.6% of females) reported five days of moderate physical activity at post-test, a 4% increase overall. At Shenandoah High School, 13.8% of the students (25.0% of the males and 7.7% of the females) reported participating in five days of moderate physical activity at post-test, a 5% increase overall from pretest. Trivalley High School was the only school in which an overall increase in the number of students reporting five days moderate physical activity did not occur, although there was a 3.8% increase from pretest among males.

Taking into account the potential for students who reported three or four days of moderate exercise in five of the seven days preceding the post-test to meet recommended guidelines with the remaining two days not captured, potential rates of physical activity decreased from pretest among students at Jackson High School and Oak Hill High School and increased from pretest among students at Shenandoah High School and Trivalley High School. At post-test, 18.2% of the students at Jackson High School (35.7% of males and 5.3% of females) had the potential to meet the guidelines for moderate physical activity, representing a 6% decrease from pretest. At Oak Hill High School, 28% of the students (0% of males and 31.8% of females) had the potential to meet the guidelines for moderate physical activity at post-test, representing a 4% decrease. Since the number of students participating in five days of moderate physical activity increased at both of these schools, it appears that students tended to move to the extremes from pretest to post-test; they either increased their physical activity participation to five days or decreased their participation to fewer than three days. At post-test, 30.1% of the students at Shenandoah High School (32.1% of males and 28.9% of females) had the potential to meet the recommended guidelines for moderate physical activity, representing a 7.5% increase from pretest. At Trivalley High School, 15.0% of the students (32.2% of males and 4.4% of females) had the potential to meet the recommended guidelines for moderate physical activity, representing a 2.7% increase from pretest.

Rates of Vigorous Physical Activity

Rates of vigorous physical activity among students participating in the final sample were also low at pretest. As stated earlier, 68.7% of high school students nation-wide (61.5% of females and 75.8% of males) reported meeting the past recommended guidelines for moderate or vigorous physical activity in the week preceding the 2005 YRBS (CDC, *YRBS*, 2006). Students participating in the current study reported meeting the recommended guidelines for vigorous physical activity at much lower rates at pretest. At Jackson High School, 6.0% of students (0% of males and 5.6% of females) reported participating in 3 or more days of vigorous physical activity. At Oak Hill High School, 4.0% of students (0% of males and 4.5% of females) reported three or more days of vigorous physical activity. At Shenandoah High School, 2.6% of students (0% of males and 4.0% of females) reported three or more days of vigorous physical activity. At Trivalley High School, 4.1% of students (6.8% of males and 2.3% of females) reported participating in three or more days of vigorous physical activity.

When taking into account that only five days of physical activity data was analyzed, potential rates of vigorous physical activity were still low. Assuming that the students who reported one or more days of vigorous physical activity had the potential to exercise on one or two of the days not captured in this study, 9.0% of students at Jackson High School (13.4% of males and 5.6% of females), 20% of students at Oak

Hill High School (33.3% of males and 18.7% of females), 10.1% of students at Shenandoah High School (10.3% of males and 9.9% of females), and 15.1% of students at Trivalley High School (20.5% of males and 11.4% of females) could have potentially met the past recommended guidelines for vigorous physical activity at the pretest. Again, even when allowing the students who reported more than 1 day of vigorous physical activity to potentially exercise at a vigorous intensity on the remaining two days of the week that were not captured, rates of students in the final sample meeting guidelines for vigorous physical activity were much lower than national rates.

The rates of adolescents meeting the guidelines for vigorous physical activity remained low at post-test. Rates appeared to either stay the same or decrease from pretest to post-test. At post-test, 6.0% of the students at Jackson High School (7.1% of males and 5.3% of females) reported participating in three or more days of vigorous physical activity, representing no overall changes from pretest. At Oak Hill High School, 4.0% of the students (0% of males and 4.5% of females) reported three or more days of vigorous physical activity at post-test, representing no overall changes from pretest. At Shenandoah High School, 1.3% of the students (0% of the males and 1.9% of the females) reported participating in three or more days of vigorous physical activity at post-test, a 1.3% decrease overall from pretest. No students at Trivalley High School reported participating in three or more days of vigorous physical activity at post-test, a 4.1% decrease from pretest rates.

Taking into account the potential for students who participated in more than one day of vigorous physical activity in five of the seven days preceding the post-test to meet recommended guidelines with the remaining two days not captured, potential rates of physical activity remained the same from pretest to post-test among students at Jackson High School and Shenandoah High School and decreased from pretest to post-test among students at Oak Hill High School and Trivalley High School. At post-test, 9.0% of the students at Jackson High School (14.2% of males and 5.3% of females) had the potential to meet the guidelines for vigorous physical activity, the same as pretest (although a 0.8% increase among males). At Shenandoah High School, 10.1% of the students (7.1% of males and 11.5% of females) had the potential to meet the guidelines for vigorous physical activity, also the same as pretest (a 3.2% decrease among males and a 1.6% increase among females). At post-test, 8.0% of the students at Oak Hill High School (0% of males and 9.0% of females) had the potential to meet the recommended guidelines for vigorous physical activity, representing a 4.0% decrease overall. At Trivalley High School, 5.5% of the students (7.8% of males and 4.4% of females) had the potential to meet the recommended guidelines for vigorous physical activity, representing a 9.6% overall decrease from pretest rates.

Evaluation of the Primary Research Questions

Primary Research Question 1: Did the *Plan for Exercise, Plan for Health* intervention account for a significant portion of the variance in the changes in the frequency of adolescent moderate physical activity?

Multiple regression analysis, using measures associated with the intervention and residualized change scores for the SCT variables, was conducted to evaluate the efficacy of the *Plan for Exercise, Plan for Health* intervention at changing the frequency of adolescent moderate physical activity; results support the efficacy of the intervention. The intervention did not explain a significant portion of the variance in changes in the frequency of moderate physical activity at one of the intervention schools, namely Shenandoah High School ($R^2 = 0.14$, $p>0.05$). The intervention explained a practically significant portion of the variance in changes in moderate physical activity at the other two intervention schools. The intervention explained 40% ($p<0.01$) of the variance in changes in the frequency of moderate physical activity among students at Trivalley High School and 35% ($p>0.05$) of the variance in changes in the frequency of moderate physical activity among students at Oak Hill High School. The lack of statistical significance at Oak Hill High School is likely due to an insufficiency in statistical power due to the small sample size at that school ($n = 25$). When comparing the variance explained in this model to models developed to predict moderate physical activity in past studies, the practical significance is evident. Past models using SCT variables to predict moderate physical activity are able to capture 11% - 59% of the variance in physical activity behavior (Winters, 2003; Sallis et al, 1999; Trost et al, 1997; Reynolds et al, 1990). As explained earlier, the results of the study should be evaluated in light of the effect sizes (R^2) rather than in light of tests of statistical significance due to the high mortality rate and the low sample sizes. The effect size for the regression model predicting variance in the changes in moderate physical activity at

Trivalley High School and Oak Hill High School are consistent with statistically significant models within the literature using SCT to predict moderate physical activity.

While the intervention was efficacious in predicting changes in moderate physical activity at two intervention schools, the model was also statistically significant for the comparison school. The regression model was able to predict 28.7% ($p<0.05$) of the variance in changes in moderate physical activity among students at Jackson High School. While the effect size for the comparison school is smaller than the other two intervention schools, the statistical significance suggests that there was confounding present in the study. The descriptive statistics suggest that moderate physical activity rates decreased among Jackson High School students over the course of the study (pretest $\mu = 1.18$, post-test $\mu = 0.94$), and the frequency distributions indicated a 9% increase in students who reported five days of moderate exercise from pretest to post-test. Various external factors (school coming to a close, events in the community, the physical education course in which the students were enrolled) could have influenced moderate physical activity rates among the Jackson High School students, leading to the statistically significant results found in the analysis.

Primary Research Question 2: Did the *Plan for Exercise, Plan for Health* intervention account for a significant portion of the variance in the changes in the frequency of adolescent vigorous physical activity?

Multiple regression analysis, using measures associated with the intervention and residualized change scores of the SCT variables, was also conducted to evaluate the efficacy of the *Plan for Exercise, Plan for Health* intervention at changing the frequency of adolescent vigorous physical activity; results indicated that the intervention could explain variance in the changes in vigorous physical activity but the changes in physical activity were in an undesired direction. When looking at the frequency distributions and descriptive statistics, vigorous physical activity rates either dropped or remained the same from pretest to post-test for each of the schools. Variables associated with the intervention were not able to predict variance in the changes in vigorous physical activity at the comparison school; 17% of the variance ($p>0.05$) in changes in vigorous physical activity could be explained by measures associated with the intervention at Jackson High School. The intervention was able to predict a significant portion of the variance in changes in the frequency of vigorous physical activity at two of the intervention schools; 24.7%

($p<0.05$) of the variance was explained at Shenandoah High School and 27.5% of the variance was explained at Trivalley High School. The model developed for Oak Hill High School explained 27% ($p>0.05$) of the variance in changes in vigorous physical activity. When compared to the other intervention schools, the effect of the intervention on predicting changes in vigorous physical activity was practically significant at Oak Hill High School; the lack of statistical significance is likely attributable to inadequate power due to a small sample size ($n = 25$). These results are consistent with the physical activity descriptive literature; in past studies, models using SCT to predict vigorous physical activity have been able to account for 5% - 29% of the variance in vigorous physical activity (Petosa et al, 2003; Winters et al, 2003; Trost et al, 1997; Zakarian et al, 1994). Because the rates of vigorous physical activity either decreased or remained the same from pretest to post-test, the efficacy of the intervention is not supported.

Summary of the Behavioral Impact Evaluation

Results of this study support the efficacy of the *Plan for Exercise, Plan for Health* intervention at changing the frequency of adolescent moderate physical activity. Taking into account the descriptive statistics and frequency distributions from pretest and post-test, the intervention was able to predict increases in the frequency of moderate physical activity. While descriptive statistics reveal relatively stable levels of moderate physical activity (no overall change at Oak Hill High School or Trivalley High School; less than a ¼ day decrease at Jackson High School, and less than 1/5 of a day increase at Shenandoah High School), frequency distributions reveal an increase in the percent of students participating in five days of moderate physical activity among students at each of the schools. While factors other than the intervention were able to impact measures associated with the intervention and subsequently predict changes in moderate physical activity at the comparison school, the effect of the intervention on moderate physical activity was greater at two of the intervention schools ($R^2_{\text{Oak Hill}} = 0.35$; $R^2_{\text{Trivalley}} = 0.40$) than the comparison school ($R^2_{\text{Jackson}} = 0.287$). This greater effect of the intervention seen at the intervention schools when compared to the comparison school, coupled with the increases in the rates of students reporting five days of moderate physical activity from pretest to post-test, supports the efficacy of the *Plan for Exercise, Plan for Health* intervention at changing moderate physical activity.

The results of this study do not support the efficacy of the intervention at changing vigorous physical activity. Frequency distributions for vigorous physical activity reveal a decrease in the percent of students either meeting or having the potential to meet past recommended guidelines among students at each of the schools. Descriptive statistics reveal a decrease in the average number of days students participated in vigorous physical activity, particularly among the students in the intervention schools. Students at Oak Hill High School participated, on average, in 0.5 fewer days of vigorous physical activity at post test when compared to pretest. Students at Shenandoah participated, on average, in 0.05 fewer days of vigorous physical activity at post test when compared to pretest. Students at Trivalley High School participated, on average, in 0.22 fewer days of physical activity from pretest to post-test. Students at Jackson High School participated, on average, in 0.03 more days of vigorous physical activity at pretest when compared to post-test. The intervention was unable to predict variance in the changes in vigorous physical activity at the comparison school, but it was able to predict the decreases in vigorous physical activity at the intervention schools ($R^2_{intervention} = 0.27, 0.247, 0.275$). The ability of the models to predict changes in vigorous physical activity is likely due to external factors.

Educational Impact Evaluation

A secondary purpose of the study was to examine the educational impact of the *Plan for Exercise, Plan for Health* intervention. The intervention was designed to target four (SCT) constructs: self-efficacy for overcoming barriers to physical activity, self-regulation of physical activity, social support for physical activity, and outcome expectancy-values for physical activity. Each of these constructs were targeted in the adolescent exercise intervention developed by Hortz (2005), under which the *Plan for Exercise, Plan for Health* intervention was developed. Three of these constructs (self-efficacy, social support, and outcome expectancy-values) were targeted in the adolescent exercise intervention, developed by Winters (2001), under which the Hortz (2005) intervention was developed. Under the first trial of the intervention, none of the targeted SCT variables were impacted (Winters, 2001). Revisions were made to the curriculum and another impact evaluation was conducted by Hortz (2005); this pilot study found self-regulation and social situation to be positively impacted by the intervention. Further curricular revisions were made before the current efficacy study was conducted.

Eight research questions were developed to examine the impact of the *Plan for Exercise, Plan for Health* intervention on the four targeted SCT constructs. These secondary research questions were evaluated by examining the descriptive statistics at pretest and at post-test, by examining the relationships between physical activity measures and the SCT constructs at pretest and post-test, and through multiple regression analysis. Residualized change scores were computed for each SCT construct; these change scores were added into the regression models predicting changes in adolescent physical activity while controlling for rival hypotheses, such as student demographics thought to impact student physical activity rates (gender and athletic status) and measures associated with the process evaluation (teacher, course type, dose received and programmatic reach). Using a hierarchical model development allowed for an assessment of the independent effect of changes in the SCT constructs (the residualized change scores) to predict changes in the physical activity variables. An examination of the descriptive statistics and the regression analysis allowed for an assessment of the educational impact of the intervention.

Secondary Research Question 1: After accounting for all other variables in the model, did changes in student social support scores predict changes in the frequency of adolescent moderate physical activity?

Secondary Research Question 2: After accounting for all other variables in the model, did changes in student social support scores predict changes in the frequency of adolescent vigorous physical activity?

Social support significantly contributed to the model predicting changes in moderate physical activity at Jackson High School, suggesting that external factors were present to impact the construct within the comparison school. Social support scores decreased from pretest to post-test. The average score at pretest was 22.21. Since there were 8 questions using a 6-point Likert scale, this represents an average rating of 2.77 for the scale; on average, Jackson High School students stated that family and friends between "rarely" and "unusually" provided them with supports for physical activity at pretest. At post-test, the average score was 19.94, representing an average rating of 2.5; at post-test, students stated that family and friends still provided them with supports for physical activity somewhere between "rarely" and "unusually". The magnitude of the relationship between social support and moderate physical activity among students at Jackson High School increased from pretest to post-test ($p_{retest} = 0.27$, $r_{post\text{-}test} = 0.60$);

the relationship between social support and vigorous physical activity was stable from pretest to post-test ($p_{retest} = 0.27$, $r_{post\text{-}test} = 0.30$). Changes in social support independently contributed to the prediction of 19% of the variance in changes in moderate physical activity (R^2change for the addition of social support = 0.19). Changes in social support did not contribute to the model predicting changes in vigorous physical activity.

Social support from family and friends for physical activity did not impact changes in physical activity among students at Oak Hill High School. Social support scores increased from pretest to post-test. The average social support score at pretest was 24.72, representing an average rating of 3.09 on the scale. On average, students at Oak Hill stated that friends and family "unusually" provided them with supports for physical activity at pretest. At post-test, the average score was a 28.48, or 3.56 for the scale; students shifted slightly to say that their family and friends provided them with support for physical activity between "unusually" and "sometimes" at post-test. The magnitude of the relationship between social support and moderate physical activity increased from pretest to post-test among students at Oak Hill High School ($r_{pretest} = 0.10$, $r_{post\text{-}test} = 0.38$). The magnitude of the relationship between social support and vigorous physical activity decreased ($r_{pretest} = 0.34$, $r_{post\text{-}test} = 0.25$). Changes in social support did not significantly contribute to the model predicting changes in moderate physical activity or to the model predicting changes in vigorous physical activity.

Social support from family and friends contributed to the model predicting changes in vigorous physical activity for Shenandoah High School; vigorous physical activity rates decreased from pretest to post-test however, suggesting that external factors influenced the model. Social support scores for physical activity increased from pretest to post-test. The average pretest score was 21.51, representing a 2.7 on the scale; students at Shenandoah stated that friends and family between "rarely" and "unusually" provided them with supports for physical activity at pretest. At post-test, the average score was 26.66, representing a 3.3 on the scale; at post-test, students stated that friends and family provided them with supports for physical activity between "unusually" and "sometimes". The magnitude of the relationship between social support and moderate physical activity decreased from pretest to post-test ($r_{pretest} = 0.14$, $r_{post\text{-}test} = 0.04$). As expected, changes in social support did not contribute significantly to the prediction of changes in moderate physical activity. The magnitude of the relationship between social support and vigorous physical activity increased from pretest to post-test but remained negative ($r_{pretest} = -0.07$, $r_{post\text{-}test} = -0.12$); according to these correlations, increases in social support predicted decreases in vigorous physical activity. This relationship was reflected in the regression analysis. Changes in social support contributed to the prediction of 3% of the variance in changes in vigorous physical activity ($b = -0.02$, $p<0.05$), a small contribution.

Social support from family and friends did not impact changes in physical activity among Trivalley High School students. Social support scores slightly increased from pretest to post-test. The average pretest score was 24.59, representing a 3.07 on the scale, and at post-test the average score was 26.71, representing a 3.3 on the scale; students at Trivalley indicated that friends and family provided them with social supports for physical activity close to "unusually" both at pretest and at post-test. The magnitude of the relationship between social support and moderate physical activity remained relatively stable over the course of the study ($r_{pretest} = 0.21$, $r_{post\text{-}test} = 0.26$), and the relationship between social support decreased in magnitude but became positive from pretest to post-test ($p_{retest} = -0.10$, $r_{post\text{-}test} = 0.04$). Changes in social support did not significantly contribute to the models predicting changes in moderate or vigorous physical activity.

Secondary Research Question 3: After accounting for all other variables in the model, did changes in student outcome expectancy-value scores predict changes in the frequency of adolescent moderate physical activity?

Secondary Research Question 4: After accounting for all other variables in the model, did changes in student outcome expectancy-value scores predict changes in the frequency of adolescent vigorous physical activity?

Outcome expectancy-values did not impact changes in the frequency of moderate or vigorous physical activity among students at Jackson High School. Outcome expectancy-value scores decreased from pretest to post-test. The average score at pretest was 417.61. Since there were 23 multiplicative pairs of questions using a 6-point Likert scale, the best estimate of how students answered on the belief and values pairs can be found by dividing the average score by 23 and then taking the square root of that quotient. Using this best estimate approach, on average, Jackson High School students scored a 4.26 for the belief and value pairs, stating that they believed specific outcomes would result from physical exercise and valued that outcome between "often" and "usually". At post-test, the average score was 356.64, representing an average rating of 3.94; at post-test students stated that they believed outcomes would result from being physically active and they valued that outcome closer to "often". The magnitude of the relationship between outcome expectancy-values and moderate physical activity among students at Jackson High School increased from pretest to post-test ($p_{retest} = 0.29$, $r_{post\text{-}test} = 0.44$); the relationship between outcome expectancy-values and vigorous physical activity slightly increased from pretest to post-test ($p_{retest} = 0.24$, $r_{post\text{-}test} = 0.32$). Changes in outcome expectancy-values did not significantly contribute to the model predicting changes in moderate physical activity or to the model predicting changes in vigorous physical activity.

Outcome expectancy-values did not impact changes in the frequency of moderate or vigorous physical activity among students at Oak Hill High School. Outcome expectancy-value scores decreased slightly from pretest to post-test. The average score at pretest was 479.44. Using the best estimate approach, on average, Oak Hill students scored a 4.56 for the belief and value pairs, stating that they believed specific outcomes would result from physical exercise and valued that outcome between "often" and "usually". At post-test, the average score was 472.44, representing an average rating of 4.53; there was very little change from pretest. The magnitude of the relationship between outcome expectancy-values and moderate physical activity among students at Oak Hill High School remained constant from pretest to post-test ($p_{retest} = 0.10$, $r_{post\text{-}test} = 0.09$); the relationship between outcome expectancy-values and vigorous physical activity decreased from pretest to post-test ($p_{retest} = 0.29$, $r_{post\text{-}test} = 0.17$). Changes in outcome expectancy-values did not significantly contribute to the model predicting changes in moderate physical activity or to the model predicting changes in vigorous physical activity.

Outcome expectancy-values did not impact changes in the frequency of moderate or vigorous physical activity among students at Shenandoah High School. Outcome expectancy-value scores increased from pretest to post-test. The average score at pretest was 479.44. Using the best estimate approach, on average, Shenandoah students scored a 4.34 for the belief and value pairs, stating that they believed specific outcomes would result from physical exercise and valued that outcome between "often" and "usually". At post-test, the average score was 460.35, representing an average rating of 4.47; at post-test students still believed outcomes would result from being physically active between "often" and "usually" but their answers shifted slightly towards "usually". The magnitude of the relationship between outcome expectancy-values and moderate physical activity among students at Shenandoah High School increased from pretest to post-test but became negative ($p_{retest} = 0.06$, $r_{post\text{-}test} = -0.21$); the relationship between outcome expectancy-values and vigorous physical activity remained constant from pretest to post-test ($p_{retest} = 0.20$, $r_{post\text{-}test} = 0.21$). Changes in outcome expectancy-values did not significantly contribute to the model predicting changes in moderate physical activity or to the model predicting changes in vigorous physical activity.

Outcome expectancy-values did not impact changes in the frequency of moderate or vigorous physical activity among students at Trivalley High School either. Outcome expectancy-value scores increased from pretest to post-test. The average score at pretest was 431.93. Using the best estimate approach, on average, Trivalley students scored a 4.33 for the belief and value pairs, stating that they too believed specific outcomes would result from physical exercise and valued that outcome between "often" and "always". At post-test, the average score was 440.73, representing an average rating of 4.36; there was very little change from pretest. The magnitude of the relationship between outcome expectancy-values and moderate physical activity among students at Trivalley High School slightly decreased from pretest to post-test ($p_{retest} = 0.24$, $r_{post\text{-}test} = 0.18$); the magnitude of the relationship between outcome expectancy-values and vigorous physical activity decreased from pretest to post-test ($p_{retest} = 0.21$, $r_{post\text{-}test} = 0.04$). Changes in outcome expectancy-values did not significantly contribute to the model predicting changes in moderate physical activity or to the model predicting changes in vigorous physical activity.

Secondary Research Question 5: After accounting for all other variables in the model, did changes in student self-efficacy scores predict changes in the frequency of adolescent moderate physical activity?

Secondary Research Question 6: After accounting for all other variables in the model, did changes in student self-efficacy scores predict changes in the frequency of adolescent vigorous physical activity?

Self-efficacy to overcome barriers to physical activity did not impact changes in physical activity among students at Jackson High School. Self-efficacy scores decreased from pretest to post-test. The average score at pretest was 27.48. Since there were 7 questions using a 6-point Likert scale, this represents an average rating of 3.9 for the scale; on average, students in the comparison school stated that they could "sometimes" overcome barriers to physical activity. At post-test the average score was 26.67, representing an average rating of 3.8; students similarly stated that they could "sometimes" overcome barriers to physical activity at post-test. The magnitude of the relationship between self-efficacy and moderate physical activity remained relatively constant from pretest to post-test ($r_{pretest} = 0.46$, $r_{post\text{-}test} = 0.42$); the relationship between self-efficacy and vigorous physical activity also remained relatively constant ($r_{pretest} = 0.29$, $r_{post\text{-}test} = 0.32$). Changes in self-efficacy did not significantly contribute to the model predicting changes in moderate physical activity or to the model predicting changes in vigorous physical activity among students at Jackson High School.

Among any of the schools, self-efficacy scores showed the greatest change among students at Oak Hill High School; the construct did not impact changes in physical activity behavior, however. Among students at Oak Hill High School, the average self-efficacy score at pretest was 30.76, representing an average rating of 4.4 on the scale. The average students felt they could overcome barriers to physical activity between "sometimes" and "often". At post-test, the average score was a 33.64, or 4.8 for the scale; students still stated they could overcome barriers between "sometimes" and "often", but their perceptions shifted closer to "often". The magnitude of the relationship between self-efficacy and moderate physical activity was consistent over the course of the study ($r_{pretest} = 0.29$, $r_{post\text{-}test} = 0.30$). The magnitude of the relationship between self-efficacy and vigorous physical activity increased from pretest to post-test ($r_{pretest} = 0.16$, $r_{post\text{-}test} = 0.34$). Changes in self-efficacy did not significantly contribute to the model predicting changes in moderate physical activity or to the model predicting changes in vigorous physical activity.

Self-efficacy remained relatively stable at the remaining two intervention schools. At Shenandoah High School, the average pretest score was 29.11, representing a 4.16 on the scale (between "sometimes" and "often"). At post-test, the average score was 30.93, representing a 4.42 on the scale. The magnitude of the relationships between self-efficacy and physical activity remained stable. The correlation between self-efficacy and vigorous physical activity was $r = 0.16$ at pretest and at post-test. The correlation increased slightly from $r = 0.17$ at pretest to $r = 0.20$ at post-test for moderate physical activity. At Trivalley High School, the average pretest score was 29.26, representing a 4.18 on the scale, and at post-test the average score was 28.64, representing a 4.09 on the scale; students indicated that they could overcome barriers to physical activity "sometimes" both at pretest and at post-test. The magnitude of the relationship between self-efficacy and moderate physical activity remained stable over the course of the study among students at Trivalley High School ($r_{pretest}$ = 0.29, $r_{post\text{-}test}$ = 0.32). The magnitude of the relationship between self-efficacy and vigorous physical activity also remained stable over the course of the study ($r_{pretest}$ = 0.13, $r_{post\text{-}test}$ = 0.12). Changes in self-efficacy did not significantly contribute to the models predicting changes in moderate or vigorous physical activity among students at either Shenandoah High School or Trivalley High School.

Secondary Research Question 7: After accounting for all other variables in the model, did changes in student self-regulation scores predict changes in the frequency of adolescent moderate physical activity?

Secondary Research Question 8: After accounting for all other variables in the model, did changes in student self-regulation scores predict changes in the frequency of adolescent vigorous physical activity?

Self-regulation for physical activity did not impact changes in the frequency of moderate or vigorous physical activity among students at Jackson High School. Self-regulation scores increased by less than one point from pretest to post-test. The average score at pretest was 59.64. Since there were 25 questions using a 6-point Likert scale, this represents an average rating of 2.39 for the scale; on average, Jackson High School students stated that they used self-regulatory strategies for physical activity between "rarely" and "unusually" at pretest. At post-test, the average score was 60.58, representing an average rating of 2.42; there was very little change from pretest to post-test. The magnitude of the relationship between self-regulation and moderate physical activity among students at Jackson High School increased from pretest to post-test (p_{retest} = 0.12, $r_{post\text{-}test}$ = 0.49); the relationship between self-regulation and vigorous physical activity also increased from pretest to post-test (p_{retest} = 0.19, $r_{post\text{-}test}$ = 0.27). Changes in self-regulation did not significantly contribute to the either the model predicting changes in vigorous physical activity or the model predicting changes in moderate physical activity.

Self-regulation for physical activity did not impact changes in the frequency of moderate or vigorous physical activity among students at Oak Hill High School. Self-regulation scores increased from pretest to post-test. The average score at pretest was 71.92. This represents an rating of 2.87 for the scale;

on average, Oak Hill High School students stated that they used self-regulatory strategies for physical activity between “rarely” and “unusually” at pretest. At post-test, the average score was 90.68, representing a rating of 3.62; at post-test, students reported using self-regulatory strategies for physical activity between “unusually’ and “sometimes”. The magnitude of the relationship between self-regulation and moderate physical activity among students at Oak Hill High School increased from pretest to post-test (p_{retest} = 0.32, $r_{post\text{-}test}$ = 0.42); the relationship between self-regulation and vigorous physical activity also increased from pretest to post-test (p_{retest} = 0.29, $r_{post\text{-}test}$ = 0.41). Changes in self-regulation did not significantly contribute to the either the model predicting changes in vigorous physical activity or the model predicting changes in moderate physical activity.

Self-regulation for physical activity did not impact changes in the frequency of moderate or vigorous physical activity among students at Shenandoah High School either. Self-regulation scores increased from pretest to post-test. The average score at pretest was 53.16. This represents a rating of 2.13 for the scale; on average, Shenandoah High School students also stated that they used self-regulatory strategies for physical activity between “rarely” and “unusually” at pretest. At post-test, the average score was 80.50, representing a rating of 3.22. Similar to students at Oak Hill High School, students at Shenandoah High School shifted to stay that they used self-regulatory skills between “unusually” and “sometimes” at post-test. The magnitude of the relationship between self-regulation and moderate physical activity among students at Shenandoah High School slightly decreased from pretest to post-test (p_{retest} = 0.10, $r_{post\text{-}test}$ = 0.06); the relationship between self-regulation and vigorous physical activity slightly increased from pretest to post-test (p_{retest} = 0.14, $r_{post\text{-}test}$ = 0.17). Changes in self-regulation did not significantly contribute to the either the model predicting changes in vigorous physical activity or the model predicting changes in moderate physical activity.

Self-regulation contributed to the model predicting changes in vigorous physical activity for Trivalley High School; vigorous physical activity rates decreased from pretest to post-test however, suggesting that external factors influenced the model. Self-regulation scores increased pretest to post-test. The average score at pretest was 58.93. This represents a rating of 2.36 for the scale; on average, Trivalley students stated that they used self-regulatory strategies for physical activity between “rarely” and “unusually” at pretest. At post-test, the average score was 75.25, representing an average rating of 3.01. At post-test, Trivalley students stated that they “unusually” used specific self-regulatory strategies for physical activity. The magnitude of the relationship between self-regulation and moderate physical activity among students at Trivalley High School was consistent from pretest to post-test ($p_{retest} = 0.29$, $r_{post\text{-}test} = 0.30$); as expected, changes in self-regulation did not predict changes in moderate physical activity. The relationship between self-regulation and vigorous physical activity increased from pretest to post-test ($p_{retest} = 0.14$, $r_{post\text{-}test} = 0.25$). Changes in self-regulation significantly contributed to the model predicting changes in vigorous physical activity ($b = 0.003$, $p<0.05$); self-regulation contributed to the prediction of 11.9% of the variance in changes in the frequency of vigorous physical activity.

Construct Validity of the Treatment

A critical component to understanding the impact of a theory-based health education program, which is under-reported in the literature, is an evaluation of the construct validity of the treatment. Components of the behavioral and educational impact evaluation have already assessed whether the *Plan for Exercise, Plan for Health* intervention impacted physical activity behaviors and whether it impacted Social Cognitive Theory constructs to a degree which allowed for changes in the construct to predict changes in behavior. Construct validity of the treatment makes the crucial link in the evaluation of the intervention to determine whether those changes in the SCT constructs actually mediated changes in physical activity behavior, as theory predicts. A ninth secondary research question was developed to assess construct validity of the *Plan for Exercise, Plan for Health* intervention. As discussed throughout this dissertation, mediation analysis was conducted for those SCT constructs found to impact changes in physical activity behavior. The assessment of mediation, or construct validity of the treatment, was conducted using a three-step multiple regression analysis suggested by Baron & Kenney (1986).

Secondary Research Question 9: Among those SCT constructs that significantly predicted changes in adolescent physical activity behavior, did changes in the Social Cognitive Theory constructs mediate changes in the frequency of adolescent leisure-time physical activity from the intervention?

Mediation analysis was conducted for the three SCT constructs found to contribute to the models predicting changes in adolescent physical activity behavior. Changes in social support for physical activity significantly predicted changes in the frequency of moderate physical activity among students at Jackson High School. Changes in social support for physical activity significantly predicted changes in the frequency of vigorous physical activity among students at Shenandoah High School. Changes in self-regulation for physical activity significantly predicted changes in vigorous physical activity among students at Trivalley High School.

Mediation analysis suggested that social support did mediate changes in moderate physical activity in the comparison school. As suggested in the behavioral evaluation, the intervention significantly predicted changes in the frequency of moderate physical activity ($R^2 = 0.287$, $p<0.05$). The intervention also significantly predicted changes in social support ($R^2 = 0.602$, $p<0.01$). Finally, the ability of the intervention to predict changes in moderate physical activity was attenuated when the effects of the intervention on social support was controlled for. Controlling for the effects of social support on changes in moderate physical activity behavior, the intervention was only able to account for 4% of the variance in the changes in moderate physical activity. Social support scores decreased from pretest to post-test among students at Jackson High School, however. While the analysis supports the ability of changes in social support to mediate changes in physical activity behavior, the relationship is in the wrong direction. Social Cognitive Theory suggests that increases in social support should predict positive changes in behavior. Confounding/external factor(s) must have influenced social support at Jackson High School, and the changes in social support mediated changes in behavior.

Little evidence existed to support the mediating effect of social support on changes in vigorous physical activity among students at Shenandoah High School. The *Plan for Exercise, Plan for Health* intervention predicted a significant portion of the variance in the changes in the frequency of adolescent vigorous physical activity ($R^2 = 0.247$, $p<0.05$) and in the changes in social support for physical activity ($R^2 = 0.408$, $p<0.01$). The ability of the intervention to predict changes in vigorous physical activity was only attenuated by 2% when social support was controlled for. Controlling for the effects of social support, the intervention was still able to account for 22% of the variance in the changes in vigorous physical activity. Because there was such a small amount of attenuation when controlling for the effects of social support on the behavior, mediation is not supported. Further, vigorous physical activity rates decreased from pretest to post-test. Construct validity of the treatment is therefore not supported.

A similar finding was found for the ability of self-regulation to mediate changes in vigorous physical activity among students at Trivalley High School. The intervention significantly predicted changes in vigorous physical activity ($R^2 = 0.275$, $p<0.05$) and changes in self-regulation ($R^2 = 0.665$, $p<0.01$). When self-regulation was controlled for, the intervention was still able to account for 21.3% of the variance in the changes in vigorous physical activity. There was only a small amount of attenuation when controlling for the effects of the construct; therefore, mediation was unlikely. Similar conclusions regarding the construct validity of the treatment can be drawn here as was drawn for social support at Shenandoah High School. The mediating effect of self-regulation on vigorous physical activity is unlikely, as there was little attenuation of the variance predicting behavior when controlling for the effect of the construct. Further, vigorous physical activity rates decreased from pretest to post-test. Construct validity of the treatment is not supported.

Summary of the Educational Impact Evaluation

There was little evidence to support the educational impact of the *Plan for Exercise, Plan for Health* intervention among the students included in the final sample. Descriptive evidence from this study supports the ability of the intervention to particularly produce positive changes in social support and self-regulation when compared to scores from students who did not receive the intervention. The regression analysis did not support the ability of the intervention to produce changes in these constructs sufficient to predict positive changes in physical activity behavior. Social support contributed to the model predicting changes in moderate physical activity in the comparison school, suggesting that external, confounding factors influenced the model. Social support and self-regulation contributed to the models predicting changes in vigorous physical activity within two of the intervention schools. Vigorous physical activity decreased among students in these intervention schools, however, and mediation analysis did not support the constructs as mediators of behavioral change. Construct validity of the treatment was not supported. It is of value to examine the effects of the intervention on each SCT construct, particularly to drive future programmatic revisions and to gain a better understanding of the efficacy of the *Plan for Exercise, Plan for Health* intervention.

Self-efficacy was examined at pretest and post-test on a 6-point scale. Descriptive statistics indicated a half of a point positive shift from pretest to post-test on the scale within two of the intervention schools, no change in one of the intervention schools, and a quarter point decrease within the comparison school. The magnitude of the relationship between self-efficacy and moderate physical activity slightly increased in the intervention schools and slightly decreased in the comparison school. The magnitude between the construct and vigorous physical activity remained the same in two intervention schools and the control school but increased in one intervention school. Changes in the construct did not significantly contribute to any of the models predicting changes in physical activity behavior. While the curriculum appeared to have self-efficacy moving in the desired direction (increasing in the intervention schools), the intervention was not sufficient to produce changes in the construct that could predict changes in adolescent physical activity.

Self-regulation was examined at pretest and post-test on a 6-point scale. Descriptive statistics indicated no movement on the scale among students in the comparison school, and between a half and over a one-point positive shift in the scale among students in the intervention schools. The magnitude of the relationship between self-regulation and moderate physical activity increased in the control school and one intervention school but remained relatively constant in two of the intervention schools. The magnitude of the relationship between self-regulation and vigorous physical activity increased in the comparison school and two of the intervention schools but remained constant in one intervention school. Changes in the construct significantly predicted changes in vigorous physical activity, but that model significantly predicted decreases in the frequency of vigorous physical activity. Similar to self-efficacy, the intervention appears to have had a positive effect on self-regulation scores when compared to a school that did not receive the intervention. These increasing scores in the construct did not produce consistent changes in the magnitude of the relationship between the construct and behavior, however. Particularly when examining the regression models, The *Plan for Exercise, Plan for Health* curriculum did not appear to be sufficient to impact self-regulation to a degree that positively influences physical activity behavior. Construct validity of the treatment was not supported.

Social support was also examined at pretest and post-test on a 6-point scale. Descriptive statistics indicated that the intervention had a positive effect on social support, particularly within two of the intervention schools when compared to a school that did not receive the intervention. There was a quarter point negative shift on the scale among students in the comparison school, a half a point positive shift in the scale among students in two intervention schools, and no change among the students in the third intervention school. These increasing scores did not produce consistent changes in the magnitude of the relationship between the construct and behavior, however. The magnitude of the relationship between social support and moderate physical activity increased in the comparison school, increased in one intervention school, decreased in one intervention school, and remained the same in the third intervention school. The magnitude of the relationship between the construct and vigorous physical activity remained stable in the comparison school, decreased in one intervention school, increased but became negative in one intervention school, and was very low but became positive in the third intervention school. Changes in the construct significantly predicted changes in moderate physical activity among students in the comparison school. Confounding factors must have been present to produce these changes in social support which were sufficient to predict changes in moderate physical activity. Changes in the construct also significantly predicted changes in vigorous physical activity in one intervention school, but, similar to the self-regulation findings, that model significantly predicted decreases in the frequency of vigorous physical activity. Construct validity of the treatment was not supported because the intervention was not sufficient to produce changes in physical activity in the desired direction.

Outcome expectancy-values was examined on a scale that used the product of pairs of 6-point items to evaluate students' beliefs about the outcomes achieved through physical activity and the value they placed on those outcomes. Descriptive statistics indicated no change in scores from pretest to post-test in two intervention schools, and a quarter point change in the comparison school (in a negative direction) and in one intervention school (in a positive direction). The magnitude of the relationship between outcome expectancy-value and moderate physical activity increased in the intervention school, decreased in one intervention school, became negative in one intervention school, and stayed the same in the third interventions school from pretest to post-test. The magnitude of the relationship between the construct and vigorous physical activity increased in the comparison school, decreased in two intervention schools, and stayed the same from pretest to post-test in the third comparison school. The construct did not contribute to the prediction of changes in physical activity behavior. The *Plan for Exercise, Plan for Health* curriculum did not appear to be sufficient to impact outcome expectancy-values, particularly to a degree that positively influenced physical activity behavior.

Sub-Group Analysis

The use of change scores when examining the impact of an educational intervention on physical activity behavior can be problematic. Physical activity is not only a behavior that adolescents adopt; it is also a behavior in which adolescents are engaged. Educational interventions designed to impact physical activity behavior can teach adolescents to either adopt a new physical activity program or to adhere to a current physical activity program. It becomes difficult to interpret the impact of a physical activity intervention among students who are adhering to a physical activity program when using change scores. Change scores are minimized by how active a student is at pretest. If a student was participating in physical activity on each of the measured days preceding the pretest, his or her score from pretest could either stay the same or decrease. If the program impacted the student to adhere to a physical activity program, a resulting change score would be zero; otherwise the change score would be negative, lending interpretation of the intervention to a detrimental impact on physical activity behavior. Making conclusions regarding the impact of the current intervention using changes scores with the data from all of the students can be confounded by the ceiling effect among those students who were active at pretest; any effects that the intervention had on students who could potentially increase their frequency of physical activity would be confounded by those students who could only maintain or decrease their behavior frequency.

Because of this problem with the use of change scores, a sub-group analysis was conducted to determine the impact of the *Plan for Exercise, Plan for Health* intervention among those students who were inactive at pretest. A student was considered to be inactive if he or she participated in zero or one day of moderate or vigorous physical activity at the pretest. This analysis allowed for an interpretation of the impact of the intervention on the adoption of a physical activity program. This analysis is also important because the intervention was particularly developed to help sedentary students adopt a physical activity program. Previous research has supported the intervention to be particularly effective for the adoption of moderate physical activity among previously sedentary adolescents (Hortz, 2005).

The data supported the efficacy of the *Plan for Exercise, Plan for Health* intervention on increasing moderate physical activity among previously inactive adolescents. Descriptive statistics indicated an increase in the frequency of moderate physical activity among each of the intervention schools; students at Oak Hill High School and Shenandoah High School were participating in less than one-half of a day of moderate physical activity at pretest and over one day of moderate physical activity, on average, at post-test (Oak Hill pretest $\mu = 0.50$ post-test $\mu = 1.42$; Shenandoah pretest $\mu = 0.24$, post-test $\mu = 1.22$). While students at Trivalley High School were still not exercising for an average of one day at post-test, the average score did increase by over a half of a day from pretest to post-test (pretest $\mu = 0.31$, post-test $\mu = 0.79$). Students in the comparison school, Jackson High School, had an increase in the frequency of moderate physical activity by an average of one-tenth of a day, and by post-test students were participating in moderate physical activity for less than one-quarter of a day, on average (pretest $\mu = 0.13$, post-test $\mu = 0.22$). Frequency distributions further supported the impact of the intervention on moderate physical activity within the intervention schools when compared to Jackson High School students. Only one inactive student at pretest within the comparison school participated in more than one day of moderate physical activity at post-test; 32 (28.07%) of the students who were inactive at pretest within the intervention schools were participating in moderate physical activity on more than one day at the post-test.

The results of the regression analysis supported the efficacy of the *Plan for Exercise, Plan for Health* intervention at changing moderate physical activity among previously inactive adolescents. The impact of the intervention within the intervention schools was first examined with the data grouped together in order to examine the model with enough subjects to have adequate statistical power (n = 114); the model was able to predict 16% ($p<0.05$) of the variance in the changes in moderate physical activity. Since the grouped model was significant, the data was then examined to evaluate the effect of intervention within each of the intervention schools separately. Results indicated a greater ability of the intervention to predict changes in physical activity within the individual schools than when the schools were grouped together; the regression models were able to predict 24 – 78% of the variance in the changes in moderate physical activity among students in the intervention schools. Consistent with the results of the Hortz (2005) intervention, from which the *Plan for Exercise, Plan for Health* intervention was developed, self-regulation and social support were the two constructs that most consistently contributed to the models predicting changes in moderate physical activity. Changes in social support contributed to the prediction of 32.9% if the variance in changes in moderate physical activity among students at Oak Hill High School (model $R^2 = 0.78$) and to the prediction of 10% of the variance in changes in moderate physical activity among students at Trivalley High School (model $R^2 = 0.31$). Changes in self-regulation contributed to the prediction of 25.1% of the variance in changes in moderate physical activity among students at Oak Hill High School and to the prediction of 6.6% of the variance in changes in moderate physical activity among students at Shenandoah High School (model $R^2 = 0.24$).

Regression analysis suggested that both social support and self-regulation mediated changes in moderate physical activity. The ability of the intervention to predict changes in behavior was attenuated by 37% when controlling for the impact of the social support among students at Oak Hill High School. The mediation of social support at Trivalley High School was minimally supported, as only 4% of the variance in changes in behavior was attenuated when the impact of the construct was controlled for. The ability of the intervention to predict changes in moderate behavior was attenuated by 46% when controlling for the impact of the self-regulation among students at Oak Hill High School. The mediation of self-regulation at Shenandoah was minimally supported, as only 3% of the variance in changes in behavior was attenuated when the impact of the construct was controlled for.

Regression models supported the ability of Social Cognitive Theory to predict changes in moderate physical activity among previously inactive adolescents within the comparison school. The model was able to predict a significant 59% ($p<0.05$) of the variance in changes in moderate physical activity. This likely supports the ability of SCT to predict physical activity behavior. There was a minimal change in moderate physical activity among previously inactive students in the comparison school; there was a minimum of a half-day increase in moderate physical activity over the course of the nine-week study among students who were inactive at the pretest within the each of the intervention schools. The average scores on each of the SCT variables decreased among students in the comparison school, while the average scores on the SCT variables increased among students in the intervention schools. Therefore, despite the significant ability of the regression model to predict behavior among students in the comparison school, conclusions can be drawn regarding the efficacy of the intervention at impacting changes in the SCT constructs sufficient to produce changes in moderate physical activity.

The results of the sub-group analysis did not support the efficacy of the *Plan for Exercise, Plan for Health* intervention at impacting the frequency of vigorous physical activity. Both the descriptive statistics and the frequency distributions of the physical activity data indicate little or no change in vigorous physical activity over the course of the study within any of the schools. The descriptive statistics indicate no change in behavior among the intervention students (pretest $\mu = 0.08$, post-test $\mu = 0.08$) and a very slight increase in the frequency of vigorous physical activity among the comparison students (pretest $\mu = 0.03$, post-test $\mu = 0.06$). The frequency distributions indicated that among all the inactive students at pretest, only three students (one in the comparison school and two at Oak Hill High School) participated in more than one day of vigorous physical activity at the post-test. These minimal changes in rates of vigorous physical activity indicate that the intervention did not impact vigorous physical activity among previously inactive adolescents.

This Study in the Context of the Literature

This study should be examined in light of three areas of the literature. First, the results presented can be compared to the literature describing the ability of Social Cognitive Theory to predict physical activity behavior. Second, the results presented can be compared to the literature using Social Cognitive Theory in the development of interventions to produce changes in adolescent physical activity rates. Third, the results can be examined as a third trial in the line of impact evaluations being conducted at The Ohio State University.

The findings of this study are consistent with the descriptive literature and provide further evidence for the ability of the Social Cognitive Theory to predict adolescent physical activity behavior. The magnitude of the relationships between the SCT constructs and physical activity behavior were similar to those found in previous studies. The relationship between self-efficacy to overcome barriers to physical activity and moderate physical activity ranged from r = 0.17 – 0.46 in this study; in past studies it has ranged from r = 0.17 – 0.24 (Hortz, 2005; Winters et al, 2003 & Motl et al, 2002). The relationship between self-efficacy to overcome barriers to physical activity and vigorous physical activity ranged from r = 0.12 – 0.34 in this study; in past studies it has ranged from 0.23 – 0.40 (Hortz, 2005; Winters et al, 2003; Petosa et al, 2003; Motl et al, 2002; Trost et al, 1997; Zakarian et al, 1994). The relationship between self-regulation and moderate physical activity and then vigorous physical activity in this study was r = 0.06 – 0.49 and r = 0.14 – 0.41, respectively. Past literature has revealed relationships between self-regulation and moderate physical activity to range from r = 0.18 – 0.26 (Hortz, 2005; Winters et al, 2003) and relationships between self-regulation and vigorous physical activity to range from r = 0.18 – 0.44 (Hortz, 2005; Winters et al, 2003; Petosa et al, 2003). The relationship between social support and moderate physical activity and then vigorous physical activity in this study was r = 0.10 – 0.34 and r = -0.04 – 0.34, respectively; in past studies it has ranged from r = 0.14 – 0.25 (Hortz, 2005; Winters et al, 2003) and r = 0.12 – 0.33 (Hortz, 2005; Winters et al, 2003; Petosa et al, 2003; Zakarian et al, 1994). The relationship between outcome expectancy-values and moderate physical activity and then vigorous physical activity in this study was r = 0.09 – 0.44 and r = 0.04 – 0.32, respectively; in past studies it has ranged from r = 0.14 – 0.28 (Hortz, 2005; Winters et al, 2003; Motl et al, 2002) and r = 0.09 – 0.49 (Hortz, 2005; Winters et al, 2003; Petosa et al, 2003; Motl et al, 2002; Trost et al, 1997). Regression models using SCT to predict moderate physical activity have been able to explain 11 – 59% of the variance in adolescent moderate physical activity (Winters et al, 2003; Sallis et al, 1999; Trost et al, 1997; Reynolds et al, 1990) and 5 – 29% of the variance in vigorous physical activity (Petosa et al, 2003; Winters et al, 2003; Trost et al, 1997; Zakarian et al, 1994). The models developed for the current study were able to predict 13.6 – 40% of the variance in moderate physical activity and 17 – 27.5% of the variance in physical activity. Clearly, the results of this study support the results of past studies and the ability of Social Cognitive Theory to predict adolescent physical activity behavior.

The relationships between the constructs in this study support the use of the theory in explaining or predicting physical activity behavior. Social Cognitive Theory explains psychosocial functioning in terms of a triadic reciprocal causation (Bandura, 1986). Within this model, internal personal factors in the form of cognitive, affective, and biologic events, behavioral patterns, and environmental influences all operate as interacting determinants that influence one another bi-directionally (Bandura, 2001). This intervention targeted three inter-related constructs within the personal/cognitive domain: self-efficacy, self-regulation, and outcome expectancy values. Based on my interpretation of the theory (Figure 2.2), the constructs within this domain interact dynamically, with bi-directional relationships expected between each of the constructs. The intervention also targeted one construct from the environmental domain, namely social support. As theory predicts, social support should bi-directionally interact with the constructs within the personal/cognitive domain. These dynamic inter-relationships, which define the Social Cognitive Theory and the underlying foundation of Triadic Reciprocality, can be confirmed by the results of this study. There are strong inter-correlations between each of the targeted constructs at pretest and at post-test, in all of the schools. Mediation analysis conducted for the inactive students, which partialed out confounding ceiling effects present in the analysis of the entire final sample, further supported the ability of social support and self-regulation to mediate behavior. This evidence provides support of the theory in predicting or explaining behavior.

A second area of the literature which can be reviewed in light of the current findings is the intervention literature. As was laid out in the literature review, health educators have used SCT in the development of school based interventions within elementary, middle, and high school settings. The impacts of the interventions on physical activity have varied. The elementary school interventions Go for Health, SPARK, CHIC, and CATCH were able to show an impact on physical activity primarily conducted within physical education settings (McKenzie et al, 1997; Harrel et al, 1996; McKenzie et al, 1996; McKenzie et al, 1993; Simons-Morton et al, 1991). Only the Go for Health program and the CATCH program documented changes in the SCT constructs, and those were among self-efficacy and behavioral capability (Edmundson et al, 1996; Simons-Morton et al, 1991; Parcel et al, 1989). None of the interventions documented construct validity of the treatment. Among the middle school interventions, the Fargo/Moorheaad-250 intervention documented changes in leisure-time physical activity, and the M-SPAN intervention documented changes in physical activity during physical education, but none of the interventions documented changes in the SCT constructs nor construct validity of the treatment (McKenzie et al, 2004; Kelder et al, 1993).

The high school interventions have had the most success at impacting physical activity using the SCT; this was expected given the underlying cognitive capabilities inherent to the theory. Each of the high school interventions reviewed (Table 2.5) was able to impact physical activity variables. Only three intervention studies documented changes in the SCT constructs and construct validity of the treatment. The LEAP study documented increases in self-efficacy and goal setting (a property of self-regulation); further, they conducted analysis to support the ability of self-efficacy to mediate changes in behavior (Dishman et al, 2004). The Winters Dissertation documented the ability of the intervention to impact self-control and moderate physical activity (Winters, 2001), and the Hortz Dissertation documented the ability of the intervention to impact self-regulation, social support, and moderate physical activity; evidence supported construct validity of the treatment (Hortz, 2005).

The current study adds to the described intervention literature by providing evidence for the ability of the *Plan for Exercise, Plan for Health* intervention to impact moderate physical activity, particularly among previously inactive adolescents. While moderate physical activity rates were relatively stable and the regression models did not support the educational impact of the intervention for all of the students included in the final sample, the use of change scores likely resulted in ceiling effects which produced confounding. The impact of the intervention was revealed in a sub-group analysis of students who were inactive at pretest. The intervention accounted for 16% of the variance in the changes in moderate physical activity among intervention students who were inactive at the pretest; by school, the intervention as able to predict 24 – 78% of the variance in the changes in moderate physical activity. Social support and self-regulation were the constructs which most consistently contributed to the models predicting changes in moderate physical activity among previously inactive adolescents; these constructs were found to mediate changes in behavior, particularly among students at Oak Hill High School. Positive changes in the constructs, coupled with positive changes in behavior and evidence of mediation, support the construct validity of the treatment for social support and self-regulation. The frequency of vigorous physical activity decreased from pretest to post-test when examining the data for the entire sample and remained very stable and low from pretest to post-test when examining the data for the students who were inactive at pretest. Therefore, there was not evidence to support the efficacy of the program to change vigorous physical activity.

The third and final area of the literature within which it is important to review the results of this study is the line of research under which the *Plan for Exercise, Plan for Health* intervention was developed. Eric Winters (2001) began the development of this SCT intervention. The intervention was delivered by a health education specialist, as mini-lessons incorporated into the physical education classes at one Ohio Appalachian High School. Results indicated that the intervention was able to impact self-control for physical activity and moderate physical activity; it was also able to decrease the number of students who were sedentary. Following Flay's model of research in health education (1986), Brian Hortz (2005) used the results of the Winters dissertation to refine the intervention and conduct a pilot study. The refined intervention was then implemented by a health education specialist for a full physical education class, once a week for nine weeks. Results of the pilot study indicated that the intervention was able to impact self-regulation, social support, and moderate physical activity, particularly among students who were sedentary at pretest (Hortz, 2005). An analysis of construct validity of the treatment revealed that changes in the constructs led to changes in behavior (Hortz, 2005).

The current study used the results of the Hortz Dissertation to make curricular revisions, and the study was developed in order to provide a test of efficacy of the intervention. Following Flay's stages of research in health education (1986), this efficacy trial was conducted in several treatment schools (rather than one) and a comparison school, and the study eased up the "ideal" program implementation by using true high school health, physical education, and life-skills teachers to deliver the curriculum rather than a health education specialist. The use of multiple treatment schools and the easing up of an "ideal" implementation are two characteristics of an efficacy trial. The results of the Hortz Dissertation suggest that the intervention was sufficient to impact self-regulation, social support, and moderate physical activity, when conducted under real world implementation contexts. Similar results were found for the current study, but only among a small sample of students who were inactive at the pretest. While evidence existed to support the effects of the intervention on social support, self-regulation, and subsequently on moderate physical activity behavior among previously inactive adolescents, the data analysis was conducted with very small sample sizes. Easing up on the implementation context resulted in a loss of subjects so large that the researchers lost the ability to make true statistical inferences and generalize the results of the study. This takes away our ability to move on to the next line of research, the effectiveness trial. The efficacy trial, using "real world" implementation, should be replicated at least one more time, and changes should be made in an effort to retain enough students to have adequate statistical power and to increase the external validity of the study.

Study Limitations

There are several limitations to this study that should be addressed. The design of the study brings with it problems associated with selection bias. The results of the study indicated a high mortality rate. The time of year that the intervention was delivered and the post-test was administered introduced confounding into the study. The implementation of the study was low, evident by measure of dose received and programmatic reach, which also may have confounded results. Finally, self-report measures were used to estimate physical activity rates and the student return rate was low, leading to an estimate of physical activity with low reliability.

Because teachers volunteered to participate in the study and volunteered to either deliver the intervention or participate as a comparison school, no random selection or random assignment was used. It is possible that there is something different about these teachers who volunteered to participate in the study and then to either deliver the program or serve as a comparison than the teachers who did not volunteer to participate in the study. There are 137 high schools within 29 Appalachian counties in Ohio, and the teachers from four schools in three counties volunteered to participate. Most of the teachers indicated that they were motivated to work with us because we offered participating programs up to $400 worth of equipment for their classes. Although the teachers were recruited from the same geographic area of the state (Appalachia Ohio) and information collected from the Ohio Department of Education indicated they had similar demographics, we cannot assume that the teachers who worked with us were similar to the teachers in the remaining 133 schools in Appalachia Ohio who did not volunteer to work with us. Future studies should attempt to collect information from other schools in the Ohio Appalachian region in order to compare both the students within participating schools to the students in the greater Ohio Appalachian region and to compare those teachers who deliver the program to teachers in the greater Ohio Appalachian region.

This study had a very high mortality rate. Across all schools, 50% of the students dropped out over the course of the study. Between schools, 30 – 70% of the students dropped out over the course of the study. Because the intervention involves a great deal of record keeping, the completion of homework activities, and careful attention to in-class, academic activities, it is likely that those students who remained in the study were more academically driven than those students who dropped out of the study. Less academically driven students are less likely to have completed the daily homework assignments that were required for the pretest and post-test physical activity records. An in depth analysis of subject mortality indicated that differential mortality occurred. Subjects who dropped out over the course of the study differed from those who remained in the final evaluation of the intervention. Particularly, students in the final sample scored lower on the SCT variables and reported more days of vigorous physical activity than those students who dropped out over the course of the study. While further analysis indicated that this high mortality rate did not lead to the groups being unequal at the pretest, the researcher cannot assume that those students who dropped out of the study would have been impacted by the program similar to those who remained in the study. The high mortality rate resulted in an inability to make inferences regarding the effects of the intervention on physical activity behavior based on tests of statistical significance. The high mortality rate also resulted in an inability to generalize the results of the study beyond the students included in the final analysis. Future studies should attempt to decrease the subject mortality rate and to recruit enough students to have adequate statistical power for tests of statistical significance.

Confounding due to seasonality may have been problematic in this study. The intervention was delivered over the course of nine weeks, beginning in early March and ending in late May. The timing of the intervention occurred in such a way that the intervention ended and post-test was completed at the end of the school year. The teachers in each of the intervention schools indicated to the project staff that the students became unmotivated to complete the intervention lessons as the school year came to a close; according to the teachers, this declining student motivation is typical to the end of the school year. The post-test was administered two days before the last day of school at two of the schools and the week before final exams at two of the schools. By this time, school sports had ended and the students were transitioning to a new schedule, either to one of final exams or to one of summer vacation. Further, seasons greatly change in Ohio between March and May. In March, temperatures were cold and snow was still falling; by the end of May the weather had turned hot (in the 80's). Each of these effects, associated with the school year ending and the seasons changing, could have confounded the results of this study. The study should be repeated during the fall semester in order to examine any differential impact of the intervention based on seasonality.

Another limitation to this study was program implementation. While the process evaluation suggested that the program was implemented with adequate fidelity and statistical analysis accounted for dose received and programmatic reach, this was the first attempt within the line of research evaluating the SCT based adolescent physical activity intervention to allow true high school teachers to implement the intervention. The *Plan for Exercise, Plan for Health* intervention was designed so that teachers delivering the program could deliver the intervention with minimal effort; this design strategy was based on the findings from past studies that physical education teachers were unwilling to deliver a curriculum that involved typical classroom teaching, such as lectures, tests, and homework assignments (Hortz, 2005). As a result, the teachers delivering the program used minimal effort to deliver the lesson components. While the lesson evaluation sheets that the teachers completed and returned each week indicated that the teachers delivered over 80% of the lesson components as written (an indication of implementation fidelity), lesson observations revealed that the teachers simply read the entire lessons to the students and asked them to complete the lesson activities as they arose. There was no indication that the teachers prepared for the lessons, there was no discussion added to the lessons to enhance conceptual understanding, and there were no additional examples or activities added to the lessons beyond what was written in the workbooks to enhance student learning. Further, homework assignments were essentially optional for students to complete, as none of the teachers made the intervention homework assignments a graded component of the course.

This low implementation is reflected in the results of the process evaluation. While dose delivered was evaluated as sufficient (teachers delivered over 80% of the lesson components), the low interaction that the teachers had with the curriculum was reflected upon in the measures of dose received and programmatic reach. Students came to class because attendance was a graded component of the courses. Less than 40% of the students completed the intervention homework assignments in the schools that delivered the intervention as part of the physical education courses, however. Less than 15% of the students in each of the intervention schools answered more than 80% of the questions correctly on the post knowledge test; while the intervention reached the students in the intervention schools to a greater degree than the comparison school, scores on the knowledge test indicated a low degree of understanding of the exercise concepts addressed in the intervention. Implementation fidelity was high based on measures of dose delivered, but measures of dose received and programmatic reach indicated that the students were not complying with the program and were not sufficiently grasping the physical activity concepts addressed in the intervention. This could have confounded the impact that the intervention had on the SCT constructs and on physical activity behavior. The problems associated with the implementation of the intervention could be addressed with more rigorous teacher training. The teachers should be taught the behavioral change strategies targeted through the intervention; this may help them convey the information to the students better. The teachers should be trained to lead discussions about the behavioral concepts addressed in the lessons and to contribute specific examples to help the students learn the concepts to a greater degree. Further, the teachers should be trained to include the program components as a graded component of the students' course grades; this may increase the attention paid to the lesson activities on behalf of the students.

The final limitation to this study was the use of self-report measures, and particularly the attempt to use seven one-day recalls to assess physical activity. The use of self-report measures, alone, is problematic in the measurement of physical activity behavior. Self-report measures rely upon the student to accurately recall and report their physical activity behavior, lending itself to self-report bias. Self-report measures are less reliable than objective measures of physical activity (such as accelerometers and heart rate monitors), which introduces error into the measurement (Baranowski et al, 2000; Trost et al, 2000). In order to achieve adequate reliability in a high school sample, between eight and nine days of measurement should be examined with objective measures and close to two weeks should be examined with self-report measures (Baranowski et al, 2000; Trost et al, 2000). According to the literature, the use of 5 days of self-report physical activity data did not provide a reliable estimate of student physical activity. The use of at least one, and preferably two, 7-day recalls could improve the reliability of the physical activity data.

Future Directions

The conclusion of this study leads researchers to further programmatic revisions and replication of the efficacy trial. According to Flay, the next stage of research would be the effectiveness trial, involving large-scale experimental or quasi-experimental trials in real-world settings, with implementation or delivery standardized and carefully assessed (Flay, 1986). Due to the low sample sizes that resulted particularly from the high mortality rate in the current study, the intervention evaluation is not ready to move on to the effectiveness trial. The efficacy trial should be repeated and an effort should be made to revise the program to address some of the problems found in this first efficacy trial. The results of this study warrant a new method of assessing student physical activity rates, strategies to have the teachers interact with students and the curriculum to a degree that increases students receiving the program, an effort to increase the number of students within health and life skills programs participating in the program, and the addition of measures of morbidity and mortality. Only with replication and adequate sample sizes will the efficacy of the intervention truly be understood.

As addressed in the study limitations, the use of five PDPAR logs did not provide a reliable estimate of student physical activity rates. According to the literature, either 8-9 days of objective measurement or two weeks of self-report measures should be used to reliably assess adolescent physical activity (Baranowski et al, 2000; Trost et al, 2000). While the use of either objective measures or more days of self-report measures would provide a more reliable estimate of physical activity, this was unrealistic for the current study. The use of objective measures are obtrusive and very expensive; it is unrealistic to fund and expect 628 high school students across four schools to wear a heart rate monitor or an accelerometer and return it unharmed after 8 – 9 days. Based on the results of the current study, it is unrealistic to expect high school students to complete and return more than five days of PDPAR logs. Perhaps the use of two 7-day exercise recalls could provide a more reliable estimate of physical activity that would neither be too expensive nor too obtrusive to use in future studies.

Implementation, and the measurement of implementation, is another area of research that this study can be improved upon. Given the findings of the process evaluation, particularly addressed in the study limitations, future studies should attempt to increase the quality and degree of teacher implementation. Increasing the dose delivered by the teachers should increase the dose received by the students. The intervention has primarily been delivered by physical education teachers, who may not have been exposed to concepts related to behavioral change. In the future, researchers should try to engage the teachers delivering the program with the curriculum to a greater degree. Efforts should be made to teach the teachers the behavioral change concepts addressed in the curriculum; a greater understanding of these concepts on behalf of the teachers may enable the teachers to provide the students with a greater understanding of the concepts. The teachers should be trained to interact with the students and to monitor the students' involvement with the intervention. Having the teachers work with the students to make sure they complete the evaluation surveys and the logs provided to them as lesson activities would reduce subject mortality, a problem in this study. Training the teachers to require that homework be completed and turned-in as a graded component of the course would increase homework completion, a measure of dose received. Training the teachers to understand the behavioral change concepts addressed in the curriculum will help the teachers incorporate discussion points, examples, and activities to enhance the lessons and students understanding; this may increase programmatic reach. Increasing the programmatic reach and dose received by the students should help to increase the impact that the intervention has on the SCT constructs and on behavior.

Third, this study attempted to recruit physical education, life skills, and health classes to participate in the delivery and evaluation of the intervention; recruitment resulted in a much greater proportion of physical education classes than either life skills or health classes. Future studies should attempt to recruit more health and life skills teachers to deliver the intervention; this will allow for a greater understanding of any differences in impact that may occur within varying classroom settings. This curriculum relies on students completing desk work in class and homework assignments to practice the strategies students learn in the class lessons over the course of the week; students were asked to apply the strategies they learned in the curriculum lessons to a personal physical activity program that they conducted outside of school. While it is a crucial component of the intervention, desk work and homework are not typical components to physical education classes. It would be beneficial to understand whether the curricular components are better suited for health and/or life skills courses, where homework and desk work are typical and expected by the students.

Finally, measures of morbidity and mortality should be added to the evaluation of the curriculum. Particularly for physical education classes, fitness testing is already conducted as part of the class. It would not be very interruptive to the course to take pretest and post-test measures of fitness, such as the Presidential Fitness Challenge, already conducted as part of physical education. Other measures that would be beneficial to the evaluation of the intervention would be measures of health and obesity, such as height, weight, and blood pressure. Such measures would not be too invasive or expensive and could be added into the fitness testing. Adding measures of morbidity and mortality to the evaluation would provide necessary empirical evidence for funding from health agencies. Funding is crucial to future dissemination studies.

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APPENDIX A
RECRUITMENT MATERIALS

TEAM-UP
With The Ohio State University
For Professional Development!!!

The Department of Exercise Science, at the Ohio State University, would like to invite high school physical educators from the Appalachian counties to participate in an innovative program for professional development.

What it is: A lifelong fitness curriculum that has been shown to be particularly effective in helping sedentary students develop physically active lifestyles. The program, especially designed to be integrated into any high school physical education course, teaches students skills to develop a personal exercise program. It involves 10 classes of instruction, delivered once a week during regular physical education classes. All program components are clearly outlined in a student workbook, facilitating instruction of all concepts and activities. Through a series of in-class and home activities, your students will learn skills to lead physically active lifestyles.

What it involves: We would like to invite you to engage in an on-going relationship, in collaboration with OSU and the Ohio Department of Health, to develop and refine this curriculum. How? Teach this program as part of your physical education classes and provide us with feedback!

BENEFITS FOR YOU:

- **RECEIVE GRADUATE CREDIT**: Participating teachers will be enrolled in a course with OSU to receive graduate credit for professional development.
- **CURRICULAR MATERIALS**: Participating teachers will be given student workbooks for all students participating in the program, as well as training in facilitating instruction with the workbook. The workbook will contain all program activities and concepts.
- **EQUIPMENT FOR YOUR CLASSES**: All participating teachers will receive equipment (i.e. pedometers, jump ropes, etc) for student class and home activities. The teachers will be invited to keep all program materials and resources for future classes.
- **PROGRESS REPORTS**: We will be providing all schools with student physical activity and fitness profiles, a technical report detailing student learning, progress reports addressing the impact of the program, and a health promotion plan tailored to the needs of your school.

How to Reach Us: If you are interested in participating in this program or if you would like more information, contact:

Emily Stevens
614-688-8648
stevens.353@osu.edu

To PE Teachers:

We would like to invite you to team-up with faculty at The Ohio State University and the Governor's Healthy Ohioan's initiative to promote health and fitness among your students.

Faculty at The Ohio State University have been field testing an innovative high school program for physical activity promotion for the past 4 years. The educational unit, which could be integrated into any existing physical education class, focuses on teaching students skills to develop a personal exercise program outside of school. The program has proven effective for increasing physical activity, particularly among previously sedentary students.

What does the program entail?

- Ten educational lessons, designed to be integrated into your physical education classes once a week for 10 weeks. This program is packaged in a series of student workbooks with complementing teacher manuals.
- The lessons are designed to teach students self-regulatory skills to develop a successful exercise program. Your students will learn the social and health benefits of regular exercise, how to set objective and measurable personal goals, how to evaluate goals, how to track their own behavior, skills in time management, skills in identifying and developing strategies to overcome barriers to exercising, and how to reward themselves for meeting personal goals.

What will we ask of you?

- We would like you and principal/superintendent to sign a letter of support for working with us to deliver and evaluate this innovative program.
- We would like you to integrate this program into your existing classes once a week for 10 weeks. All participating teachers will be asked to deliver the lessons in their entirety and to assign and collect all in-class and homework activities as a graded part of the class.
- We would like you to attend a one-day teacher training session, where you will receive all curricular materials and training on program delivery. The training days will be held at a regional campus in your area for your convenience.
- We would like you to allow the project co-investigators to visit your classes on two occasions to collect all materials required for us to evaluate this program. This includes parental consent and student assent forms, as well as student surveys about the health and social benefits of physical activity.
- We would like you to allow the project co-investigators to visit your classes on one scheduled occasion to observe the program delivery.
- We would like to develop an on-going relationship with you and your school. We hope to have weekly contact with you and to help your school develop a health promotion plan for the future.

What do we have to offer you for participating?

- **FREE GRADUATE CREDIT**: Each participating teacher will be enrolled in a FREE graduate level class at The Ohio State University. This will provide each participating teacher with graduate credit hours for the purpose of professional development.

- **CURRICULAR MATERIALS**: Participating teachers will be given student workbooks for each student in their classes, as well as a teacher manual for instruction on the lesson concepts. The workbooks will contain all program activities and homework assignments.

- **EQUIPMENT**: Participating teachers will receive free equipment (i.e. pedometers, jump ropes, etc) to facilitate program delivery. Teachers will be invited to keep all program materials and equipment for future classes.
- **WEBSITE ACCESS**: Students and teachers will have access to a website designed to support the objectives of the course.
- **PROGRESS REPORTS**: We will be providing all schools with student physical activity and fitness profiles, a technical report detailing student learning, progress reports addressing the impact of the program, and a health promotion plan tailored to the needs of your school.

If you are interested in your school participating in the delivery and evaluation of this innovative curriculum, or if you are interested in hearing more about the program, please contact me. I can be reached by phone at 614-688-8648 or through email at stevens.353@osu.edu. I will be sending you a copy of this letter by mail in the next week, and I may contact you in the near future to ask if you have any questions.

Sincerely,
Emily Stevens

Rick Petosa, Ph.D.
Health and Exercise Science
Petosa.1@osu.edu
614-292-8345

To Superintendent/Principal:

We would like to invite your school to team-up with faculty at The Ohio State University and the Governor's Healthy Ohioans initiative to promote health and fitness among your students.

Faculty at The Ohio State University have been field testing an innovative high school program for health promotion for the past 4 years. The educational unit, which could be integrated into existing physical education curricula, focuses on teaching students behavior change strategies to increase their physical activity levels. The program has proven effective for increasing physical activity, particularly among previously sedentary students.

What does the program entail?

- Ten educational lessons, designed to be integrated into any health, physical education, or life skills course once a week for 10 weeks. This program is packaged in a series of student workbooks with complementing teacher manuals.
- The lessons are designed to teach students self-regulatory skills to develop a successful exercise program. Your students will learn the social and health benefits of regular exercise, how to set objective and measurable personal goals, how to evaluate goals, how to track their own behavior, skills in time management, skills in identifying and developing strategies to overcome barriers to exercising, and how to reward themselves for meeting personal goals.
- The lessons have been designed to help students practice proficiency skills that they learn in other course areas. Each lesson integrates homework and in-class activities that help students develop skills in reading, writing, critical thinking, and self-evaluation.

What will we ask of you?

- We would like you and your participating teacher(s) to sign a letter of support for working with us to deliver and evaluate this innovative program.
- We would like your physical education teachers to integrate this program into their existing classes once a week for 10 weeks. All participating teachers will be asked to deliver the lessons in their entirety and to assign and collect all in-class and homework activities as a graded part of the class.
- We would like participating teachers to attend a one-day teacher training session, where they will receive all curricular materials and training on program delivery. The training days will be held at a regional campus in your area.
- We would like participating teachers to allow the project co-investigators to visit their classes on two occasions to collect all materials required for us to evaluate this program. This includes parental consent and student assent forms, as well as student surveys about the health and social benefits of physical activity.
- We would like to develop an on-going relationship with your school and participating teachers. We hope to have weekly contact with the participating teachers and to help your school develop a health promotion plan for the future.

What do we have to offer you for participating?

- **FREE GRADUATE CREDIT**: Each participating teacher will be enrolled in a FREE graduate level class at The Ohio State University. This will provide each participating teacher with graduate credit hours for the purpose of professional development.

- **CURRICULAR MATERIALS**: Participating teachers will be given student workbooks for each student in their classes, as well as a teacher manual for instruction on the lesson concepts. The workbooks will contain all program activities and homework assignments.
- **EQUIPMENT**: Participating teachers will receive free equipment (i.e. pedometers, jump ropes, etc) to facilitate program delivery. Teachers will be invited to keep all program materials and equipment for future classes.
- **WEBSITE ACCESS**: Students and teachers will have access to a website designed to support the objectives of the course.
- **PROGRESS REPORTS**: We will be providing all schools with student physical activity and fitness profiles, a technical report detailing student learning, progress reports addressing the impact of the program, and a health promotion plan tailored to the needs of your school.

If you are interested in your school participating in the delivery and evaluation of this innovative curriculum, or if you are interested in hearing more about the program, please contact me. I can be reached by phone at 614-688-8648 or through email at stevens.353@osu.edu. I will be sending you a copy of this letter by mail in the next week, and I may contact you in the near future to ask if you have any questions.

Sincerely,

Emily Stevens, M.A
Health and Exercise Science

Rick Petosa, Ph.D.
Health and Exercise Science
Petosa.1@osu.edu
614-292-8345

APPENDIX B
SCHOOL LETTER OF SUPPORT
&
TEACHER VOLUNTEER FORM

Ohio high schools who wish to participate in the project described below, please submit (1) the teacher volunteer form below and (2) a letter of support from an administrator (details below).

Evaluation of a High School Leisure-Time Physical Activity Curriculum

Project Description

The purpose of this project is to develop and evaluate an educational unit aimed increasing physical activity levels among high school students. The educational unit has been designed to be integrated into existing physical education, health, or life skills classes once a week, for 10 weeks.

The curriculum involves ten lessons, packaged in a series of student workbooks with a complementing teacher manual. The lessons are designed to teach students self-regulatory skills to develop a successful exercise program. Students will learn the social and health benefits of regular exercise, how to set objective and measurable personal goals, how to evaluate goals, how to track their own behavior, skills in time management, skills in identifying and developing strategies to overcome barriers to exercising, and how to reward themselves for meeting personal goals. Each lesson integrates homework and in-class activities that help students develop skills in reading, writing, critical thinking, and self-evaluation.

To participate in this program, we will ask volunteering teachers to deliver the lessons in their entirety and to assign and collect all in-class and homework activities as a graded part of the class. We will ask participating teachers to attend a teacher training session, where they will receive all curricular materials and training on program delivery. We hope to develop an on-going relationship with the school and participating teachers. We hope to have weekly contact with the participating teachers and to help the school develop a health promotion plan for the future.

In order to evaluate this program, we would like to collect data from participating students and teachers. Students will be asked to complete paper and pencil questionnaires regarding the health and social benefits of exercise, as well as exercise logs to document their physical activity levels. Parental consent and student assent will be collected from students before collecting any data to evaluate the program. Teachers will be asked to provide information regarding the degree to which each program component was delivered and the ease of program delivery. They will also be asked to schedule one day when the project staff can come and observer the program delivery in their classes.

We have several incentives to provide the participating schools and volunteer teachers for participating in the project. Each participating teacher will be enrolled in a graduate level class at The Ohio State University, paid for by the grant. This will provide each participating teacher with 3 graduate credit hours for the purpose of professional development. Participating teachers will be given student workbooks for each student in their classes, a teacher manual for instruction on the lesson concepts, and free equipment (i.e. pedometers, jump ropes, etc) to facilitate program delivery. Students and teachers will have access to a website designed to support the objectives of the course. The project staff will be providing all schools with student physical activity and fitness profiles, a technical report detailing student learning, progress reports addressing the impact of the program, and a health promotion plan tailored to the needs of each school.

Teacher Volunteer Form

Please refer to the Project Description, above. Health, physical education, and/or life skills teachers volunteering to deliver the educational unit will participate in the project. The time commitment requires: a total of 2 classes for the project staff to collect parental consent forms, students assent forms, and paper and pencil questionnaires regarding the social and health benefits of exercise; 10 classes of instruction using the program educational unit; and, an average of 30 minutes per week to report to the project staff regarding degree to which program components were delivered, student attendance, and the ease of program delivery. To volunteer, please complete this form and send or fax it to:

Dr. Rick Petosa
268B Cunz Hall
1841 Millikin Rd
Columbus, OH 43210
Email Address: petosa.1@osu.edu Fax: 614-688-3432 Phone: 614-292-8345

Teacher's Name: _________________________ Email_______________________________

Home/Summer Address____

Home Phone_________________________ School Phone___________________________

School Name____

School Address____

How many classes of do you anticipate delivering the program to? ________

I am willing to integrate this program into my existing health, physical education, and/or life skills classes once a week for 10 weeks.

I am willing to deliver the program lessons in their entirety and to assign and collect all in-class and homework activities as a graded part of the class.

I am willing to participate in a training session, where I will receive all curricular materials and training on program delivery.

I am willing to allow the program staff to come to my classes on two occasions to collect student assent forms, parental consent forms, and questionnaires regarding the social and health benefits of exercise from my students.

I am willing to report back to the project staff weekly regarding the degree of lesson activities that were delivered, student attendance, and my evaluation of the lessons.

I am willing to allow the project staff to observe my classes on one scheduled day of program delivery.

Teacher's Signature __________________________ Date______________________

For the School Administrator (Principal or Superintendent)

The section below is addressed to principals or superintendents who have authority to approve that the project occur at their school.

For teachers to participate in the project, we must have letters of support to be submitted to our IRB. The letters are provided below and should be printed on the school's letterhead. This letter indicates that you and the participating teacher(s) understand what is involved in the project and that you will permit the project to take place in your school. Letters can be faxed; they do not need to be original copies. Letters of support should be addressed to:

Dr. Rick Petosa
268B Cunz Hall
1841 Millikin Rd
Columbus, OH 43210
Email Address: petosa.1@osu.edu Fax: 614-688-3432 Phone: 614-292-8345

School Administrator (Principal or Superintendent) agrees to:

1. Permit the volunteer health, life skills, and/or physical education teachers to deliver the program's educational unit in their classes once a week for 10 weeks.

2. Permit the project staff to meet with volunteer teachers for program training.

3. Permit the project staff to visit the school on two occasions for collection of student assent forms, parental consent forms, and data collection.

4. Permit the project staff to visit the school on one occasion for observation of program delivery.

5. The administration agrees to data collection using paper and pencil questionnaires regarding the health and social benefits of physical activity, as well as daily logs of physical activity behavior. (Parental consent will be sought for minors)

Thank you for your consideration in working with us.

Dr. Rick Petosa
Exercise Science
The Ohio State University

Letter of Support for Participation

This letter is a support letter for the research project titled "Evaluation of a High School Leisure-Time Physical Activity Curriculum". This project is being conducted within the Exercise Science Department at The Ohio State University. The researchers have discussed the project with me and I understand that the purpose of this curricular add-on is to have students develop and plan physical activity opportunities outside of school hours.

I understand that this project requires informed consent procedures, that forms will need to be filled out by the students and their parents, and that the entire project will involve one day a week for twelve weeks. I also understand this project will involve class assignments as well as homework. I understand that this curricular component will involve pen and paper assessments only and will not require exercise testing. I am in support of this project and wish to work with the researchers to evaluate this program.

Signature of Administrator: _______________________ Date: _________________

APPENDIX C
PARENTAL CONSENT FORM
&
STUDENT ASSENT FORM

Assent to Participate in Research

Project Title:	**Evaluation of a High School Leisure-Time Physical Activity Curriculum**
Researchers:	Dr. Rick Petosa, The Ohio State University; Dr. Brian Hortz, Denison University

Dear Student,

You are taking a physical education class which will include a new exercise unit. This exercise unit will be taught once a week during your regular physical education class, for 9 weeks. It will teach you skills to develop your own personal exercise program. The unit involves both in-class and homework activities, much like any of the activities you complete in your other classes. Many of the lessons in this exercise unit will ask you to keep records of the exercise you do outside of school. You will also be asked to answer questions about the social and health benefits of exercise.

I would like your permission to use the assignments you complete as part of this physical education class to evaluate the new exercise unit. If you choose to allow me to use the information you provide on assignments, **please sign the bottom of the page**. If you allow me to use this information, you will not be asked to do anything beyond the activities and homework assignments that are a part of your class. If you choose not to allow me to use this information, simply do not sign this form. You will still complete all of the in-class and homework activities as part of physical education class; however, I will not use your assignments to evaluate the exercise unit. Please read the entire form before making a decision.

Signing the form
I have read (or someone has read to me) this form. I have had a chance to ask questions before making up my mind. I am providing permission for Ohio State and Denison to use the assignments I complete in physical education class to evaluate a new exercise unit.

AM/PM

Signature or printed name of subject **Date and time**

1. What is this study about?
The exercise unit has been designed to teach you skills to develop your own personal exercise program. The purpose of the unit is to increase exercise outside of school. If you agree to participate, we will be using the assignments that you complete for class to evaluate the lifestyle fitness unit.

2. What will I need to do if I am in this study?
The exercise unit involves both in-class activities and homework activities, much like any of the activities you complete in your other classes. As part of the lesson activities within this class, you will be asked to keep records of your exercise. You will also be asked to answer paper and pencil questions about the social and health benefits of exercise.

3. How long will I be in the study?
The exercise unit will be taught once a week, during your regular physical education class, for 9 weeks. During each class, you will be completing activities which teach you skills to develop a personal exercise program. For homework, you will be keeping records of your exercise.

4. Can I stop being in the study?
You may stop being in the study at any time. If you decide to stop being in the study, you will still complete all of the in-class and homework activities assigned for the exercise unit. We will not use the assignments you complete to evaluate the program, however.

5. What bad things might happen to me if I am in the study?
If you provide permission to be included in the study, you will not be asked to do anything other than what you are already doing within your physical education class. You are giving us permission to use the assignments you complete in physical education class to evaluate the exercise program.

6. What good things might happen to me if I am in the study?
You will learn how to develop a personal exercise program. You will also be given the opportunity to join an exercise club, as a continuation of this program.

7. Will I be given anything for being in this study?
You will be given a student workbook, which contains all of the in-class and homework activities, needed for the exercise unit. You will also be given a step counter to complete the program activities.

8. Who can I talk to about the study?
For questions about the study you may contact **Rick Petosa or Emily Stevens, at 614-688-8648**.

To discuss other study-related questions with someone who is not part of the evaluation team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.

Parental Permission
For Child's Participation in Research

Project Title: **Evaluation of a High School Leisure-Time Physical Activity Curriculum**

Researchers: Dr. Rick Petosa, The Ohio State University; Dr. Brian Hortz, Denison University

Dear Parent,

Your child is currently enrolled in a physical education class. The physical education teacher is working with The Ohio State University and Denison University to deliver a new educational unit within your child's class. This new unit teaches students how to set up a personal exercise program. We would like your permission to use the assignments that your child completes as part of this class to evaluate the new physical education unit. You may provide us with permission by **signing this parental consent form**. Please read the entire form before making a decision.

I have read (or someone has read to me) this form and I am aware that I am being asked to provide permission for my child to participate in a study to evaluate a new physical education unit. I have had the opportunity to ask questions and have had them answered to my satisfaction. I voluntarily agree to permit my child to participate in this study.

I am not giving up any legal rights by signing this form.

Printed name of subject

Printed name of person authorized to provide permission for subject	**Signature of person authorized to provide permission for subject**
Relationship to the subject	**AM/PM** **Date and time**

Purpose of the Study : The Ohio State University and Denison University have developed a new physical education unit. The program is designed to increase student's exercise after school. By evaluating what students learn, we can help physical educators better understand the impact this program produces.

Procedures/Tasks: The physical education unit will be taught once a week, for 9 weeks, during regular physical education classes. The unit involves both in-class activities and homework activities about planning for regular exercise. Your child will be asked to keep track of their weekly exercise using paper and pencil records. They will also be asked to complete paper and pencil questionnaires about the health benefits of exercise.

Duration: The exercise unit will be taught once a week during regular physical education classes, for 9 weeks

Risks and Benefits: Your child will not be asked to participate in any activities beyond the scope of typical physical education classes. This curriculum has been evaluated and has shown to be effective particularly among previously sedentary adolescents. This evaluation will provide physical educators with a new approach for teaching students to develop exercise programs to promote health.

Incentives: Your child will receive a student workbook and a step counter free of charge. The high school will be receiving curricular materials and equipment to use in the physical education program.

Participant Rights**: If you and your child choose to participate in the study, you may discontinue participation at any time without penalty or loss of benefits. Your child will complete all of the class and homework activities as part of his/her physical education class, but we will not use his/her assignments to evaluate the exercise unit.**

Institutional Review Boards responsible for research involving human subjects at The Ohio State University and Denison University reviewed this research project and found it to be acceptable, according to applicable state and federal regulations and University policies designed to protect the rights and welfare of participants in research.

Contacts and Questions: **For questions, concerns, or complaints about the study you may contact either Dr. Rick Petosa or Emily Stevens, at 614-688-8648.**

For questions about your child's rights as a participant in this study or to discuss other study-related concerns or complaints with someone who is not part of the research team, you may contact Ms. Sandra Meadows in the Office of Responsible Research Practices at 1-800-678-6251.

APPENDIX D
SCT CONSTRUCT SUBSCALE SUMMING SCHEME
&
PDPAR CODING SCHEME

PDPAR Coding Rules

Leisure-Time Moderate Physical Activity:

- Activity Codes 21-27, 29 (walking fast), and 32 (Lifting Weights) are coded as moderate physical activity **ONLY** if they are ranked as medium or high intensity activities
- The maximum consecutive ½-hour blocks of moderate physical activity coded will be 4 blocks, equal to 2 consecutive hours of moderate physical activity
    - Multiple bouts (up to 4, ½-hour blocks) will be coded, making it possible for a student to have >4 blocks of Moderate PA in one day

Leisure-Time Vigorous Physical Activity

- Activity Codes 28, 30, 31, 33, 35 will be coded as Vigorous Physical Activity **IF** the student rates it as a high intensity activity, up to 2 consecutive ½-hour blocks.
    - If the student rates the above activity numbers as medium intensity activity, it will be coded as Moderate Physical Activity
    - If the student rates the above activity numbers as light intensity, it will be coded as Moderate Physical Activity
- If the student records more than 2 consecutive ½-hour blocks of Vigorous Physical Activity, it will be coded as Moderate Physical Activity
    - Multiple bouts (up to 2, ½-hour blocks) will be coded, making it possible for a student to have either >2 blocks of Vigorous PA or >4 blocks of Moderate PA in one day

Organized Sports

- Activity numbers 26 & 34 will be coded as organized sport participation.

Physical Education

- Physical Activity recorded for 1-4 consecutive ½ hour blocks in the middle of the school-day (week day), consistently (for 3-5 days per week), will be coded as physical education class

Activities of Daily Living

- Activity codes 8,9,10,12,19,20 will be coded as activities of daily living if the student ranks it as either a medium or high intensity activity
    - All ADL's will be interpreted as Moderate PA

Summing the SCT Subscales

Self-Efficacy

se1pre + se2pre + se3pre + se4pre + se5pre + se6pre + se7pre

Social Situation- Total

ssfriepretot + ssfampretot

Self-Regulation

sr1pre + sr2pre + sr3pre + sr4pre + sr5pre + sr6pre + sr7pre + sr8pre + sr9pre + sr10pre + sr11pre + sr12pre + sr13pre + sr14pre + sr15pre + sr16pre + sr17pre + sr18pre + sr19pre + sr20pre + sr21pre + sr22pre + sr23pre + sr24pre + sr25pre

Outcome Expectancy-Values

(oe1belpre * oe1valpre) + (oe2belpre * oe2valpre) + (oe3belpre * oe3valpre) + (oe4belpre * oe4valpre) + (oe5belpre * oe5valpre) + (oe6belpre * oe6valpre) + (oe7belpre * oe7valpre) + (oe8belpre * oe8valpre) + (oe9belpre * oe9valpre) + (oe10belpre * oe10valpre) + (oe11belpre * oe11valpre) + (oe12belpre * oe12valpre) + (oe13belpre * oe13valpre) + (oe14belpre * oe14valpre) + (oe15belpre * oe15valpre) + (oe16belpre * oe16valpre) + (oe17belpre * oe17valpre) + (oe18belpre * oe18valpre) + (oe19belpre * oe19valpre) + (oe20belpre * oe20valpre) + (oe21belpre * oe21valpre) + (oe22belpre * oe22valpre) + (oe23belpre * oe23valpre)