School Health Screening and the Utility of Acanthosis Nigricans to Assess for Metabolic Change

Dissertation

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By

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Abstract

Dietary behaviors begin in the first few years of life, with the child adopting the eating habits of the family. The current pattern of the American diet reflects the consumption of calorie dense, low nutritional quality foods. As a result, Americans have become obese and significantly undernourished. Combined, nutritional inadequacy and obesity are drivers for the development of insulin resistance and subsequent chronic health conditions such as hypertension, dyslipidemias and impaired glucose tolerance. This constellation of chronic metabolic disorders that cluster around obesity and insulin resistance are known as the metabolic syndrome. Yet, in pediatrics the metabolic syndrome as a diagnosable entity remains controversial due to changes in growth and development. Despite its criticisms, the metabolic syndrome may be used as a framework to offer important information about risk for cardiovascular disease. Evidence presented herein, demonstrated that very young, pre-pubertal children have manifest metabolic syndrome-like components. Furthermore, the metabolic profile among Caucasians and African American children were starkly different, indicating that the development of metabolic syndrome is unequal between races. Other studies have documented that among obese children with the metabolic syndrome phenotype, early functional and morphological changes to the heart and blood vessels develop silently and without warning. Therefore, screening is our most effective public health strategy to identify imminent health risks at the earliest stage possible. However, despite primary care guidelines that direct pediatricians to conduct assessments for obesity, compliancy remains
low. In response, schools across the nation have taken action, initiating screening for body mass index (BMI). Acanthosis nigricans (AN) have also been adopted by some school districts as an opportunity to augment information on BMI. Screenings conducted for this dissertation manuscript indicated the prevalence of AN to be greatest among severely obese, African American children in elementary school. Findings of AN, when coupled with information on BMI, should alert the screener that more invasive health evaluations are necessary. Additionally, evidence from screening direct prevention and treatment efforts. Regardless of the school nurse’s extensive assessment efforts, health screening information is only truly effective when acted on by the parent and the child’s pediatrician. As demonstrated in the research presented herein, significant barriers that preclude parent follow-up were evident among parents and school nurses. Furthermore, school nurses indicated that pediatricians impede the success of their scope of practice. Despite effective screening methodologies, major ramifications to the health of the obese child are at stake if barriers to the health assessment process are not overcome. Without the acceptance of pertinent screening information that signify impending health risk, the task of motivating Americans to change nutrition and lifestyle behaviors that precede obesity appears impossible.
Dedication

Dedicated to my parents, James and Louise Battista. The life lessons you have taught me are invaluable. Your undying love, endless support and your acceptance of my inquisition and independence has enabled me to soar and reach for my dreams.

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Field of Study

Major Field: The Ohio State University Nutrition (OSUN) Graduate Program
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Chapter 1: Introduction

Adequate nutrition is essential to maintain functional demands of the body

Adequate nutrition is defined as a state where 1) the nutrient demands of the body to support normal metabolic and physical function are met, as well as 2) a nutrient storage surplus that can be utilized in times of increased nutritional demands. In the United States (US) nutritional adequacy is met by a set of evidence based dietary standards and reference intake values. The Dietary Guidelines for Americans is one public health strategy to promote health and disease prevention through the consumption of a healthful diet and physical activity. From the perspective of nutrition, the guidelines provide Americans with recommendations on how to achieve dietary patterns that meet an optimal total diet. The Report of the Dietary Guidelines Advisory Committee for the 2010 Dietary Guidelines for Americans implicates that the latest guidelines will integrate information on nutrient and energy intake to provide Americans with a more practical diet approach that is inclusive of calorie balance and the consumption of nutrient dense foods. Unlike the Dietary Guidelines that address broad food consumption patterns, the Dietary Reference Intakes (DRI’s), are standards of essential micronutrient adequacy which meet the nutritional needs of practically all healthy Americans. The DRI’s consist of four different reference values: Adequate Intakes (AI), Estimated Average Requirement (EAR), Recommended Daily Allowance (RDA), and Tolerable Upper Intake Level (UL). These benchmarks are widely used in a practice or clinical based setting as a baseline reference for the assessment and planning of
usual dietary intake and the detection of nutritional inadequacy among individuals and subgroups.  

When the essential nutrient consumption is inadequate to meet the nutritional demands of the body, nutritional status deteriorates. This is classified as poor-nutrition. Chronic nutritional depletion, which results in deficiency of one or more essential nutrients, persists over time to diminished bodily function. Often poor nutritional status is followed by the onset of morbidity and, all too commonly, mortality.  

Currently macronutrient (carbohydrates, protein and lipid) and micronutrient (vitamins and minerals) deficiencies affect 1/6th of the world’s population in both developed and developing nations. Obtaining adequate nutrition is problematic as the availability and accessibility of high nutrient quality, calorie rich foods is challenging. Poverty and policy constraints further exacerbate the issue. Shortfalls in the global diet have resulted in malnutrition and deficiencies of several key essential nutrients, including but not limited to, vitamin A, iron, folic acid, calcium and zinc. Deficiencies among these nutrients have raised significant public health challenges on a global scale as their deficits present a unique set of health consequences. For example in developing nations, vitamin A deficiency is likely the most prominent essential nutrient deficiency, with more than 125 million children under the age of 5 years having inadequate intakes of vitamin A. Vitamin A is critical for immunity, growth and development among infants and toddlers. A deficiency may result in the loss of sight, increased susceptibility to illness and in severe cases mortality.
Dramatic shifts in the nutritional composition of the American diet have occurred over the last 100 years. The current eating habits are characterized by a high calorie, nutrient poor diet. This has essentially lead to an American public that is overweight and significantly undernourished.

Historically, the US has experienced periods of depressed nutritional status. It was through the recognition of overt symptoms that catalogued nutritional deficiencies as the root cause of several morbidities and even mortality. This was particularly evident among individuals deficient in essential B vitamins (pellagra, beriberi, xerophthalmia), vitamin C (scurvy) and vitamin D (rickets). Such discoveries at the turn of the century underscored the relationship between inadequate nutrition, illness and mortality. Economic wealth in the US lead to the stabilization of nutritional status by the mid-20th century. Several studies beginning in the late 1940’s recorded the steady improvements in nutritional status. Although most individuals met nutritional requirements during this time, deficiencies in vitamin A, iron and ascorbic acid persisted among certain sub-populations, particularly among children, the elderly and individuals of lower socioeconomic status. From the early 1900’s, up until the mid-1970’s, food energy consumption (calories) remained consistent, despite shifts in the macronutrient composition of the US diet. Over a 70 year span, consumption of fats consistently increased from 127 g per day to 158 g per day, with a subsequent decrease in carbohydrates from 497 g per day to 388 g per day.

In the 70’s an important nationwide survey examined nutrient intakes and current nutritional status of the US population. To date, the National Health and Nutrition Examination Survey (NHANES) is our nation’s best source of vital health statistics. NHANES is not only responsible for yielding assessments of the nation’s nutritional status,
but also serves as the cornerstone for health promotion and disease prevention. A recent review\(^8\) summarized the trends in energy and nutrient consumption from years 1971-74, 1976-80, 1988-94, 1999-2000 that were derived from the NHANES. Findings from these cross sectional examinations implicated trends that were consistent with increased energy intake, mainly among adults.\(^8\) The increase in energy consumption corresponded to rising rates of obesity among both adults and adolescents today, is considered the impetus for the epidemic of obesity. Shifts in the macronutrient composition of the American diet during the second half of the 20\(^{th}\) century were met with a decline in overall fat consumption and an increase in total carbohydrate composition. Despite increased calorie consumption and a shift in macronutrient make-up, spanning over the past 30 years, inadequate levels of micronutrients were also reported among specific subgroups. Among them were calcium, particularly among children and adolescents, and iron, lowest among adolescent girls and low income women.\(^8\) Previous problem nutrients, such as folate and vitamin A, were reported to be adequate,\(^8\) which quite possibly is due to the intensive fortification programs of these nutrients to ensure their sufficiency in the American diet.\(^9,10\) One of the NHANES surveys, the Health Eating Index (HEI), measured diet quality among Americans. The most recent HEI taken in 2000, indicated that 74% of Americans needed substantial improvement in their diet, as key food groups such as fruit, vegetables and dairy were inadequately represented.\(^8\) Behavior plays a crucial role in driving the decision making process implicated in food choice. The inundation of processed snack and convenience foods and sugar sweetened beverages into the market place is responsible for contributing an American diet that is nutrient poor and calorie dense. Nearly 25% of total calories consumed daily are comprised of such nutritionally poor food choices.\(^11\) Collectively, these data suggest that the shift in
diet pattern of Americans is consistent with the selection of foods that are high calorie and of poor nutritional quality and are at the expense of including foods in the diet that are highly nutritious.

*Dietary behaviors are established in the first years of life, with the child adopting the eating habits of the family.*

Dietary preferences are cemented in the first two years of life and the nutritional choices available to the infant and toddler is highly dependant on the diet of the family. 12,13 So it is no surprise that these trends in the consumption of poorer nutritional quality foods are apparent among infants and toddlers living in the US. In 2006, The Feeding Infants and Toddlers Study (FITS) 14 chronicled the major sources of energy and nutrients in the diets of infants and toddlers, birth to 24 months, in the US. Conclusions from these studies were alarming and indicated that as infants move from a breast milk or formula- based diet to complementary foods, the nutritional quality of the diet, in certain areas, significantly declined. For example, significant energy (calories) sources in the diet of 6 to 11 months old toddlers include 100% Juice, contributing 4.4% of total energy, cookies and baby food desserts contributing 1.8% and 1.6% of daily energy, respectively. From 12 to 24 months, 100% juice and sugar-sweetened beverages contributed 6.4% and 4.7% of daily energy, respectively. Fruits and vegetables are scarce in the diets among US infants and toddlers. 14 However, despite this decline in the consumption of nutrient dense foods, the nutritional status of US infants and toddlers is adequate for most nutrients. 15 Using vitamin A as an example, in both toddler sub-groups, the consumption of vitamin A rich vegetables declines as the child ages. Nutritionally, toddlers appear to be satisfying their vitamin A requirements.
through the consumption of fortified cereals and supplements. In fact, for toddlers 12 to 24 months, vegetables do not appear on the list of top 26 energy sources and for vitamin A. Nutritionally rich sources such as sweet potatoes, are being displaced by foods like eggs and fortified sweetened beverages.  

The NHANES and FITS series has shown a rapid shift in the American diet. Yet, unlike nutritional deficiencies among developing and third-world countries, which are characterized by macro and micronutrient insufficiency, obesity is marked by macronutrient surplus, yet essential nutrient inadequacy. This is novel. In fact, the 2010 Dietary Guidelines Advisory Committee, explicitly states that the latest guidelines are distinctive from previous recommendations as they address an American public, in which many are overweight, obese and significantly undernourished. The challenges of nutrient inadequacy for the obese individual are starkly different than those who suffer from nutritional deficits of the combined macro and micronutrient type, as it is predominantly driven by behaviors resulting in excess consumption of nutrient poor foods; that is foods high in calories, fats and sugars and increased sedentary lifestyle. The revolution of the obesogenic environment has now allowed for vast availability of nutrient-poor choices, encouraging consumers to establish eating patterns that are consistent with eating more energy than necessary, yet providing few essential nutrients than required. Major conclusions in the Dietary Guidelines Advisory Committee for the 2010 Dietary Guidelines for Americans report indicated that for children, energy intake from solid fats, added sugar, sodium and refined grains are high enough to raise concern. The committee encourages concentrated public health efforts across all segments of society to reverse the current dietary trends among Americans.
The development of chronic conditions and disease are associated with inadequate nutrition and excessive body weight. Screening is our most effective public health strategy to restore nutritional quality and reverse the co-morbid burden.

As quality nutrition is important in maintaining optimal physiological function and managing disease, poor nutrition is implicated in disease etiology. In both macro and micronutrient deficient and obese states, failing health often results in disease due to chronic deficits in nutritional status. This represents not only a lifelong personal health burden, but also a strain on economic and societal resources that are required to mitigate morbidity and mortality. Therefore, public health efforts seek to continue to promote health and reduce disease risk through optimal dietary intake that emphasizes prevention, yet address intervention. Setting the benchmark for prevention and intervention strategies first involves the awareness of an individual’s current health status. Alerting the public through screening is an effective, cost beneficial strategy. Screening in any capacity involves the use of measures that detect the presence or absence of adverse health conditions, where additional tests are required to confirm a diagnosis. The premise of screening is to find a condition or disease before overt clinical symptoms manifest. Nutritional screening assessments, are critical not only for the identification and verification of a nutrient deficiency (or excess), but also for shaping the decision-making of prevention guidelines, nutritional intervention support and national policy strategies to overcome nutritional deficits.

The techniques used to evaluate and interpret the characteristics and risks of health and nutritional status vary. Initial nutritional screenings that capture diet pattern and usual dietary intake of a specific nutrient(s) rely on tools, such as a 24-hour diet recall or food frequency questionnaire. DRIs, may be used as standards to assess usual dietary intake
captured by dietary assessment tools. Based on their interpretation, if nutrient deficiency is suspected, further screening assessments may be warranted. That is, along the course of the disease process, symptoms and signs of failing health may not be overt. This requires the clinician to scrutinize the patient with information from family and past medical history and physical examination. For example, physical findings and biochemical assessments may yield more specific information about the individual’s health status in response to nutrient deficiency than dietary intake and assessment tools alone. The degree to which the depletion of nutritional status affects health related outcomes will impact the prevention or intervention strategies that are selected to overcome nutritional deficiencies. Further, several public health interventions, such as food fortification and supplementation programs have been employed and have proven successful at improving nutritional quality and restoring nutritional status on both the individual and population levels.\textsuperscript{10,18}

In the US, although obesity is associated with nutritional deficiencies, the degree to which they present are not on the level of severity as that seen among developing and third-world nations; this is, in part due to a steady stream food supply, strong policy and advocacy for fortification and supplementation, and the interest of public and private financial stakeholders to sustain food based and alternative nutrition programs within developed nations.\textsuperscript{19} In developed countries, nutritional deficits among obese individuals often manifest chronic, physical diseases such as hypertension, type 2 diabetes mellitus and cardiovascular disease rather than specific, individual nutritional deficiencies. For example, the alarming increase in the prevalence of childhood overweight (BMI \( \geq 85^{th} - 94^{th} \) percentile) and obesity (BMI \( \geq 95^{th} \) percentile)\textsuperscript{20} during the last decade has given rise to early clinical, physiological and functional changes to the vascular system, thus increasing risk for future
diabetes and cardiovascular events. The presence of such metabolic risk factors combined with poor dietary habits may have a more serious effect on health related outcomes, not only as the child ages through adolescences, but as they enter adulthood.

Screening is our most effective public health strategy to identify adverse health and nutritional risks at their earliest stage of disease progression. In addition, the basis of nutrition and health prevention and intervention guidelines is predicated on outcomes from assessment and screening of usual nutritional and health status. Using the obese child as an example, timing is critical. The assessment of high risk obese children may be a great opportunity to identify health risks early in the disease process. Without screening, chronic conditions such as insulin resistance, elevated blood pressure, hyperlipidemia, and glucose intolerance remain hidden, as the child appears healthy. In children the cardiovascular system remains plastic and capable of reversing injury provided that early and appropriate interventions are established. So, early identification is critical. Furthermore, childhood offers a time to shape optimal nutrition and physical activity to establish a lifelong commitment to behaviors supportive of health.

*BMI screenings have been recommended for pediatrics and should be conducted at least annually.*

BMI is the most important clinical tool to combat childhood obesity. National recommendations have urged pediatricians to screen for BMI as a mechanism to identify early risk for diabetes and cardiovascular disease. Regardless of national directives, *BMI screening has been slowly adopted* into standard of care practice. Pediatricians cite a lack of parent involvement, lack of patient motivation, reimbursement and insufficient support
services for the appropriate follow up care for their patients as reasons to bypass BMI screenings. The Expert Committee on the Assessment, Prevention and Treatment of Childhood and Adolescent Overweight and Obesity recommend BMI screenings during well child check-ups, at least annually. Well child visits coincide with developmental milestones, making them a prime opportunity to screen for BMI early in the child’s life and track the trajectory of weight change as the child grows. Failure to screen for obesity is a disservice to the health of the child now and in the future.

If screening for obesity is not being conducted consistently at the child’s pediatrician’s office, there needs to be other opportunities for BMI assessment. The reluctance among pediatricians to evaluate obesity has created an urgency among schools to conduct high quality health screenings for BMI. National Association of School Nurses (NASN) and the American Academy of Pediatrics Council on School Health (AAP-CSH) have emphasized the role of the school nurse to take the lead as the health authority in the school building. States such as Arkansas have positioned themselves in the forefront of BMI screening and surveillance in schools across the state. Successes of the multifaceted initiative to prevent and reduce childhood obesity included the development of policy that focuses on nutritional and physical activity standards, creating awareness among parents, and reaching a flat line in childhood obesity rates. Despite the successes seen in Arkansas, the evidence is still not compelling enough for the Centers for Disease Control and Prevention. Most concerning is the communication of sensitive health screening information on excess body weight. A review conducted by the CDC cautioned against BMI for screening purposes, concluding that BMI may have negative consequences on the child and family, as information reporting has created resistance from families. Other studies
have confirmed a negative parental perception about school based BMI screenings, viewing such health assessments as unimportant.\textsuperscript{28} In addition, the information is not being acted upon as parents fail to follow though with health screening directives recommended by the school nurse.\textsuperscript{29,30} To reinforce to parents the health concerns that are related to obesity, some school districts have begun to utilize other biomarkers such as acanthosis nigricans (AN) to identify emerging health risk.\textsuperscript{31} Strong evidence indicates that AN is a reliable clinical marker for hyperinsulinemia.\textsuperscript{32,33} Despite concerns from the CDC\textsuperscript{34} that AN is not a good screen for type 2 diabetes, the evidence is quite compelling that high insulin levels fuel the development of metabolic changes that lead to chronic diseases. AN may afford the best opportunity to identify early changes in metabolism that are associated with type 2 diabetes and cardiovascular disease.\textsuperscript{35,36,37} What is missing is information on how to screen, at what age and at what cost. Furthermore, evidence of AN as a marker for metabolic changes may be an ideal way to help families overcome barriers seen with communicating information about their child’s weight.\textsuperscript{38}

\textit{AN is a physical manifestation of metabolic changes and may be an important augment to BMI information.}

BMI is representative of health risk; where as AN signifies a tangible sign of metabolic trouble in the body. When found together, BMI and AN are an immediate prompt for further, more invasive scrutiny of the child’s health status.\textsuperscript{22} Communicating information to parents with AN as the focus, presents an opportunity to approach childhood obesity from the perspective of comprised health, as opposed to the cosmetic concern that obesity often implies.\textsuperscript{38} A secondary benefit to screening is the prospect of prevention and intervention
through nutritional support, given the strong association between chronic disease and nutrition. Through strong evidence base guidelines, we have the potential to change the trajectory of obesity through behavioral change that emphasizes optimal nutrition and daily activity. Therefore, the opportunity to educate families on the relationship between health and nutrition and the importance of improving their child’s health status through a well balanced diet and daily activity is critical at this step. Mounting evidence in support of optimal nutrition, physical activity, and weight maintenance to ameliorate obesity and therefore lessen health risk, has prompted the Expert Committee to establish nine core messages that clinicians should reinforce as preventative and treatment strategies, applicable both for low-risk and high-risk children. Evidence-informed prevention and treatment goals should focus on:

1) Limiting sugar-sweetened beverages
2) Encouraging a healthful diet with at least 9 servings of fruits and vegetables
3) Limiting television and screen time to 2 hours a day or less
4) Eating breakfast daily
5) Limiting eating out away from home
6) Encouraging family meals
7) Limiting portion sizes
8) Engaging in 1 hour or more of moderate to vigorous physical activity each day
9) Breastfeeding exclusively until 6 months of age
The culmination of persistent screening efforts, particularly in a school based setting and evidence based prevention and intervention guidelines that strive to enhance the nutritional quality of the diets of American children and mitigate chronic health problems associated with obesity in childhood has inspired this dissertation. Overall, the investigations leading to the results and conclusions described herein are based on the following hypothesis and aims:

**Hypothesis**

An as a screening tool to augment BMI will 1) identify children at increased risk for diabetes and cardiovascular disease and 2) serve as an effective communication strategy to discuss health risks and raise urgency among families.

![Figure 1: The Optimal School Based Screening Process](image)
Overall Aim
Investigate the utility of AN as a school based screening tool to 1) augment screening information on body mass index and 2) identify a subset of children at risk for metabolic change.

Aim 1
Determine the association of the presence or absence of AN to demonstrate metabolic changes that signify developing health risk.

Sub-Aim 1.1
Investigate the use of a continuous metabolic syndrome score to establish metabolic risk among pre-pubertal children with AN in two ethnic sub-populations.

Aim 2
Determine the utility of AN with BMI as a health screening strategy.

Sub- Aim 2.1
Determine the frequency of AN in association with increasing or decreasing BMI among a low-socioeconomic, ethnically diverse population of elementary school age children.

Aim 3
Explore parental attitudes, perceptions and actions to the screening, notification and referral process specifically around AN health screenings.

Aim 4
Determine the perception of the school nurse towards obesity in childhood and the attitudes and perceptions that school nurses have towards the health evaluation.
Chapter 2: Review of the Literature

*Childhood obesity has increased alarmingly over the last decade.*

National trends in childhood obesity over the last 50 years have shown a dramatic increase in prevalence. During the decades of 1960 and 1970, rates of obesity among children hovered at 5%. The late 1970’s marked an abrupt increase in childhood overweight and obesity. By 2000, the prevalence had risen from 10.5%, 11.3%, 7.2%, to 15.3% and 10.4% among 12-19 year old, 6-11 year old and 2-5 year olds children and adolescents, respectively. 39 The most rapid and sharpest increase in childhood overweight and obesity occurred from 2000-2006, particularly among children aged 2-5 years. 40 Prevalence of overweight and obesity in this age group leaped from 10% to nearly 13%. Among children and adolescents 6-19 years old a more steady increase of overweight and obesity from 15%-17% was noted. 40 Combined, these data illustrated that the epidemic of childhood overweight and obesity has increasingly affected children of younger ages over time.

National rates of childhood overweight and obesity currently holds steady at 32%. 40 On the state level, Ohio exceeds the national average of childhood overweight and obesity. An assessment of Ohio’s 3rd grade children was conducted by the Ohio Department of Health in 2004. 41 Three hundred eighty- seven elementary schools and 14,543 children were included in the screening for BMI, according to CDC guidelines. 20 These data indicated that 37.6% of Ohio’s 3rd grade children were identified as overweight and obese. 41 Here in Franklin County, prevalence was equal to that found at the state level, with 37.6% of 3rd
grade children classified as overweight and obese. Nearly half of the children identified, clustered within the obese sub-category. Comparing urban regions to rural regions of Ohio, total rates of overweight and obesity among 3rd graders were similar. A more concentrated assessment of BMI was conducted by the Columbus City School District during the 2007-2008 school year. Among 4,287 3rd grade children, 42% were classified as overweight or obese. Sixty percent of these children were classified within the obese sub-category. Collectively, the statewide and local assessments of BMI among Ohio’s youth indicated that overweight and obesity in childhood is widespread and the proportion of children identified as obese equal or exceeds the number of children identified as overweight. Due to the higher incidence of obese BMI seen among our youth, the CDC has recently revised their BMI guidelines to include BMI > 97th percentile and reflects a subset of children and adolescents who are severely obese.

Obesity derived insulin resistance precedes metabolic change associated with the metabolic syndrome.

Coinciding with increasing rates of excess body fat in childhood has been a rise in the incidence of co-morbid conditions that include: hypertension, hyperlipidemia, and type II diabetes mellitus (diabetes), among others. Researchers estimate that upwards of 45% of all newly diagnosed cases of diabetes are of type 2 origin among children and teens. Already 7% of the adolescents between the ages of 12-19 have impaired fasting glucose, or pre-diabetes, a stage that can advance to type 2 diabetes. Genetics and lifestyle steer the course of diabetes progression. As insulin resistance worsens, fasting levels of glucose become abnormal. Over time diabetes may ensue in susceptible children.
Insulin receptors are found ubiquitously throughout the body. Therefore its role spans beyond the control of blood glucose. For example, insulin is responsible for the regulation of fat storage through the esterification and reesterification of free fatty acids. Insulin also controls free fatty acid release from the adipose tissue through the suppression of hormone sensitive lipase (HSL). Increased body fat leads to a decrease in insulin effectiveness. To compensate, the body increases insulin output after a meal to normalize blood glucose levels, a condition characterized as **insulin resistance**. Several mechanisms have been implicated in the development of insulin resistance among obese individuals including the release of inflammatory cytokines from the adipose cell that inhibit downstream molecules in the insulin signaling pathway, ectopic lipid accumulation and fatty acid spill-over from adipose to non-adipose tissues, and hyperglycemia (glucotoxicity) that increases the production of reactive oxygen species (ROS) resulting in decreased GLUT-4 translocation (Table 2). \(^{46,47,48}\)

*Figure 2: Widespread metabolic dysregulation in the insulin resistant state.* 
*Adapted from Lewis et al.* \(^{47}\)
Originally, it was Gerald Reaven\textsuperscript{49} that described the relationship between excess body weight, hyperinsulinemia, glucose intolerance, hypertension and free-fatty acid metabolism and their association with cardiovascular disease. In his Banting Lecture,\textsuperscript{49} Reaven first hypothesized that the state of insulin resistance was the driver for broad metabolic changes that represented the common pathophysiological link between seemingly disconnected metabolic events.\textsuperscript{49} Reaven’s recognition of a cluster of metabolic risks inclusive of excess body weight, hyperinsulinemia, glucose intolerance, dyslipidemia and hypertension was among the earliest conceptual framework for the \textit{metabolic syndrome}. The term \textit{metabolic syndrome} was first intended to describe how environmental and genetic factors work together to produce a constellation of chronic metabolic disorders.\textsuperscript{50} Furthermore, the collective parts of the syndrome may help to identify a subset of individuals at greatest risk for cardiovascular disease and thus in urgent need of lifestyle intervention. Clinically, Reaven’s\textsuperscript{49} concept of an association of metabolic conditions has been far overshadowed by the quest to make the metabolic syndrome a diagnosable entity in the adult population and the pediatric population, to a lesser extent. The National Cholesterol Education Program (NCEP),\textsuperscript{51} the World Health Organization (WHO),\textsuperscript{52} and the International Diabetes Foundation (IDF)\textsuperscript{53} each have offered unique definitions of the metabolic syndrome (Table 1). However, no consensus decision on which components comprise metabolic syndrome in adults has been reached, thus creating confusion and controversy.\textsuperscript{54} Yet, regardless of the definition used for diagnosis, the clustering of metabolic events offers useful information about \textit{metabolic risk} that is associated with future cardiovascular disease and increased cardiovascular mortality.\textsuperscript{55}
Is the risk of metabolic syndrome greater than the sum of its parts? In other words, is it truly a syndrome? This is one of the most controversial questions of the metabolic syndrome in adults. Even Reaven challenged the idea that the diagnosis of the metabolic syndrome was itself a clinical entity of greater value than its individual components. From a clinical standpoint, the influence of the metabolic syndrome suggests to the practitioner the presence of cardiovascular disease risk and therefore should be fully evaluated and aggressively treated. A clear consensus has not been reached regarding the metabolic syndrome.
syndrome and increased cardiovascular disease mortality. Some evidence implies that after adjusting for each of its individual components, the metabolic syndrome is no longer associated with early cardiovascular disease mortality. In an analysis of diabetics and non-diabetics with the presence or absence of the metabolic syndrome, those with diabetes and the metabolic syndrome had the highest prevalence (19.2%) of coronary heart disease mortality, followed by individuals with metabolic syndrome only (13.9%). Despite this significant association of metabolic syndrome and cardiovascular disease mortality, multivariate analysis confirmed the presence of elevated blood pressure, diabetes and low HDL-cholesterol, not metabolic syndrome, as the significant predictors for coronary heart disease. Similarly, the evaluation of metabolic syndrome and the 11 year risk of incident cardiovascular disease confirmed that when all 5 metabolic syndrome parameters are considered, metabolic syndrome as a whole does not incur greater cardiovascular disease risk when compared with the sum of the individual components. Yet, other data show that individuals diagnosed with the cluster of disorders that comprise the metabolic syndrome suffer greater cardiovascular morbidity and mortality when compared with individuals without the syndrome. According to the NCEP/ATP III Framingham Risk Score, approximately 1/3 of individuals with the metabolic syndrome are classified as “high risk” for the development of cardiovascular disease. As demonstrated in the Framingham Offspring and San Antonio Heart Study, the predicted risk of coronary heart disease in individuals with metabolic syndrome was significant (11.8% and 9.8%, respectively) when compared with individuals without the metabolic syndrome (7.0% and 6.8%, respectively). Studies looking at incident cardiovascular disease mortality indicated a 2-fold increase
among individuals having metabolic syndrome compared with those without the syndrome.\textsuperscript{58,59,61}

Similar to the adult classification of metabolic syndrome, no consensus definition in the pediatric population exists, despite begin widely studied among adolescents. This has created further controversy in the utility of the metabolic syndrome in children. Approximately 2/3 of all overweight children in the US present with at least one chronic metabolic disorder.\textsuperscript{62} Among overweight and obese children and adolescents, rates of the metabolic syndrome range from 26\%-49.7\%, depending on the definition used and the population sampled.\textsuperscript{63,64,65} A recent review of metabolic syndrome in children indicated over 40 unique definitions in recently published studies.\textsuperscript{66} As Brambilla et al\textsuperscript{67} suggests, there are several fundamental problems with diagnosing metabolic syndrome in children that make a consensus problematic.\textsuperscript{67} Among the most controversial are the role of puberty, the lack of definitive cut-points documented to establish future health risk, and the role of non-traditional risk factors. Appendix A\textsuperscript{68} reviews these shortfalls and how the conceptual framework of the metabolic syndrome can be integrated into pediatric research and medicine.

\textit{The metabolic consequence of obesity have been documented to occur in early childhood}

Metabolic syndrome has largely been studied in adolescents. To date, data looking at excess body weight and the association with the development of metabolic risk in children under the age of 10 are scarce, but emerging. With rates of childhood obesity rising among young school aged children, the finding of metabolic adaptations is alarming and warrants greater attention.
Early reports of adverse metabolic profiles in elementary school children have been documented in the Bogalusa Heart Study. A cohort of 3599 children, ages 5-10 was studied during three time intervals: 1984-1985, 1987-1988 and 1992-1994. Eleven percent of all children were identified as obese. Among all children identified to have 1 metabolic risk factor, 22% were obese. As the number of adverse risk factors increased among all children, so did the proportion of children identified as obese. So, among children with 3 or more adverse risk factors, 75% were classified as obese. These data suggested that metabolic risks, particularly those that cluster, are more commonly found among obese children.

Since the Bogalusa Heart Study, a more current picture of adverse metabolic risks coinciding with the increases in childhood obesity has been reported. To date, studies have shifted focus from studying individual metabolic risks to studying a cluster of metabolic risks also known as the metabolic syndrome. When modified NCEP criteria are applied to the pediatric population, the total prevalence of metabolic syndrome among an ethnically diverse sample of elementary school children is reported to be 5%. Variations in the prevalence of metabolic syndrome have been noted and differ based on the criteria used to define it, ethnicity, age, gender and socioeconomic status of the population under study. When adult definitions were adjusted to reflect the pediatric specific cut-points, the prevalence of metabolic syndrome among pre-pubescent overweight and obese children ranged from 20%-59%. As weight increases so does the prevalence of the metabolic syndrome. For example, among 1009 elementary aged children from Argentina, 32% of severely obese had the metabolic syndrome based on modified NCEP criteria; among those overweight and obese, metabolic syndrome was found in 16.4%. 
Even more sobering are the number of children who exhibit at least one metabolic abnormality secondary to obesity. Among obese school aged children in urban Mexico, 90% had insulin resistance based on the HOMA-IR model. In addition, 14% of all children screened were already frankly hypertensive. In Eastern Kansas, hypertension and raised triglycerides persisted among 18% and 37% of elementary school children, respectively. The most common metabolic abnormalities among overweight school aged children in an urban Chicago were impaired fasting glucose, raised triacylglycerols, and elevated blood pressure.

In sum, these data confirmed that as the obesity epidemic envelopes very young school aged children, the prevalence and severity of metabolic syndrome increases. This is troublesome as the development of serious health threats that are synonymous with risk for cardiovascular disease, among a young age group, implicates the prospect for life long determents to the child’s health if risks go undetected and untreated. The need for better prevention and screening focused on children of elementary and even pre-school age is strongly underscored.

**Childhood obesity ignites early cardiovascular damage**

Although the metabolic syndrome concept does not function well as a diagnosable entity in the pediatric population, awareness of the collective evidence of metabolic risk factors in the young child should be helpful to the clinician. When considered together as a cluster, the components of the metabolic syndrome are documented to contribute to cardiovascular disease risk. For example in adults, having the metabolic syndrome imparts a 2-fold greater risk of incident cardiovascular disease mortality compared with those without
the syndrome. So, the concept of metabolic syndrome in pediatrics may be used as an opportunity to identify children most at risk for cardiovascular disease and in most urgent need of lifestyle modification. The fact that not one set of metabolic syndrome criteria exists in pediatrics, may actually be beneficial as the components that could make up the syndrome are ever evolving, as more evidence on the health risks associated with obesity emerges. Inflammatory markers, cytokines and indicators of compromised functional and physiological integrity to the cardiovascular system have been considered as non-traditional risk factors that could augment the current metabolic syndrome definitions. Unlike, the current components used to define metabolic syndrome, non-traditional factors are a sign of early cardiovascular damage that with time accelerate the atherosclerotic process. Biomarkers of advanced cardiovascular damage will remain undetected, unless overtly screened for.

The triad of obesity, inflammation, and insulin resistance ignite early cardiovascular damage in childhood and adolescences thus accelerating the atherosclerotic process. Yet, the interplay of inflammation and insulin resistance acts as a futile cycle. Fat accrual in adipose, initiates the release of pro-inflammatory cytokines including TNF-alpha, C-reactive protein and IL-6. The inflammatory cascade initiates action directly on the insulin receptor, impairing insulin signaling and consequently increasing insulin resistance. To overcome insulin resistance, the pancreas increases insulin output as a compensatory mechanism in response to increased adiposity, defects in insulin signaling and reduced insulin function across a host of organ systems. As body fat continues to increase, the pro-inflammatory release and insulin resistance worsen. Overtime the compensatory response weakens and
adverse health outcomes manifest. All the while, silently, damage to the cardiovascular system ensues.

Formation of plaques and fatty streaks, deposited in the blood vessel walls, are associated with abnormal lipids and high blood pressure. As metabolism is altered by excess weight, vascular dysfunction develops. Over time, the intima thickens. Such anatomic changes in the arterial wall are thought to be the earliest indicators of risk for cardiovascular disease.\textsuperscript{21,79} As endothelial damage progresses, arterial distensibility is compromised. The ability of the blood vessel to contract and relax in response to demands is reduced. Vascular resistance rises, resulting in higher blood pressure.\textsuperscript{21} Disruption of the anatomical and physiological integrity of the vascular system develops silently during childhood. In fact, functional arterial changes have been identified in overweight children as young as 5 years old.\textsuperscript{21}

Children and adolescents who are morbidly obese are more insulin resistant and present with higher levels of inflammatory biomarkers including IL-6, ICAM, and E-selectin, compared to lean counterparts.\textsuperscript{80,81} In obese children and adolescents, the presence of traditional metabolic syndrome components is associated with non-traditional risk factors including CRP and IL-6.\textsuperscript{82,83} Furthermore, early functional and morphological changes of cardiovascular function, measured by intima-media thickness and flow-mediated dilation, are associated with markers of inflammation and the metabolic syndrome.\textsuperscript{84,85,86}

Collectively, these data suggest that the body’s metabolic milieu is adapting to the presence of excess body fat. Disruption of the normal anatomical and functional integrity of the vascular system develops silently during early childhood. This represents a high-risk finding among children and adolescents. Developing metabolic risk at a young age implies
that the health burden of cardiovascular damage could be greatly amplified by time the child ages into adulthood. Yet happily, because of the plasticity of the cardiovascular system in the developing child, the damage is not necessarily permanent. Evidence on vascular changes among children indicate that the process is reversible if detected early and corrected with appropriate management, including weight loss, the consumption of a highly nutritious diet and improved fitness.\textsuperscript{87,88} This harks back to Reaven’s original concept of the metabolic syndrome; that insulin resistant individuals are at risk for cardiovascular disease and in most urgent need of lifestyle intervention.\textsuperscript{56} The overweight pediatric patient represents the leading edge of cardiovascular risk. Therefore a comprehensive approach to the assessment of metabolic syndrome and its components could allow the clinician to uncover the development of metabolic risk at its earliest stages and intervene to arrest the prospect of lifelong cardiovascular disease risk.

\textit{Finding risk early in the stage of disease progression may afford the best opportunity to intervene.}

Risk is essentially defined as someone or something in a state of high susceptibility.\textsuperscript{89} Cardiovascular disease mortality is the ultimate endpoint for individuals carrying metabolic risk. In pediatrics, the younger the child is when they acquire metabolic risk, the higher the likelihood of tracking these risk factors into adulthood.\textsuperscript{90,91,92} For example, in the first decade of life, 80% of children will track their weight into adulthood.\textsuperscript{90} On examining the metabolic syndrome, metabolic predictors track reasonably well across childhood, through young adulthood and into adulthood.\textsuperscript{91,92} The diagnosis of metabolic syndrome in childhood increases the odds of developing adult metabolic syndrome and adult
type 2 diabetes by 9 fold and 11 fold, respectively.\textsuperscript{92} So, screening for certain metabolic signs may alert the clinician early in the course of disease progression. Early identification through health screening may afford the best opportunity to reverse adverse health trends developing among children.

Evidence of health disparities among overweight and obese children and adolescents has prompted comprehensive assessments in a primary care setting. In December 2007, the Expert Committee\textsuperscript{22} released national, evidenced based guidelines for pediatricians. Recognizing the complex interaction of social, environmental and genetic influences on obesity and health risk, the Expert Committee\textsuperscript{22} offered guidance for pediatricians on universal assessments to improve the \textit{identification of early risk} and provide \textit{directives for screening} and appropriate \textit{follow-up}. The Expert Committee\textsuperscript{22} strongly advises pediatricians to screen children at least annually for BMI. Additional assessments should be conducted when a child presents with a BMI \( \geq 85^{th} \) percentile. As part of screening for the overweight or obese child’s overall health risk profile, pediatricians are directed to collect the following information: family history, socio-demographics, behavioral assessment detailing nutrition and physical activity behaviors.\textsuperscript{22} Through this initial screening process physicians may be alerted of potential problems that should be targeted in the treatment regimen.

Upon completion of the initial assessments for family history and indicators of nutrition and physical activity behaviors, pediatricians are guided to further scrutinize the patient’s physical health through a focused review of systems, physical examination including the assessment of AN, the measurement of blood pressure and laboratory testing focusing on the evaluation of \textit{dyslipidemias}.\textsuperscript{22} A more aggressive stance to lipid screening is
recommended by Daniels, Geer and the Committee on Nutrition of the American Academy of Pediatrics. They suggest that overweight children with additional risk factors should be screened for dyslipidemias beginning at the age of 2.

The synthesis of assessment outcomes drives the counseling and treatment regimen for the overweight or obese child. Currently the Expert Committee recommends 4 tiers of intervention which range from monthly follow-up visits with the pediatrician to surgical options including gastric bypass. Essentially all treatment approaches include behavioral counseling, motivational interviewing, and developing a targeted set of goals that focus on improving long-term health status and establishing life-long healthy habits through optimal nutrition and physical activity. Pediatricians should encourage families to adopt and maintain the following evidence-based target behaviors: limit sugar sweetened beverages, eat five servings of fruits and vegetables each day, consume breakfast daily, eat proper portions, limit screen time to 2 hours or less each day, engage in 1 hour of physical activity each day, limit eating out, and eat more family meals.

AN is a skin manifestation representative of early metabolic changes.

Insulin resistance and consequent hyperinsulinemia have been identified as the pathophysiological link preceding several derangements in metabolism that occur due to excess body weight. As a result, the advent of other metabolic risk factors may persist. Ultimately the clustering of metabolic parameters brings attention to the serious health risks that are associated with insulin resistance and obesity and identifies individuals in most urgent need for lifestyle intervention. Recognized by the Expert Committee, the finding of AN should prompt the primary care provider to conduct further, more invasive assessments.
Essentially, identifying such physical signs may alert clinicians early in the clinical course of disease progression. Findings of such health disparities among overweight and obese children serve as the underlying rationale for the Expert Committee’s intensive evaluation of the overweight and obese child’s behavioral risk and physical health.

Unlike family history, ethnicity, lifestyle, behavior, and BMI, that predict future health burden, AN represents a physical manifestation of existing metabolic change. Metaphorically, AN is a window into the body, symbolizing the otherwise hidden metabolic adjustment to excess body fat. AN manifests as a result of high circulating levels of insulin. The mechanism by which insulin acts on the keratinocyte (skin cell) is not well understood. Researchers believe that insulin binds to the insulin-like growth factor receptor (IGF-R) on the cell surface of the keratinocyte, resulting in the stimulation of both keratinocytes and melanocytes, yielding the classic hyperkeratinization (thickening) and hyperpigmentation (darkening). AN is most commonly found on the nape of the neck. However, lesions have been documented to appear on the axilla, groin, knees, knuckles, and in other skin folds, as well.

The first reports of AN among an unselected population was published in 1989 by Steward et al. Among African American, Hispanic, and Caucasian youth, 13.3%, 5.5% and .5%, respectively, were identified to have AN. Since 1989, trends of childhood overweight and the prevalence of AN have sharply increased, especially among ethnic populations. More recent data indicates the prevalence of AN among African American, Hispanic, and Caucasian youth is 19.4%, 23.1% and 4.9%, respectively. Several studies reported total prevalence of AN ranging from 18%-34%, depending on the ethnic diversity of the sample. When overweight and obese sub-populations are examined specifically, rates of
AN are much higher. Among an ethnically diverse sample of obese children, AN was seen in 46%. Those with severe obesity, beyond the 99th percentile, present with AN 70% of the time. 97

The association between AN, hyperinsulinemia, and insulin resistance is well studied and validated among individuals who are overweight or obese. 35,98,99,100 However, the current evidence is conflicting on the association between AN and the onset of glucose intolerance and impaired fasting glucose in the pediatric population. Some studies have shown that AN is a reliable marker of hyperinsulinemia, insulin resistance and impaired glucose tolerances. 101,102,103 Where as others have reported that children and adolescents with AN do not have any significant increases in glucose intolerance or impaired fasting glucose compared to children without AN. 35,97,99 Yet, children and adolescents with AN have more risk factors for type 2 diabetes including high risk ethnicity and family history of diabetes compared to children without the skin marker. 36 For example, among Hispanic children and adolescents, AN was more prevalent among children who had family members with diabetes and were born to mothers with gestational diabetes. 38 Based on the compilation of data, further evidence is needed among children and adolescents to clarify the associations between AN and metabolic changes that are associated with type 2 diabetes.

The emphasis of AN screening has been heavily placed on its ability to screen for diabetes risk. 34 Yet as physiology explains, the role of insulin and insulin resistance spans beyond the relationship of the insulin / glucose axis. Screenings that focus on health risks such as dyslipidemias, hypertension and the presence of the metabolic syndrome are emergent among children and adolescents with AN. For example, in one study among obese, pre-pubertal children screened for the components of the metabolic syndrome, children who
screened positive for AN have significantly higher levels of fasting triglycerides compared to children without AN. Among a sample of 5th grade children in West Virginia who screened positive for acanthosis nigricans, nearly 50% have the metabolic syndrome based on the definition proposed by Cook et al. Commonly the onset of AN in childhood is linked with the presence of hypertension. In one school based screening study in Texas, nearly 1/3 of 5-19 year old Mexican- American children and adolescents with AN were also hypertensive. Among an ethnically diverse sample of overweight or obese elementary age children in Columbus, Ohio, (n=69) over 1/5 of 3rd and 5th grade children with AN were classified as pre-hypertensive or hypertensive.

Comprehensive health assessments in school based settings have urged school nurses to screen for obesity and related metabolic disorders.

In addition to the opportunity to assess for BMI at the well-child check up, the school is one referral input for the pediatrician to scrutinize the child further. With 50 million children attending America’s public schools, emerging health concerns are often addressed initially at the school site. School nurses are the health authority in the school building and are qualified to execute comprehensive health services. One of 7 core roles of the school nurse within in the school environment is the execution of high quality screening programs. Furthermore, the school nurse’s training around prevention and management of health outcomes is instrumental in providing counseling, offering anticipatory guidance and making a referral back to the child’s medical home. Favorable outcomes for the health of the child are supported through early identification, partnership with parents and primary care physicians, and referral for further evaluation. School nurses are encouraged to work
closely with community organizations, local businesses and health care providers to promote healthy lifestyles, achieve goals and improve health related outcomes for children and adolescents. \textsuperscript{24,107}

In the CDC’s 2009 report, \textit{BMI Measurements in Schools}, at least 13 states have implemented BMI measurement programs. \textsuperscript{26} In June 18, 2010, Ohio passed Healthy Choices for Healthy Children Act inclusive of mandatory, statewide BMI screenings in kindergarten, 3\textsuperscript{rd}, 5\textsuperscript{th} and 9\textsuperscript{th} grades. Aggregate BMI data from each district must be reported yearly to the Ohio Department of Health for state-wide surveillance. \textsuperscript{108} Yet despite national initiatives for BMI screening, screening in a school based setting has been topic of much debate. Recognizing the value of the school as an extension of the child’s medical home to screen for and track trajectories in excess body weight, over time, the Institutes of Medicine (IOM) have called upon schools to take action. \textsuperscript{109} The current position of the IOM states, \textit{“Schools should measure yearly each student’s weight, height, and gender- and age-specific BMI percentile and make this information available to parents and to the student (when age appropriate).”} \textsuperscript{109} Regarding perceptions of parents to BMI screening information from the school, several studies have documented that parents view receiving school based obesity screening information as important. \textsuperscript{28,30,110} Nearly 70\% of parents reported wanting to receive a letter from the school nurse about their child’s BMI. \textsuperscript{28} Yet, despite wanting to receive BMI screening information, the follow-up and concern among parents to their child’s overweight or obese BMI is low. Among parents who were supportive of receiving information on their child’s BMI, only 16\% indicated that they would like the school nurse to refer their child to the pediatrician for follow-up. \textsuperscript{28} Only ¼ of parents who did receive BMI screening results were actually concerned that their child was
overweight or obese. These data suggest that after a huge investment of time and effort on the part of the school nurse, these important screening data are not being effectively used to help the individual child. This creates an unnecessary and preventable health disparity with serious implications for the child’s future health.

Despite the IOM’s recommendation and receptivity among parents to BMI screening information, the CDC cautions against BMI screening in schools, as currently BMI fails to meet the criteria for successful screening in schools, established by the American Academy of Pediatrics (AAP). Screening guidelines from the AAP include the following: a threat for disease associated with adverse outcomes, disease or condition is responsive to early intervention, parameters for screening demonstrate reliability, sensitivity and specificity, those performing the screening are well trained, screening initiatives are directed to those most likely to benefit, mechanism for referral and treatment, cost/benefit ratio, appropriate site to conduct screenings, and program effectiveness. Hesitations of the CDC to recommend BMI screenings in schools also include fear of intensifying stigma among children and their families who are identified as overweight or obese, the lack of resources and treatment programs to address the needs of children identified as overweight or obese, and the lack of evidence that demonstrates the effectiveness of these programs to impact weight related outcomes.

The identification of early health risks associated with obesity is our current public health priority. In light of the CDC’s reluctance to recommend school based screenings for BMI and lack of follow-up among parents to BMI information, has prompted other school districts to screen for biomarkers such as AN. AN as an augment to BMI screening information brings to attention the delirious health consequences of carrying
excess body weight. Where as, BMI alone is an indicator of future health risk, AN is a marker of current metabolic change in the body.

One hallmark school screening program was initiated in 1999 by the state of Texas. The Acanthosis Nigricans: The Screening and Education Study (ANTES) focused on 11 educational service center regions in Texas that predominately borders Mexico. In 2001, the state of Texas enacted legislation that mandated AN screening in these regions. Each year over 700,000 students age 5-19 are screened by a school nurse for AN, BMI and blood pressure. The ANTES program has recently been changed to the Risk Assessment for Type 2 Diabetes in Children. Current data from 2005-2006 indicate that 13% of children and adolescents in this region have AN. In past reports, prevalence rates have been highest among 8, 11, and 14 year olds, showing rates of 16%, 20%, 14.5% respectively. In 2005-2006, 75% of children who presented with AN were also obese. Furthermore, 29.5% of children who screened positive for AN were found to be hypertensive.

In the West Virginia, The Coronary Artery Risk Detection in the Appalachian Communities (CARDIAC) project, conducted screenings for AN among 29,436 5th grade children during 1997 to 2006. The prevalence of AN among the total sample was 5.7%. When BMI was considered, 3.2% of overweight children and 17.5% of obese children screened positive for AN.

Combined, these data illustrate the tendency of overweight and obese children to develop biomarkers that are associated with the development of insulin resistance, type 2 diabetes and cardiovascular disease early in life. As the identification of childhood obesity and associated co-morbidities have evolved into a public health priority, screening for AN as an augment to BMI information may be an ideal way to find health risks among children.
early in the course of the disease process and provide appropriate intervention strategies to reduce the burden on the child’s health now and in the future. It is clear that AN is a unique clinical sign of metabolic change, pointing to developing health risks for the child.
Chapter 3: The Utility of AN to Signify Metabolic Health Risks Associated with the Metabolic Syndrome among Obese, Pre-pubertal Children

INTRODUCTION

Traditionally in adults, the metabolic syndrome is characterized by a state of insulin resistance resulting in or associated with abdominal obesity, dyslipidemias, glucose intolerance and hypertension. Yet, in the pediatric population, the diagnosis of the metabolic syndrome is inadequate on several levels. First, and arguably most important is the rhetorical, what actually comprises the syndrome in pediatrics? This answer remains unclear. In a recently published review, Ford et al points out that over 40 unique definitions of the metabolic syndrome have been published in pediatrics. Furthermore, the advent of “non-traditional risk factors”, such as the role of adipokines, inflammatory biomarkers and functional and morphological changes to the cardiovascular system, further complicates a single definition of pediatric metabolic syndrome. Secondly, pediatric metabolic syndrome is further compounded by the lack of standard cutpoints for each of the components that collectively comprise health risk in the pediatric population. Thirdly, the diagnosis of the metabolic syndrome depends on a categorical or dichotomous set of characteristics; that is, one either has it or doesn’t. This is troublesome both in the pediatric and adult population as these approaches oversimplify the complexity of the syndrome’s many components.
Furthermore, with the advent of health risks newly emerging in the pediatric population, the detection and identification are often missed altogether. Lastly the onset of puberty normally results in the development of an insulin resistant state, which may interfere with the ability to tease out the metabolic changes brought on by obesity versus those changes naturally associated with puberty.\textsuperscript{114,115} For a more extensive evaluation of the challenges of metabolic syndrome in the pediatric population see the recent reviews published by Brambilla et al\textsuperscript{67} and Battista et al.\textsuperscript{68}

This ambiguity around making a diagnosis of the metabolic syndrome in children and adolescents impacts both clinical and research perspectives. However, this does not mean that health risks associated with the metabolic syndrome, particularly at a young age, have no bearing on the child’s current and future health status. In order to overcome the problems inherent in the dichotomous definition, the use of a continuous metabolic syndrome score has been proposed by several investigators as a way to develop a more unified set of criteria.\textsuperscript{113} According to Eisenmann,\textsuperscript{113} unlike dichotomies, which impair the ability to distinguish among interactions of component variables over time, a continuous outcome approach can evaluate the shifting interactions between metabolic risk factors and the degree of metabolic change. The initial task is to determine what risk factors should be included in such a design. Is there really a rationale for simply adopting the adult parameters?

In pediatrics, the lack of a unified set of criteria may be a blessing. As newer evidence emerges, new criteria for what constitutes the metabolic syndrome may evolve. The focus of a continuous metabolic syndrome (cMets) score in pediatrics should be weighted toward measures of insulin resistance and chronic inflammation rather than toward glucose and type 2 diabetes, as they [insulin resistance and chronic inflammation] appear to
be the underlying driver for the development of disordered metabolism.\textsuperscript{80,81,82,83} For young children, with steady changes in both physical growth and hormonal output, this may be the only way to assess diverse risk factors as a cluster. Consider that overweight children mature faster than other children, both in terms of height as well as sexual maturation. Further, the overweight pediatric patient represents the leading edge of cardiovascular risk, showing evidence of developing adverse risk factors even among young children.

A continuous approach, as reflected by a composite risk score, offers a sensitive and less error-prone method to monitor metabolic fluctuations throughout critical periods of growth and development and accounts for the degree of metabolic change throughout such periods of instability. A composite approach to the assessment of metabolic syndrome and its components allows the pediatrician to observe the development of metabolic risk at its earliest stages and intervene. We chose to investigate the use of a continuous metabolic syndrome (cMets) score to establish metabolic risk in children. The goal of this study was to explore health status more globally, and in particular, aim to demonstrate how a cMets score relates to children who manifest AN and among children from two ethnic subpopulations, African American and Caucasian.

\textbf{METHODS}

\textit{Retrospective Chart Review}

An observational study was conducted at the Center for Healthy Weight and Nutrition (CHWN), a tertiary care obesity clinic at Nationwide Children’s Hospital (NCH), between June 2006 and April 2009. Inclusion criteria for the study analysis is as follows: BMI \( \geq 95^{th} \) percentile, the completion of an initial medical evaluation at the CHWN-NCH, age 5-10 years at the time of the initial medical evaluation, full clinical and laboratory workup
including a fasting lipid panel, fasting glucose, fasting insulin and a minimum of 3 consecutive blood pressure measurements, only those with known African American or Caucasian ethnicity were included (self-reported by family) and all had tanner stage measured. All demographic, clinical and laboratory data were collected at the time of the initial medical evaluation by the clinician and were retrospectively collected from the medical record. Of 472 charts reviewed only 172 patients met the full inclusion criteria, with 66 patients having inadequate information on ethnicity, 49 patients having inadequate information on tanner stage and 185 patients having inadequate or missing laboratory data.

**Clinical and Laboratory Protocols**

**Evaluation of Height, Weight and BMI, AN, Ethnicity and Tanner Stage**

Height was measured using a Seca stadiometer, calibrated according to manufacture’s recommendations. A Frankfort Horizontal Plane was used to ensure accuracy of the height evaluation. Weight was measured using a Scale Tronix digital scale, calibrated according to manufacturer’s instructions. Shoes were removed prior to measuring height and weight. BMI was calculated and BMI percentile plotted based on the CDC Guidelines.\(^{20}\) BMI \(\geq 95^{\text{th}}\) -98\(^{\text{th}}\) percentile were classified as obese. A BMI \(\geq 99^{\text{th}}\) percentile were classified as severely obese.\(^{43}\) The presence or absence of AN was identified on the nape of the neck during the physical examination. Ethnicity and date of birth were self reported by the family. Age at visit was categorized using the visit date subtracted from the date of birth and rounded to the nearest year. Tanner stage was indicated based on the tanner scale\(^{116}\) and was determined by a CHWN pediatrician or nurse practitioner.
**Evaluation of Blood Pressure**

A Dinamap PRO 100v2-400v2 vital signs monitor was used to evaluate blood pressure. When appropriate an adult size cuff or thigh cuff was used. Cuff bladder length was fitted to cover \( \frac{3}{4} \) of the circumference of the upper arm. Bladder width circumference was set within range specified on the blood pressure cuff. The patient remained upright in a chair with feet flat on the floor and were rested for at least 5 minutes prior to evaluating blood pressure. A minimum of 3 consecutive blood pressure measurements were taken with the average systolic and diastolic blood pressure reported.

**Laboratory Analysis**

After fasting for at least 8 hours, a complete lipid panel of very low density lipoprotein-cholesterol (VLDL-C), high density lipoprotein-cholesterol (HDL-C), low density lipoprotein-cholesterol (LDL-C) and triglycerides (TG), blood glucose and blood insulin were drawn and analyzed by NCH Child-Labs. Laboratory normative cut points used for the study analysis were derived from NCH Child- Labs normative values according to quality procedures. Labs included in the analysis were required to be taken within 6 months before or after the initial medical evaluation. For the purposes of this evaluation on metabolic syndrome HDL-C, TG, blood glucose and insulin were obtained from the medical chart for the analysis.
The Metabolic Syndrome & The cMets Score

Classification of the Metabolic Syndrome

The metabolic syndrome was defined as having three or more of the following risk factors: BMI ≥95th percentile, clinically high triglycerides (>134 mg/dL), clinically low HDL cholesterol (<45 mg/dL (5-9 y/o); <44 mg/dL (10 y/o)), impaired fasting glucose (≥100 mg/dL), and a systolic or diastolic BP ≥90th percentile for height percentile, gender, and age. The metabolic syndrome by this definition is dichotomous that is, based on individual cut points for each factor. The individual cut-points for the metabolic syndrome were derived from NCH-Child Labs and for blood pressure derived from the 4th Report on the Assessment and Treatment of Blood Pressure. 117

cMets Score

The same components that comprised the dichotomous definition of the metabolic syndrome were used to derive a cMets score with the exception of impaired fasting glucose (≥100 mg/dL). 113 Due to the low prevalence of glucose intolerance among our sample, homeostatic model assessment of insulin resistance (HOMA-IR) was used in its place to evaluate insulin resistance. HOMA-IR was calculated as fasting insulin (uU/mL) * fasting glucose (mg/dL)/ 22.5. 118 Z-scores were derived for each patient’s set of metabolic syndrome criteria (BMI percentile, triglycerides, HDL-cholesterol, HOMA-IR and systolic and diastolic blood pressure). Normative comparisons for lipids, 93 blood pressure 117 and HOMA-IR 118 were based on published recommendations. The HOMA-IR cutpoint for insulin resistance was selected to be >3.16. 119 cMets scores were calculated for each patient. A patient’s deviations from the norm for each component was designated by the z-scores. Summation of the z-scores formed a composite metabolic syndrome score. 112
composed of two distinct z-scores, the average of diastolic and systolic blood pressure scores was included in the composite.

**Ethics**

All study procedures were approved by the Institutional Review Board (IRB) at NCH, Columbus, OH.

**Statistical Analysis**

Multiple linear regression was used to model the cMets score. The primary risk-factor of interest was the presence of AN. As an observational study, race, gender, and tanner stage (greater than 1 vs. less than or equal to 1) were included along with the AN as potential confounding variables. As the distribution of AN was found to vary by race, the presence of a differential effect by race was evaluated in two ways. First, the race by AN interaction term was examined in the full sample. Second, the multivariable model was fitted on the two monoracial subsets. Model fit and the adequacy of the model assumptions were evaluated by examining the residual plots. Fisher’s exact test was used to compare the presence or absence of the metabolic syndrome components by race. Analyses were conducted in SAS version 9.2 (SAS Institute, Cary, NC) and Stata version 10.1 (StatCorp LP, College Station, TX).
RESULTS

Patient Descriptives and Demographics

One-hundred and seventy-two obese children were included in the analysis. Among the total sample, 54.7% were Caucasian and 54.7% were female. Mean age among males and females in our sample were 8.53 (1.63) and 8.49 (1.33) years, respectively. Roughly 60 percent of children in our sample had a tanner stage of 1 (Table 2). Among children with AN, 71.1% were African American and 60.0% were female. Mean age was higher, particularly among males with AN (9.03 +/-1.46) compared to males without AN (8.10 +/- 1.66) and was slightly higher among females with AN (8.52 +/-1.22) compared to females.

Table 2: Patient Characteristics among 172 Severely Obese Children
without AN (8.45 +/-1.47). Fifty-one percent of children with AN had a tanner stage >1 compared to only 33% of children without AN. The difference of tanner stage among children with AN compared with children without AN was non-significant (data not shown). Utilizing the dichotomous definition the prevalence of metabolic syndrome among the total sample was 41.28% (Table 2). Looking at metabolic syndrome among children with AN compared to children without AN, 45.6 and 26.6%, respectively had 3 or more metabolic syndrome components. No statistical significance was detected between the 2 groups (data not shown).

**cMets in Relation to AN Status**

Figure 3 displays boxplots of the c-Mets score by AN and ethnicity. In both Caucasians and African Americans, an increase in cMets score was observed for patients presenting with AN. Mean cMets Scores for Caucasians and African American children with AN were 1.48 and 1.33 compared to 1.33 and 1.24 for Caucasians and African American children without AN, respectively (Table 3). In a multiple regression model, a significant increase of 0.12 (p=0.037) in mean c-Mets score was detected among children presenting with AN compared to children without AN after adjusting for gender (p = 0.843), race (p=.015) and tanner stage (p=.311) (Table 4). As the distribution of AN across race was unequal, an interaction between race and AN was added to the model, but was not significant (p=0.502). This result indicated little evidence of a differential effect of AN by race. The sample was also divided into monoracial subsets and the multivariable analysis was repeated. A mean increase in the cMets score for patients presenting with AN was exhibited in both Caucasians (0.152, p = 0.029) and African Americans (0.041, p=0.684) although the effect was stronger in Caucasians (Table 4).
Caucasian | African American  
--- | ---  
AN | 1.48 (0.29) | 1.32 (0.33)  
No AN | 1.33 (0.30) | 1.24 (0.31)  

*Table 3: Mean (std dev) cMets score by Race and AN*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimate</th>
<th>95% CI</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>1.178</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>AN</td>
<td>0.120</td>
<td>(0.007, 0.233)</td>
<td>0.037</td>
</tr>
<tr>
<td>Male vs. Female</td>
<td>0.010</td>
<td>(-0.089, 0.109)</td>
<td>0.843</td>
</tr>
<tr>
<td>Caucasian vs. African American</td>
<td>0.140</td>
<td>(0.028, 0.253)</td>
<td>0.015</td>
</tr>
<tr>
<td>Tanner &gt; 1</td>
<td>0.052</td>
<td>(-0.049, 0.153)</td>
<td>0.311</td>
</tr>
</tbody>
</table>

*Table 4: Multivariable Model Estimates for the cMets Outcome*

*Figure 3: Plot of cMets Score by AN Status and Ethnicity*

**Metabolic Syndrome Components by Ethnicity**

Total prevalence of metabolic syndrome among African American and Caucasian children was 35.9% and 45.7%, respectively. No significance between the two groups was detected (p-value = .215). In an analysis of the frequency of metabolic syndrome components among the total sample, the following are ranked from most frequent to less
frequent: low HDL-C (42.5 mg/dL; 56.4%), systolic or diastolic pre-hypertension/hypertension (113.6 mmg/Hg, 48.8%), HOMA-IR >3.16 (3.5, 35.5%), high triglycerides (109.2 mg/dL, 23.8%) and fasting glucose (83.6 mg/dL, 1.7%). The prevalence of the metabolic syndrome components varied among Caucasian and African American ethnicity. Caucasian children were found to have significantly higher levels of triglycerides (35.1 vs. 10.3%; p <.0001); whereas African American children were found to have significantly higher HOMA-IR scores (51.3% vs 22.3%; p <.0001). Although not included in the metabolic syndrome definition, fasting insulin levels were found to be elevated significantly among African American children relative to Caucasian subjects (28.2% vs. 13.8%; p=0.023) (Table 5).

<table>
<thead>
<tr>
<th>Frequency of MetS Components</th>
<th>Total (n=172) mean (count*, %)</th>
<th>Total Among African Americans (n=78) mean (count*, %)</th>
<th>Total Among Caucasians (n=94) mean (count*, %)</th>
<th>p-value†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metabolic Syndrome</td>
<td>41.28 (71, n/a)</td>
<td>35.9 (28, n/a)</td>
<td>45.7 (43, n/a)</td>
<td>.215</td>
</tr>
<tr>
<td>BMI</td>
<td>99.3 (172, 100)</td>
<td>99.5 (78, 100)</td>
<td>99.2 (94, 100)</td>
<td>n/a</td>
</tr>
<tr>
<td>HDL-C (mg/dL)</td>
<td>42.5 (97, 56.4)</td>
<td>45.5 (40, 51.3)</td>
<td>40.1 (57, 60.6)</td>
<td>.280</td>
</tr>
<tr>
<td>Systolic BP/ Diastolic BP (mm/Hg)#</td>
<td>113.6/64.6 (84, 48.8)</td>
<td>114.9/65.6 (38, 48.7)</td>
<td>112.6/63.8 (46, 48.9)</td>
<td>1.0</td>
</tr>
<tr>
<td>HOMA-IR</td>
<td>3.5 (61, 35.5)</td>
<td>4.1 (40, 51.3)</td>
<td>2.9 (21, 22.3)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Triglyceride (mg/dL)</td>
<td>109.2 (41, 23.8)</td>
<td>86.8 (8, 10.3)</td>
<td>127.8 (33, 35.1)</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Insulin (uU/L)</td>
<td>16.4 (35, 20.4)</td>
<td>19.4 (22, 28.2)</td>
<td>13.9 (13,13.8)</td>
<td>.023</td>
</tr>
<tr>
<td>Glucose (mg/dL)</td>
<td>83.6 (3, 1.7)</td>
<td>84.2 (3, 3.9)</td>
<td>83.1 (0,0)</td>
<td>.091</td>
</tr>
</tbody>
</table>

Table 5: Frequency and Significance of the Metabolic Syndrome Components by Ethnicity
* Count is reported as the number considered abnormal relative to the normative cutpoint.
# Means systolic and diastolic blood pressure are reported separately. Counts and percents are combined and report systolic and diastolic blood pressure ≥90th percentile for height percentile, age and gender.
† Fisher’s exact test p-value
DISCUSSION

The primary aim of our study was to determine whether the metabolic profile as reflected by a cMets score differed among children with or without the AN lesion. In our sample of severely obese children, the prevalence of metabolic syndrome reflected as a dichotomy was not statistically significant between children with AN compared to children without AN. However, mean cMets scores were significantly higher among children with AN compared to children without AN. Therefore we can suggest that the degree to which metabolic risks associated with the metabolic syndrome do appear to be more severe among obese children with AN, when a continuous metabolic syndrome score is applied. This is a reasonable finding as the AN manifestation signify hyperinsulinemia and a subsequent state of insulin resistance. Insulin resistance fuels changes to the body’s metabolic milieu. Increased free fatty acid flux from the adipose to the liver is initiated by the state of insulin resistance, within the adipose cell. Fatty acids circulating at high levels have one of three fates. Among them is the release of triglyceride rich lipoproteins from the liver. The result is the further exacerbation of the insulin resistant state and increased blood levels of atherogenic compounds.

To our knowledge this is the first study to present information on health risks associated with the presence of AN using a cMets score in a sample of pre-pubertal children. Yet, other studies have noted the association between AN and risk factors for type 2 diabetes mellitus and cardiovascular disease. In one study conducted by Guran and colleagues, among obese children who screened positive for AN, insulin resistance and significantly higher levels of triglycerides were found compared with obese children without AN. A recent study looking at the relationship between AN, applied a definition of metabolic
syndrome in 5th graders from West Virginia. The data showed that almost half of obese and severely obese children with AN met the study’s criteria for the metabolic syndrome.

The prevalence of AN in our cohort mirrored earlier reports showing AN to be higher among African American children than Caucasian children. However, our data also showed that Caucasian children who present with AN appeared to have a more advanced metabolic risk profile, as reflected by an increased mean cMets score. The fact that the prevalence of AN is higher among African Americans, but does not reflect a more adverse risk profile suggests that the state of insulin resistance affects the manifestation of health risks differently between children based on ethnic groups. To investigate this further, we determined the frequencies at which HDL-c, triglycerides, systolic and diastolic hypertension, HOMA-IR, hyperinsulinemia and impaired fasting glucose was present among African American and Caucasian children. In African American children there was a statistically significant relationship between ethnicity and measures of insulin resistance (HOMA-IR and fasting insulin); whereas among Caucasian children, we identified a statistical and clinical association between ethnicity and dyslipidemias (ie: TG and HDL-C).

Other studies looking at determinants of health among African American and Caucasian children have also found stark differences. Studies investigating the impact of insulin resistance on the modulation of glycemia have found that despite comparable degrees of insulin resistance, insulin secretion to maintain normo-glycemia was significantly higher among African Americans compared with Caucasian children. This has also been confirmed among pre-pubertal obese children in whom insulin secretion was significantly greater among African American children. Among obese Caucasian children, significantly higher levels of triglycerides and lower levels of HDL-c were detected.
when compared to their African American counterparts. The metabolic differences among diverse ethnic groups might be explained by the degree of body fatness. African American children and adolescents were found to have less total body fat compared with their Caucasian counterparts, as measured by DXA scans.\textsuperscript{128} This significance of body fatness may be impacted by the partitioning of adipose tissue. African American children have less visceral fat compared with Caucasian children.\textsuperscript{126,129,130} Although we did not look at differences in fat partitioning, our data are consistent with others suggesting that African American children have a tendency to present with health risks that emphasize a diabetogenic profile compared with Caucasian children, who develop risk factors associated with a pro-atherogenic profile.\textsuperscript{123,124,125,126,127}

The cohort represented in this study is particularly unique. The data show the development of burgeoning health risks among pre-pubertal, school aged children. Such metabolic changes might be expected in puberty. The combined actions of insulin like growth factor (IGF-1) and growth hormone that induce a natural state of insulin resistance.\textsuperscript{114,115} It is reasonable to speculate that without early intervention, the onset of puberty will likely advance metabolic changes that were detected among children in this study.

We chose to use HOMA-IR as a maker of insulin resistance in metabolic syndrome criteria in place of impaired fasting glucose based on the premise that the prevalence of impaired fasting glucose was only 1.5% among all children in our cohort. The low prevalence of impaired fasting glucose is a clinically important finding, specifically its association with the presence of AN. Screening for AN is often recognized as factor that implies a risk for type 2 diabetes mellitus. Due to inconclusive evidence that AN will lead to the development of type 2 diabetes mellitus, the CDC has cautioned against broad based
screening for AN as a means to identify future diabetes. Our finding of high insulin resistance, as measured by HOMA-IR, without corresponding impaired fasting glucose is likely due to the fact that the development of frank type 2 diabetes is progressive. Despite its increased incidence over the last several years, the prevalence still remains quite low among school aged children. Furthermore, among our sample, we found that HOMA-IR and fasting insulin were highly correlated ($r = .99$) compared with HOMA-IR and fasting glucose which were not strongly correlated ($r = .36$). These findings indicated that the variation in HOMA-IR noted among our population is primarily driven by fasting insulin levels. These data, among a pre-pubertal cohort of obese children, also reinforce current national recommendations from the American Diabetes Association that screening for impaired fasting glucose should be withheld until age 10 years. However, screening for AN may have a broader purpose than simply identifying risk for type 2 diabetes. Others have viewed AN as a non-invasive tool to identify changes in metabolism that are associated with numerous risk factors for cardiovascular disease, including abnormal lipid metabolism.

Our data indicated that more attention should be paid not only to the relationship between AN and other health risk factors, such as dyslipidemias, but also to the ethnic differences in health risks that present among children with AN.

**Clinical Implications of our Findings**

In 2007, the Expert Committee released clinical guidelines for pediatricians. As part of the overall health evaluation of the obese child, they suggested screening for AN during the physical examination. Upon finding this skin marker, the pediatrician is prompted
to screen further with laboratory studies. Our data reinforced the need for such screening initiatives, among obese children with AN.

Our data show a divergence of health risks between children with and those without AN. Obese children African American and Caucasian origin appear to warrant an individualized approach to the screening, interpretation and clinical care. Information on racial differences in metabolic risk is especially important for clinicians as they collect and evaluate both clinical and non-clinical risk indicators to determine the health status of the child. The cMets score is an example of the collective use of metabolic health information that may be easily applied in a clinical setting.

The findings demonstrated in our study strengthen the current argument that a suitable pediatric definition of the metabolic syndrome is needed. In terms of indicators that should comprise the metabolic syndrome, currently 2 dyslipidemic components, a measure of systolic or diastolic hypertension and a measure of glucose intolerance are most common. The use of glucose intolerance may be inappropriate among young children as the prevalence of this risk factor is seemingly low in pre-pubertal years. For children who are Caucasian, the emphasis may need to be placed on identifying and mitigating the risks associated with dyslipidemias. As for African Americans, more emphasis may need to be placed on screening for insulin resistance and derangements in glucose metabolism among children.

**LIMITATIONS**

The cohort in this study included all children 5-10 years old referred to a hospital-based center for weight management of obese children, so selection bias is implicated. Secondly, the study is observational in nature and therefore a causal relationship cannot be
determined. Like the dichotomous metabolic syndrome definition there are challenges to using a cMets score. First, the use of a cMets score produces an arbitrary reference that may be difficult to interpret and compare across studies of different cohorts. Second, the metabolic syndrome variables loaded into the cMets score are given an equal weight in terms of their impact on health risk. As we demonstrated, there is a divergence of health risk factors among African American and Caucasian children and their future health outcomes may also be quite different. Nonetheless, a cMets score may be a more efficient way for clinicians to evaluate and monitor the cluster of adverse health risks associated with metabolic syndrome over time.
Chapter 4: School Based Screening for Acanthosis Nigricans Among a Sample of Ethnically Diverse, Elementary Aged Children

**INTRODUCTION**

School nurses are the health authority in the school building and are qualified to execute comprehensive health services. The NASN and the AAP-CSH has identified 7 core roles which the school nurse fulfills in the school environment. Evaluation of health through high quality assessments is one of her many responsibilities. The role of school nurse expands beyond screening as often times it is they who are the first to become aware of emerging health concerns. As the health lead for the school system, school nurses are in the position to counsel, offer anticipatory guidance, access community resources and make a referral back to the child’s medical home. Favorable outcomes for the health of the child are supported through the school nurse’s early identification, partnership with parents, collaborations with community physicians and health related organizations, referral to the child’s medical home and follow-up.

Health assessments that identify risk factors associated with obesity and chronic disease in childhood are gaining momentum in a school based setting. Arkansas established one of the first and most notorious school based, policy driven screening and surveillance programs for BMI. Each year, children in kindergarten and even grades, through high school, are screened for overweight and obesity. Coupled with the health assessment is a notification system, where parents are alerted of the school’s findings.
Arkansas also exercises surveillance of BMI screening which is intended to track changes in the trajectory of BMI across the state, while providing valuable outcomes to drive policy changes that support physical activity and healthy eating. Since the inception of the BMI screening and surveillance program in 2003, Arkansas has seen a trend in the stabilization of overweight and obesity in childhood. Despite successes like those seen in Arkansas, the CDC has raised concerns regarding BMI screening in schools, specifically due to the sensitive nature and stigma of information on BMI, the lack of treatment programs and inadequate community based resources that address obesity in childhood. At this time, the CDC offers rigorous safeguards for the implementation of BMI screening in schools.

In light of concerns to BMI screening, school districts have begun to utilize other biomarkers such as AN to identify health risks among children. AN as a marker for insulin resistance and subsequent hyperinsulinemia. From a clinical perspective, evidence of AN presents itself as a marker for global changes in both glucose and lipid metabolism as modulated by the insulin resistant state. This makes AN a valuable indicator of risk for the development of type 2 diabetes mellitus and cardiovascular disease. From a public health standpoint, the discussion of AN as marker for metabolic change that signify the advent of chronic disease risk may be an opportunity to help families overcome barriers seen with communicating information about excess body weight in childhood.

One hallmark school based screening program for the identification of AN is the Texas based screening program, The Risk Assessment for Type 2 Diabetes in Children. Each year over 700,000 students are screened for AN within 11 educational service regions predominantly across the Pan-Am boarder. Prevalence of AN among children in Texas has been reported as high as 14%, with the majority of the AN lesion (75%) found among
children who are classified as obese. Other studies have confirmed these findings, indicating that among obese and severely obese children and adolescents the prevalence of acanthosis nigricans is as high as 70%. 

Given the high prevalence of acanthosis nigricans demonstrated among school aged children living in Texas and the potential for this skin marker to identify chronic health risks among children with excess body weight, we aim to determine 1) the prevalence of AN among elementary age children attending a large, urban school district in Ohio and 2) the association between AN and other indicators of health risk including BMI, blood pressure, ethnicity and grade.

**METHODOLOGY**

**Health Screenings- Year 1 & Year 2**

Three elementary schools from a large, urban school district in Ohio were recruited for the AN pilot screening program. Two schools were screened in both year one and year two. A third school was added in year two. The pilot screening for AN was intended to augment state and local mandated screenings for height, weight and blood pressure in 3rd and 5th grades. Five school nurses were trained by the research study team using a series of photographs that indicated the range of severity of AN to identify the absence or presence of this skin marker on visual examination of the nape of the neck. For quality control, cases of subtle skin changes were corroborated by a research team member (MB).

Height, weight, BMI, blood pressure and the presence or absence of AN were determined in all children in 3rd and 5th grades in each of the 3 schools (total n=491 students). Ethnicity was self-reported and obtained from school records by the school nurse. School nurses measured height and weight using the school district’s standardized protocol in which
a calibrated SECA 700 scale and SECA portable stadiometer were utilized. Children were required to remove shoes prior to measuring height and weight. BMI was automatically calculated by computerized software and classified based on the CDC Guidelines. Overweight was defined as having a BMI percentile ≥ 85\(^{th}\) - 94\(^{th}\); obese was defined as having a BMI percentile ≥ 95\(^{th}\) – 98\(^{th}\), and severe obesity was defined as ≥ 99\(^{th}\) percentile. Blood pressure was evaluated using auscultation. Children were required to be seated, clothing on the right arm removed, and the arm resting on a desk or table about heart level. The standard blood pressure cuff covered approximately two-thirds of the upper arm from the shoulder to the elbow, overlapped and fastened comfortably. If these criteria were not met by a large adult, adult or child cuff the measurement was invalid. Blood pressure arm cuffs were calibrated at least annually. Pre-hypertension or hypertension was defined as having an initial and a subsequent blood pressure percentile ≥ 90\(^{th}\) for age, gender and height percentile, respectively.

All children (n=491) received a health screening letter informing the parent of the child’s health screening results. Parents/ guardians of children found “at risk” received a letter explaining the results and correlation to specific health risks with a recommendation from the school nurse to follow up with their child’s pediatrician. The following risk factors contributed to the nurse’s assessment of health risk: BMI ≥ 85\(^{th}\) percentile for age and gender, a duplicate blood pressure measurement of ≥ 90\(^{th}\) percentile, a positive screen for acanthosis nigricans, or any combination thereof. One hundred ninety-two children met the criteria of being at risk.
Follow-up

School nurses were responsible for follow-up with the family regarding the child’s health screening letter. In year one, the school nurse’s health screening result was accompanied with a letter from the study staff at NCH inviting families to participate in a biochemical screening. The screening was offered to the families at the school site for no cost. The letter prompted families to either contact the study staff directly or to make an appointment with their child’s school nurse. Due to a low compliance, school nurses contacted families by telephone for follow-up and were responsible for recruiting families to participate. Those participating in the biochemical screening were required to sign parent consent and child assent, where appropriate. Participants were notified of their child’s results and when indicated by parents, results were sent to their child’s primary care provider. Upon completion or attempt of a biochemical screening, the child received a gift card to a local general store to compensate them for their time and inconvenience.

In year two, the district’s diabetes educator nurse was responsible for contacting families who received health screening referrals and were responsible for recruitment of families into the research study where the family had the choice of follow-up with their child’s primary care provider or to see a pediatrician at NCH. Parents were asked for their verbal consent to allow the study coordinator (MB) to contact them to schedule an appointment. The study coordinator was responsible for working with the central scheduling department to organize patient scheduling for the research study. Those who opted to set up an appointment with their own primary care provider were given the study forms and were asked to provide the pediatrician with the forms. For confirmation of the visit, pediatricians were directed to send the forms back to the study coordinator. Upon arriving at the health
care appointment, families received a gift card to a local gas station or bus tickets and a token for free parking at NCH.

**Ethics**

All procedures were approved by the IRB at NCH, Columbus, OH and the Columbus City School District (CCS).

**Statistical Analysis**

Fifteen children were omitted from this study due to incomplete data on height and weight (n=2), blood pressure (n=6), ethnicity (n=4), and/or presenting with AN with a ‘normal weight’ BMI percentile (BMI <85th percentile) (n=2), since acanthosis nigricans was selected as the outcome variable in the analysis. This leaves 177 “at risk” children in the study group.

Descriptive statistics and logistic regression analysis were conducted using SPSS Statistical software version 17.0. Statistical significance was indicated as having a p-value <.05.

**RESULTS**

Four hundred and ninety one 3rd and 5th grade children were screened over 2 years. A total of 177 children had a BMI ≥ 85th percentile for age and gender plus one or both of the following health risk factors: duplicate blood pressure measurements ≥ 90th percentile and/or a positive screen for AN. Among the 177 at risk children, the total prevalence of overweight, obesity and severe obesity was 34.5%, 15.3% and 50.3%, respectively. Total prevalence of
AN was 38.4% among overweight, obese and severely obese children. Nineteen percent had a blood pressure classified as pre-hypertensive or hypertensive (Table 6).

<table>
<thead>
<tr>
<th>Prevalence</th>
<th>Total</th>
<th>3rd Grade</th>
<th>5th Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BMI Percentile</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 85th -94th</td>
<td>34.5% (61)</td>
<td>27.9% (24)</td>
<td>40.7% (37)</td>
</tr>
<tr>
<td>&gt; 95th -98th</td>
<td>15.3% (27)</td>
<td>18.6% (16)</td>
<td>12.1% (11)</td>
</tr>
<tr>
<td>&gt;99th</td>
<td>50.3% (89)</td>
<td>53.5% (46)</td>
<td>47.3% (43)</td>
</tr>
<tr>
<td><strong>Presence of Acanthosis Nigricans</strong></td>
<td>38.4% (68)</td>
<td>33.7% (29)</td>
<td>42.9% (39)</td>
</tr>
<tr>
<td><strong>Blood Pressure &gt; 90th %</strong></td>
<td>19.2% (34)</td>
<td>16.3% (14)</td>
<td>22.0% (20)</td>
</tr>
</tbody>
</table>

*Table 6: Prevalence of BMI%, Blood Pressure >90th Percentile and Acanthosis Nigricans among “at risk” 3rd and 5th grade children (n =177)*

**Student Descriptives by AN Status**

Twenty-nine 3rd grade (33.7%) and 39 5th grade (42.9%) overweight, obese and severely obese children screened positive for AN. AN was more prevalent among African American children with 58.6% having AN compared with only 18.9% of Caucasian children. Mean height (57.43 inches), weight (131.08 pounds) and BMI (27.73) was highest among children with AN compared to children without AN (55.73 inches, 104.72 pounds and 23.50). Mean systolic and diastolic blood pressure was higher among children with AN (108.24 mm/Hg and 66.01 mm/Hg, respectively) compared to children without AN (105.83 mm/Hg and 62.43 mm/Hg, respectively) (Table 7).
Among overweight, obese and severely obese children, the prevalence of AN increased with the increase of each BMI percentile classification. Approximately two-thirds of the AN found in the sample clustered in the severely obese BMI percentile category (67.60%) (Table 8).

<table>
<thead>
<tr>
<th>Total Sample</th>
<th>By Acanthosis Nigricans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N=177</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>Count</td>
</tr>
<tr>
<td><strong>Height (in)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Weight (lbs.)</strong></td>
<td>114.85 (30.64)</td>
</tr>
<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td>25.13 (4.67)</td>
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<tr>
<td><strong>BMI Percentile</strong></td>
<td>95.36 (4.49)</td>
</tr>
<tr>
<td><strong>Systolic Blood Pressure (mm/ Hg)</strong></td>
<td>106.76 (11.21)</td>
</tr>
<tr>
<td><strong>Diastolic Blood Pressure (mm/ Hg)</strong></td>
<td>63.81 (8.01)</td>
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<table>
<thead>
<tr>
<th>Grade</th>
<th>3rd</th>
<th>5th</th>
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<tbody>
<tr>
<td>n</td>
<td>86</td>
<td>57</td>
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<tr>
<td></td>
<td>91</td>
<td>52</td>
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<table>
<thead>
<tr>
<th>Ethnicity</th>
<th>Caucasian</th>
<th>n=90</th>
<th>n=73</th>
<th>n=17</th>
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<tbody>
<tr>
<td></td>
<td>African American</td>
<td>n=87</td>
<td>n=36</td>
<td>n=51</td>
</tr>
</tbody>
</table>

Table 7: Student Descriptives by the Presence or Absence of Acanthosis Nigricans

<table>
<thead>
<tr>
<th>BMI %</th>
<th>AN, Positive (n = 68)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&gt; 85th-94th %</td>
</tr>
<tr>
<td></td>
<td>13.20%</td>
</tr>
</tbody>
</table>

Table 8: Distribution & Prevalence of Acanthosis Nigricans Across BMI Percentile Classification
In a univariate logistic regression analysis, comparing children who had AN versus children who did not have AN, height (OR: 1.12; (95% CI: 1.03-1.21)), weight (1.04; (1.02-1.05)), BMI (1.27; 1.16-1.39)), BMI percentile category (4.89; (2.70-13.25)), and African American ethnicity (6.08; (3.09-11.99)) were all found to be statistically significant (<.05). BP >90th% was boarder line significant (.056; (.98-4.46)). Obese and severely obese children were nearly 6 times more likely to have AN than those who were merely overweight. Also, African American children were over 6 times more likely to have AN compared to their Caucasian peers (Table 9).

In a multivariate analysis BMI %, blood pressure >90th percentile, and ethnicity were included. Obese/severely obese (7.24 (2.94-17.84)) and African American ethnicity (9.76 (4.31-22.11)) remained statistically significant. The odds of having AN increased to over 8.5 times greater among obese/severely obese children compared to overweight children and nearly 14 times more likely to be found among African American children compared to
Caucasian children (Table 9). Children with an elevated blood pressure ≥90th percentile, are over 2.5 time more likely to have AN (Table 9).

**Follow-up**

**Year 1**

School nurses contacted all families of which health screening letters were sent home (n = 68). Of the 68 potential biochemical assessments, school nurses were only able to schedule 13 (19%) appointments for biochemical assessments at the school site. Seven of the 13 children had AN.

**Year 2**

The diabetes educator nurse contacted 59 of 124 (48%) families in year two. Constraints of the school year and unanticipated amount of time required for the follow-up contributed to the inability for the school nurse to contact all families. Therefore, the school nurse prioritized the urgency of referrals, thus contacting the families with children who were identified to have multiple health risks. Of the 59 families contacted, 20 (34%) were declared unreachable after multiple attempts. Among families who were reached (n=39; 66%), the school nurse obtained verbal consent to forward their contact information to schedule a primary care appointment. Upon being contacted by the study coordinator, 17 families declined at this step, with some indicating that they have already followed-up with a pediatrician (n=5) or were not concerned about their child’s health status at this time (n=2). Of the remaining 10 families, all were unreachable after multiple attempts. Seven families agreed to schedule an appointment, with only 5 families actually attending the primary care appointment.
**DISCUSSION**

AN is a unique screening tool and, unlike BMI, has the ability to signify a physical manifestation of metabolic change that is driven by the development of insulin resistance and hyperinsulinemia. Our school based pilot screening for AN among elementary aged children in an urban setting revealed that the prevalence of this skin marker among overweight, obese and severely obese children was 38.4%. The prevalence of AN greatly increased across the distribution of BMI percentile. That is children in the lowest BMI percentile classification (≥85-94th) had the lowest percentage of AN at 13.2%, compared to children classified in the highest BMI percentile category (≥99th percentile) where the distribution was heavily skewed (67.6%). In a linear regression analysis, the difference in the prevalence among obese and severely obese children compared to overweight children was found to be statistically significant. This indicates that as BMI percentile category increases the likelihood of finding AN also increases. These findings have also been confirmed by Brickmann et al where among children and adolescents classified as severely obese, the prevalence of AN reached 70%.

Despite having a homogenous sampling of Caucasian (n=90) and African American children (n=87), AN was found in over half (58.6%) of African American children compared to a prevalence of 19% among Caucasian children. The association between ethnicity and AN in our cohort was found to be statistically significant in both the univariate and multivariate analysis. Ethnic differences in the prevalence of AN have been demonstrated by others and have been attributed to the degree of excess adiposity and body weight that is responsible for driving the hyperinsulinemic and insulin resistant state.
From the standpoint of screening and risk identification, this is particularly important as the metabolic effects of insulin resistance on the body appear to differ between African Americans and Caucasian children and adolescents. In a study conducted by Weiss et al., despite having comparable degrees of insulin resistance, insulin secretion, to maintain normal glycemia, was significantly greater among obese African American children and adolescents compared to Caucasian children and adolescents. These results have been further confirmed among a group of obese, pre-pubertal children where insulin secretion was found to be significantly greater among African American children compared to their Caucasian counterparts. Studies have also indicated that Caucasian children, compared to African American children have significantly higher levels of triglycerides and significantly lower levels of HDL-c. In total, these data suggest that African American children have a tendency to develop risk factors consistent with a more diabetogenic state, compared with Caucasians who manifest health risks associated with a pro-atherogenic risk profile. Ultimately, this finding may impact how school nurses and primary care clinicians approach the follow up and treatment of insulin resistance among children of diverse ethnic backgrounds. The need for ethnically based screening parameters to maximize the identification of adverse health risks in their earliest stages of disease progression is warranted.

In a multivariate analysis, blood pressure was found to be significantly higher in children with AN compared to children without AN. In our cohort of children, elevated blood pressure was classified as ≥90th percentile, as pre-hypertension and hypertension in the pediatric population is evaluated against percentile standards that account for height percentile, gender and age. Among children with AN, 26.5% have elevated blood pressure ≥
90th percentile, compared to 14.7% of children without AN. The high prevalence of and associations between hypertension and AN have been reported elsewhere. In two separate school based screenings for AN, hypertension (BP >95th percentile) was found among 40% of children with acanthosis nigricans. Brickmann et al recently reported a similar and significant association between AN and blood pressure, with 27% of AN positive children and adolescents having systolic hypertension compared to 14% of children without AN.

The prevalence of children classified as severely obese (50.3%) in our sample is quite alarming and is likely to contribute to the high prevalence of AN (38.4%) among our cohort. This finding is particularly important as these children are already demonstrating the potential for developing future adverse health outcomes. Carrying excess weight through the first decade of life not only greatly increases the chance of the child becoming an obese adult, but also suggests that the health burden will only amplify over time unless intervention is undertaken. Our data reinforce the need for early screening initiatives, ideally in a school based setting, as a means of identifying adverse health risks early in the disease process.

From a clinical perspective, AN is an easily identifiable skin marker that when coupled with information on BMI could help identify children who are at risk for developing future health consequences from type 2 diabetes mellitus and cardiovascular disease. The non-invasive nature of AN allows for this screening to be easily incorporated into other routine school health screenings such as BMI, vision and hearing. Furthermore, the physical finding of AN may prompt concern and action among families and clinicians who are often less inclined to react to the BMI alone. Yet, as we demonstrated in a follow-up to the health screening letter during both years of screening, even among children with the most
prominent health risks, parental response to health screening information on BMI, AN and elevated blood pressure was poor. These findings are consistent with other school based screening initiatives in which follow-up with a clinician was low. Resincow and colleagues found that as many as 17% of parents actually followed up by discussing the results of a school site cardiovascular risk screening with their child’s doctor. Yet, based on the information collected during the school nurse’s follow-up conversations, parents indicated that it was not the results of excess body weight among their child that was concerning, rather the mention of high blood pressure and risk for diabetes. These preliminary data implicated that framing the message of excess weight to reflect the risk for the development of adverse health problems at least created more alarm among parents. It is likely that the concern raised by the discussion of such health risks among children may impact the urgency of the family to follow-up.

Collectively, our findings are suggestive of the benefits of the school based screening process. Health screenings are a powerful public health tool that provides valuable information on the health status of an individual and grounds to conduct further health evaluations. Yet, there are pitfalls to the screening process, which predominated in the communication of health screening information and the lack of follow-up response initiated by the parent. Optimization of the communication of health screening information to parents and pediatricians should be a priority. The school nurse invests a considerable amount of her time and resources that enable her to provide pertinent information to parents regarding the health status of their child. This valuable information is not being fully utilized nor recognized within the health care model, as it exists. Efforts should be aimed at raising urgency among parents to the results of health screenings and the nature of information that
they yield. It is important that upon finding a child with AN, and particularly when
accompanied by excess body weight, that further follow up should be ensured from the
primary care clinician. In the year two follow-up to the health screening, the nurse
indicated that parents expressed concern as to why the physician never discussed the child’s
weight issues and their child’s risk for health consequences. Parents reported that some
PCP’s even reinforce that the student “will grow out of it.” It is recommended by the Expert
Committee that overweight or obese children with AN should undergo a full laboratory
work up including screening for blood cholesterols, impaired fasting glucose and indicators
of liver function.

LIMITATIONS

This study is an observational study and the school buildings where the screenings
were conducted were non-randomly recruited based on the needs and preferences of the
school district to accommodate screening and follow up initiatives (ie: full time nursing
staff).

Although school nurses were trained to identify acanthosis nigricans it is likely that
acanthosis nigricans could have been misidentified. Intra-observer reliabilities were not
calculated for each nurse’s screening set and therefore we are unable to determine the true
accuracy of their screening result.
Chapter 5: AN and Associated Health Risks: Changing the Culture of Screening from the Parent Perspective

INTRODUCTION

Obesity in childhood has become a national public health priority. Even more alarming is the increased incidence of co-morbid conditions, such as hypertension, hyperlipidemia and even type 2 diabetes that are being found among obese children. This second wave epidemic of chronic disease that develops second to obesity, will not only be a lifelong detriment to the child’s health as he or she ages, but also places an overwhelming economic burden on our society.

Coordinated school health programs are gaining momentum in response to the current health trends seen among children. The role of the school nurse to conduct high quality screening programs that identify health risks have been emphasized by the AAP and the NASN. One of seven core roles of the school nurse, defined by NASN, underscores the ability of the school nurse to execute screening activities, referral directives and to promote optimal health within the school building through health education and information sharing. Furthermore, the care process, facilitated by the school nurse, should reach beyond the scope of the family. For students with chronic and acute health problems, the school nurse often acts as a liaison between the school and community, drawing in resources such as primary care and public health programs to augment screening and follow-up directives. In spite of the school nurse’s exhaustive efforts to intervene, urgency to health screening information
often falls short at the home or at the doctor’s office, particularly when the screening focuses on excess body weight. Parents are reluctant to identify a weight problem in their child; whereas the physician often fails to screen for or acknowledge the child’s BMI, regardless of national directives that urge physicians to identify obesity, intervene and follow closely.  

Health screenings for school-aged children are vital for early recognition of obesity-related issues. Yet, many barriers prohibit the appropriate use of such important information on excess body weight in childhood. Screening biomarkers that identify weight related metabolic changes have been recently piloted. AN is a skin manifestation in response to hyperinsulinemia and is a signal for insulin resistance. The screening for AN, along with information on BMI, strengthens the argument for further scrutiny. The Expert Committee recommend that an overweight or obese child with AN should be further evaluated with laboratory tests including lipids, biomarkers of liver function and where appropriate glucose.  

Practically, the AN screen may be helpful in emphasizing the health risks that manifest in response to excess body weight in childhood. Structuring the conversation to focus on the adverse health risks of diabetes and cardiovascular disease that develop as a result of obesity in childhood may not only increase general awareness, but also increase parent urgency and response to the school nurse’s screening recommendation to follow-up.  

Evidence indicates that metabolic changes driven by excess body weight are amenable when detected at the earliest stage possible and treated aggressively with highly nutritious foods and physical activity. Therefore school based screening activities are intended to identify children who are most at risk and who are in most urgent need for closer scrutiny by the PCP.
During the 2007/2008 and 2008/2009 school years, AN screenings were piloted along with BMI and blood pressure screenings in select elementary schools in the 43206 and 43207 regions of Columbus, OH (Chapter 4). Prevalence of AN reached 38%, with nearly all of the AN clustering among children classified as obese and morbidly obese. The overwhelming finding of AN in elementary aged children suggested that burgeoning health risks associated with the development of diabetes and cardiovascular disease are evident at a very early age. If the trajectory continues, without timely intervention, the disease process is likely to accelerate.

Provided the need for AN screenings, as evidenced in the pilot work, the urban school district has proposed to include AN as part of the screening programs for height, weight, BMI and blood pressure in elementary schools, district wide. Following the guidelines for successful screening recommended by the AAP\textsuperscript{106} and the CDC\textsuperscript{26,27}, the school district has sought to determine the best practices for the screening, notification and referral of AN health screening information to parents. The intention is to increase awareness and urgency to health screening information from the school nurse and to increase compliancy to the school nurse’s recommendation to follow-up with the child’s PCP.

The current protocol for parent notification of health screening results for BMI is through a health assessment letter. Supplemental information on how BMI is calculated and the definitions of underweight, healthy weight, overweight and obese BMI are also provided. The focus of the current project is to develop concepts and recommendations so that a similar AN notification program may be developed.

Although mechanisms for early identification through health screenings have been established in the school district, screening information is only effective when acted upon.
So, as a way to enhance the practice of the school nurse and the scope of school based health assessments we aim to explore parental attitudes, perceptions and actions to the screening, notification and referral process specifically around for AN health screenings. Furthermore we will investigate parental intent to respond to the school nurse’s follow-up recommendations.

**METHODOLOGY**

**Focus Group Demographics**

Four focus group sessions were conducted with parents of elementary aged children from 4 pre-selected elementary schools in an urban school district in Columbus, Ohio during the months of April and May 2010. A total of 18 individuals (average age range 26-35 years old) participated in one of four focus groups. Participants were recruited by parent consultants designated at each of the 4 school sites. Fifty-nine percent and 28% of participants were African American and Caucasian, respectively. Educational achievement was obtained as a proxy for income. Sixty-seven percent of participants reported completing high school. Four participants reported completing college. One participant reported completing middle school. Participants had on average 2.7 children.

**Developing Focus Group Questions**

A research team with combined expertise in pediatric obesity, human nutrition, and school nursing were responsible for the development and revision of focus group questions until a consensus was reached (Appendix B). Question design and the aims of the focus group sessions were based on outcomes of the AN pilot screening. Focus group questions
followed an in-formal, semi-structured interview format. Question types that queried participant knowledge, participant feeling and participant opinion/values were framed to further explore parent preference of the school nurses communication of health screening information, preference in messaging styles to convey health risks and intended response to health screening information on acanthosis nigricans. Probing questions, to seek further explanation and description on a particular concept or participant response, were conceived at the discretion of the focus group moderator.

**Focus Group Procedures and Incentives**

All focus group participants received an information sheet describing the research study. Participants completed a brief, anonymous demographic survey. Since all information collected from the focus group participants was unspecified, focus group members were given the opportunity to grant passive consent based on their willingness to participate. All focus group sessions were digitally audio taped. Field notes were collected by the research team members. At the culmination of the focus group session, participants received a $25 gift card to a local grocery store. All procedures were approved by the IRB at NCH, Columbus, Ohio.

**Transcription and Analysis of Focus Group Dialogue**

Dialogue was transcribed verbatim from audio tape recordings for analysis. Field notes were collected by the research team and were used to corroborate transcribed dialogue. Participant identifiers that may have been used were omitted during the transcription process. Audio dialogue was erased upon completion of the transcription process. Research team
members were trained and responsible for coding the focus group discussion. The coding strategy allows the researcher to capture and develop the backbone for the analytical frame of the interpretation. This includes remaining open to the data, capturing its fit and relevance, define emergent themes as they present themselves, yet allowing for the researcher to explore their own expert voice through the selection and wording of phrases through the coding process. Transcripts were divided into data fragments (n=820) with attention being paid to the convergence and divergence of emerging ideas. Resulting data fragments were coded for their content. Categorical topics were coded first to capture general data. Categorical topics were then sub-coded to extract themes and capture the core meaning of the data. A data display (Figure 4) presenting the major themes were developed to display overall patterns and assist with guiding data analysis and interpretation.
Figure 4: Emergent Themes among Parent Focus Group Sessions
RESULTS

Themes

- Parent Knowledge/Perceptions of Obesity in Childhood
- Respondent Knowledge/Perception of AN
- Parent Reaction to School Based Screening Information
  - Denial
  - Baby Fat
  - Standards
- Parent Role and Influence of Parent Attitudes on their Child’s Weight Status
- School Based Screening for AN
- School Based Screening Barriers
- School Based Screening for AN, Potential Messaging
- School Based Screening and The School Nurse
- Resources
- Nutrition
  - Nutrition Barriers
  - Family Influence
- Physical Activity
  - Physical Activity Barriers

Parent Knowledge/ Perceptions of Obesity in Childhood

Participants were able to identify the following co-morbidities associated with obesity: diabetes, heart problems, depression, joint problem, blood pressure, sleep apnea, asthma, and early menses. Participants recognized a connection between obesity, diabetes and heart disease, with some referring to this as a chain reaction of events or a pyramid of one condition leading to the other. Through anecdotal encounters, participants also identified a genetic association with obesity and co-morbidities that result in childhood. Furthermore, participants indicated the possibility of generational differences in the prevalence of obesity and co-morbidities. For example, participants expressed that obesity was not as concerning and was less prevalent when they were younger, compared to youth today.
“I think that diabetes is easier, it is easier for people to develop, children to develop type 2 diabetes and from diabetes your body can have a chain reaction of many, many health problems.”

[Associated Health Risk, Recognition]

“I think often times they go together (yeah) like when you lose weight you lose your diabetes you lose your heart attacks you lose your strokes, your blood pressure, your cholesterol”

[Associated Health Risk, Recognition]

“It is just like a pyramid [obesity] one thing can lead to another can lead to another and it is not good...”

[Associated Health Risk, Recognition]

“We didn’t hear about that, I am older in this group, I didn’t hear about diabetes in my day when I was in school I never heard of it until now.”

[Associated Health Risk, Generational]

“I think it is having effects like this that we weren’t aware of when I was growing up 20 years ago. We weren’t aware that these effects were going to take place [childhood obesity] and I think this is what are kids are suffering”

[Associated Health Risk, Generational]

Participants indicated that childhood overweight and obesity in today’s society is concerning, as the development of obesity may lead to other health risks or death.

“Okay, I think it is like a major problem [obesity in childhood]. I think it is a major problem, from my perspective.”

[Childhood Obesity, Attitudes]
“You can die from obesity, you can die from either one [obesity and diabetes] so they are both sitting at the top of the list that you can’t ignore.”

[Childhood Obesity, Attitudes]

Participants acknowledged that certain eating habits and inactive lifestyle both impact the health of a child. Participants identified poor nutritional diet quality including processed foods and preservatives as dietary contributors to obesity in childhood. Participants perceived sedentary lifestyle and lack of exercise, seemingly promoted by excessive screen time, (video games, computer and TV) as contributors to obesity in childhood. This potentially leaves less time for outside physical activity and play.

“Not eating healthy, bad eating habits [contribute to obesity in childhood]”

[Associated Health Risk, Nutrition]

“The type of foods now we eat, we eat a lot of processed foods. I think it has a lot to do with what we put in our bodies.”

[Childhood Obesity, Nutrition]

“I think all of the processed foods and the preservatives that are put in our foods and are available to our kids is umm terrible”

[Childhood Obesity, Nutrition]

“Video games”

[Childhood Obesity, Sedentary]

“Video games have taken over the world ... and the internet and cell phones the texting”

[Physical Activity, Sedentary]
“Because there is no exercise at all”

[Physical Activity, Sedentary]

**Respondent Knowledge/ Perception of AN**

Upon seeing photographs of AN, parents perceived AN to be a skin disease, dirty skin, a sign of morbid obesity, eczema, bruising, or skin rash.

“Some type of skin disease.”

[Knowledge, AN Identification]

“I think it is trying to show eczema, like skin a skin rash.”

[Knowledge, AN identification]

“It looks like bruising.”

[Knowledge, AN identification]

Respondents who were educated on AN, previously or were familiar with this skin marker, indicating that AN is present within their family or even on themselves.

“I heard it from my son’s doctor About 2 months ago when he went for his check up.”

[Knowledge, AN Identification]

“For me it was a physician, probably 10 years ago now. I went for something else, but it was in a clinic so he used the opportunity for me being there to teach his students about obesity.”

[Knowledge, AN Identification]

“Oh I have [heard of AN], in our parent consultant meeting last week…a gentleman…from Children’s Hospital…told us exactly what that is.”

[Knowledge, AN Identification]
"My husband has that [acanthosis nigricans] that is why I looked at it like woah!"

[Knowledge, AN Identification]

**Parent Reaction to School Based BMI Screening Information**

Participants expressed the importance of knowing if their child had a weight problem. Yet, among participants who shared their experience with receiving BMI screening information from the school nurse, it appeared that excess weight on their child was not perceived to be an immediate health threat. Participants indicated that they did not take this information seriously. Participants also perceived that other parents may not take BMI screening information seriously or may feel offended.

"I think as a parent you would want to know those things because you want your child to be in the best health possible."

[Health Screening Identification, Parent Attitude]

"I would definitely want to know if there was a problem."

[Health Screening Identification, Parent Attitude]

"I can see a lot of parents that would probably not pay attention. So I would say there is probably about 10% that would really want to know that information cause they are not sure if their child really has a weight problem."

[Health Screening Identification, Parent Attitudes]

"No if that is just all it said then no most people would just ball it up and throw it away, keep on chuggin, go run around and lose a little bit of that weight, you know joke it off."

[Anticipatory Health Screening, Reaction]
“Some parents might get mad. Like I could have gotten mad [at receiving the BMI screening letter] cause I know my son isn’t you know...”

[Anticipatory Health Screening, Reaction]

**Denial**

Participants indicated their misperceptions of obesity among their children. As a reaction to the school nurse’s health screening result, parents reported feelings of denial, defensiveness or indicated a fatalist attitude as obesity is a hereditary trait or is a common finding among their social circles.

“Well yeah the overweight was alarming at first. I was in denial with it.”

[Anticipatory Health Screening, Reaction/Denial]

“I was in denial with mine because I didn’t see her as fat or obese or whatever. She's a cute little kid and got the chunky cheeks and everything...”

[Anticipatory Health Screening, Reaction/ Denial]

“The letter I got that said that his BMI was too high, I didn’t come to the school, I didn’t talk to the doctor about it, I didn’t ask anyone about it. I called my daddy on the phone and made jokes about it.”

[Health Screening Identification, Reaction/Denial]

“How is somebody going to tell me that my child is overweight and that don’t even know my child. He is big boned....he’s real big!”

[Anticipatory Health Screening, Reaction/Denial]
“And we are the ones that see our kids so what we don’t see and if we don’t see them as obese then why do we care what anyone else says?”

[Anticipatory Health Screening, Parent Perception]

“I was like what the hell is she looking at? I started questioning everything else on that letter myself because I was like are they looking at [son’s name]? Were they looking at him? Or were they looking at someone else or gave me some other kid’s letter?”

[Anticipatory Health Screening, Parent Attitudes]

“I know personally people that would get that report and say oh well everyone is fat in the family that is how it is going to be.”

[Health Screening Identification, Reaction/Fatalist]

“ It’s in our bloodlines. It’s something I see every day. My mother, my aunt, well my grandmother died. She had several different things and so if it was brought to me on paper that it was a possibility for either one of my children to end up with this or this or this, then I would already know because it’s a possibility.”

[Anticipatory Health Screening, Reaction]

“It’s just so common [obesity] in my circle and you know.”

[Childhood Obesity, Family History]

“My daughter has never been overweight, but you know she’s a girl. She gets a lot of stuff from her mama so she’s already hippy and all that.”

[Childhood Obesity, Family History]
Baby Fat

Participants shared that excess body weight on their child may be a result of their “baby fat.” Participants shared their consideration of time and growth so the “baby fat” has time to go away. This potential reaction that parents exhibited to health screening results may account, in part, for the lack of alarm parents may feel towards obesity.

“You're putting so much pressure on this whole weight thing; let's give them a little bit of time to start getting taller because that's what's going on with her right now. Let's at least wait until they're in the third grade and start labeling and potentially-- again that's the baby fat thing. I guess that's where I'm at. Let the baby fat go away.”

[Childhood Obesity, Misperception]

“You stay with the baby fat. Because it is cute.”

[Childhood Obesity, Misperception]

Standards

Participants indicated that they perceive the BMI test and comparison standards for overweight and obesity to be unrealistic and potentially produce an incorrect result. Participants particularly emphasized this point for minorities. Participants reported that they would be weary of and would question the process of how the BMI screening result was obtained.

“I really think those standards are off I do, I think they are off I think hardly anyone in the black community accept for my sister over here will fit into those standards.”

[Anticipatory Health Screening, Perception]
“I think they are unrealistic…it has made something in my brain click, that you are always going to think we are obese. So if I see the word obese or that your BMI is high I am automatically like whatever, cause you are going to think that no matter what.”

[Anticipatory Health Screening, Perception]

“They label us the same when culturally we are different.”

[Anticipatory Health Screening, Culture]

“I actually did get this letter. I am like you have to understand he is 6 ft 3 and over 200 pounds. He is 16… I thought do they take into consideration his height and his size of his bone structure?”

[Health Screening Identification, Reaction/Denial]

I would immediately be like who took the test, just like what are they using, what parameters are they using? I would question the whole process. I know I would.

[Health Screening Identification, Reaction]

I would need a lot of documentation and everybody better be certified and licensees I would be really, really analytical about it.

[Health Screening Identification, Reaction]

“I would ask how is that determined because if you go to a doctor or whatever and there’s something like that…the people that come in to do the screenings [at school], how would they determine that?”

[Anticipatory Health Screening, Reaction]

**Cultural Impact on the Perception of Obesity**

Participants indicated that among various cultures, the definition of obesity and the acceptance of excess body weight differ. For example in the Spanish culture, obesity is
equated to having health. Among individuals who are African American, the culture advocates for being bigger. Participants indicated that African American men are appreciative of larger hips and buttocks.

“In the Spanish culture being obese means being healthy. So, it’s like what culture are you talking about?”

[Anticipatory Health Screening, Culture]

“Black men appreciate that (hips) so therefore we like it in our culture. There is a difference I mean my white girlfriends I mean there is so much pressure form them to be thin”

[Anticipatory Health Screening, Culture]

“Because like I was saying in the black community we want our kids to not be this big around [holding up finger as a comparison] we want them to have some weight on them, we don’t want them to be obese.”

[Anticipatory Health Screening, Culture]

“To be a little larger, yeah I mean culturally it is frowned upon to be really big, but still there is that big mama grandma comfort attached to it.”

[Anticipatory Health Screening, Culture]

**Parent Role and Influence of Parent Attitudes on their Child’s Weight Status**

The influence of parental attitudes appeared to affect reaction and response to health screening information from the school nurse. Participants indicated that parents are themselves a barrier to receiving health screening information. Specifically, participants perceived other parents not to take the responsibility to check for such information. Participants also shared that parents may place blame on themselves in response to their
child’s health status. Furthermore, participants commented on their perceptions of the attitudes of young single mothers which may impact reaction and response to their child’s weight status. Participants indicated that young single mothers may lack the support from other family members, are irresponsible, appear to have other priorities aside from their family and are perceived to be unstable and lazy.

“Yeah I think it is more likely that they don’t even bother to look (right) instead of them not getting it.”
[Anticipatory Health Screening, Parent Involvement]

“I hear a lot of that in the office my child didn’t give that to me and the first thing that comes to my mind is why did the child have to give it to you?”
[Anticipatory Health Screening, Parent Involvement]

“I think there are situations too where you have to be careful of well nobody told me well I gave it to your child...it is just a lazy excuse for what you are not doing [checking backpack].”
[Anticipatory Health Screening, Parent Involvement]

“I mean there’s a lot of, lets be real, in our community there are a lot of mentally unstable parents, single mothers who are struggling just to survive and depressed.”
[General, Parenting]

“New school moms, they need love. I can’t speak for all of them They are looking for love that’s not in their home and the love they have in their home is just with them and their children because that’s what they have, their grateful for that.”
[General, Parenting]
“New school moms the majority of them, none of them do work. I just feel like they are lazy and tired but I don’t know. I worked, went to school, I did it all, but they just don’t want to do it.”

[General, Parenting]

“I don’t think they care [in response to the “new school mom’s”]. These parents right now, they depend on grandmas and grandpas to do everything.”

[Health Screening Identification, Response Follow-up]

School Based Screening for AN

In general, it appeared that participants perceived AN to be a more severe health threat for children than obesity. Participants suggested that health screening information which discusses AN is more attention grabbing and represents a more tangible health concern. Despite the potential to produce a more favorable reaction among parents, participants shared their concerns. Participants felt that AN may take on several interpretations by parents. Parents may perceive AN as part of the body or natural skin coloring. Participants also indicated their worry that information on AN may be interpreted as “over-alerting” or “over-alarming” given its association to diabetes and cardiovascular disease risk.

“Cause it [AN] would just like grab your attention like it is urgent. Urgency. You wouldn’t feel that [for obesity]”

[Anticipatory Health Screening, Reaction]

“It has a name, it has some medical term to it”

[Health Screening Identification, Reaction]
“Yes, now we are talking about real legitimate solid problems [AN]”

[Health Screening Identification, Response/Follow-up]

“Initially of course I would be skeptical when you first see something like that [AN] you think well maybe my child’s neck is dirty you know…”

[Anticipatory Health Screening, Reaction]

Think of how many parents, think of how many children have that and the parents think it is a part of their skin?

[Anticipatory Health Screening, Reaction]

“I guess, I guess I don’t know by reading this how I don’t want a parent to be overly concerned like I have to run my kid to the doctor today”

[Anticipatory Health Screening, Reaction]

“Yeah cause people would rush to the doctor right away [upon receiving the letter about AN]

[Anticipatory Health Screening, Reaction]

“Yeah they would probably think it is something that’s going to kill them right then, you know what I mean.”

[Potential AN Messaging, Preference]

Participants indicated that AN would likely initiate a more favorable response among parents and potentially trigger a follow-up reaction compared to receiving information on obesity.

“AN, oh yeah that rings home!”

[Potential AN Messaging, Reaction]
“Yeah they would be stagnant at obesity but if you go ahead and put that skin darkening AN, heart disease yeah, oh yeah parents would be [alarmed]”

[Potential AN Messaging, Reaction]

“I think it would trigger them more [AN]. At least to at least make an initial appointment...or call the doctor on the letter”

[Potential AN Messaging, Reaction]

Among participants who indicated urgency to AN health screening information also indicated their intention to follow-up either immediately or at some point. Participants emphasized they would follow-up with their child’s pediatrician.

“Yeah run to the doctor and try to something proactive.”

[Potential AN Messaging, Response/Follow-up]

“Me too I would go to the doctor immediately and try to get some programs, some health program fitness program.”

[Potential AN Messaging, Response/Follow-up]

“That saying, at risk, like my grandmother she had a lot of heart disease, strokes heart attacks and diabetes so that could mean for me that I was ask risk....I would have a fit. Oh yeah I am like her [daughter], [take her]strait to the doctor. Like, ‘what do I do?’”

[Potential AN Messaging, Response/Follow-up]

“I mean if this[AN] is explained more I think to mothers and fathers would be more proactive in trying to make changes.”

[Potential AN Message, Response/Follow-up]
**School Based Screening Barriers**

In addition to personal attitudes and cultural and familial influences regarding excess body weight, participants further described barriers that may impact their ability to respond and follow-up to the school nurse’s health screening results. Participants perceived screenings conducted in schools to be less thorough today than when they were growing up. Furthermore, doctors and nurses at the local hospital and health clinics were perceived as barriers for parents when dealing with excess weight in their child. Participants reported that their child’s pediatrician were not overly concerned about obesity in their child, even though the school nurse’s screen confirmed this finding. This is worrisome as parents seemingly reported to rely on their pediatrician’s guidance to make decisions about their child’s care and prevention strategies. Other participants shared their experiences with physicians and nurses who have made them feel guilty in the past about having a child that was heavy.

“’Hey doctor, the school said she was overweight’ and he was like ‘don’t worry about it’. He’s really involved in the health department so you know I take his word and everything. I trusted him so he was like ‘don’t worry about it’.”

*Health Screening Identification, Doctor’s Response*

“When they sent me that letter [letter on BMI], because I go to the doctor, they go to the doctor. They’ve been to the same doctor all their lives, and he would tell me if I needed to do something different.”

*Health Screening Identification, Doctor’s Response*

“I wouldn’t do anything until my doctor said so.”

*Health Screening Identification, Response/Follow-up*
“Yeah if the doctor said it isn’t AN then I wouldn’t do a thing but if it was then oh yeah I would”

[Health Screening Identification, Response/Follow-up]

“So if parents are getting this letter [BMI] and their children go to Children’s Close to Home, which I am sure about 90% of those kids do, they might feel like the doctor is too accusatory or nasty toward them. If they brought it up in an appointment.”

[Health Screening Identification, Doctor’s Response]

**School Based Screening for AN, Potential Messaging**

For AN screening and notification participants preferred the following message: ‘AN is a skin condition where the skin’s surface may look darkened and velvety or rough. It may mean that your child has high levels of insulin in the blood, which is one risk factor for developing type 2 diabetes and/or cardiovascular disease.’ Participants indicated feelings of urgency and their likeliness to follow-up upon reading this message.

“Well, at least three explains what you are looking for too what the skin sort of looks like.”

[Potential AN Message, Preference]

“I think I like message three. I like the fact that it says ‘may mean.’”

[Potential AN Message, Preference]

“Yeah it [the message] doesn’t make you worry too fast. It makes you think about what you need to do. Instead of ‘oh my God, my baby is sick’ or these people just sent me some stuff and throw it away. It actually makes you sit there and look at it.

[Potential AN Message, Preference]

“[Message three], really gives you a sense of urgency!”

[Potential AN Message, Preference]
Yet, participants suggested that some adjustments should be made to the health screening message for AN, to make it more comprehensible to parents. Participants suggested that health terms be simplified, as medical jargon is less familiar to families and may be confusing. Participants also indicated that the definition of AN should be provided first, then the name introduced. The phonetic spelling of AN should also be included. Participants strongly suggested that a photograph of AN also be included with the message.

“I mean who understands all those big words? I mean I do cause I did pharmacy tech, but I have friends and people I have around with would be like they have what?”

[Potential AN Message, Language]

“You got to speak in layman’s terms and calm down stuff so people can understand what you are saying.”

[Potential AN Message, Language]

“There not going to understand it [the large medical terms].”

[Potential AN Message, Language]

“You know these big words I don’t know nothing about this so you got to tell what diabetes does what heart disease does.”

[Potential AN Message, Language]

“First I think these are all wrong, they shouldn’t start with the word acanthosis.”

[Potential AN Message, Language]

“Again with AN, you just put in parenthesis behind the definition.”

[Potential AN Message, Language]
“To see a picture says a 1000 words and I think if you could send a colored picture with this that would help a lot.”

[Potential AN Message, Marketing]

“Even though you are saying this is a skin condition, just showing us the pictures right there has done something for me.”

[Potential An Message, Marketing]

“…to see a picture of something [AN] you know I think it would really press the issue that this [AN] is serious.”

[Potential AN Message, Marketing]

Participants also made suggestions for the notification of AN and indicated that the school should alert parents beforehand to anticipate health screening information on AN. Parents also desired to be alerted of AN only if the child has screened positive for the skin marker. For more detail, participants suggested that additional informational resources including websites should be included. Participants also requested that the school nurse include a directive as to what steps the parent should take next.

“The more information that you get the more worried you get... So wouldn’t it be better to be notified if there only is a problem?”

[Potential AN Message, Messaging]

“Yeah I would prefer if you detect it on my child then let me know I don’t want to know [if they don't have it].”

[Potential AN Message, Messaging]
“A website that accesses the information, a website that would give more information about it.”

[Potential AN Message, Marketing]

“But all that information, I would want on a website. I wouldn’t want it all written down on a sheet of paper. I would want a website in case I wanted to learn more about it.”

[Potential AN Message, Marketing]

“What is my next step, what should I do next?”

[Potential AN Message, Follow-up]

“I would probably include something like, ‘you may want to go get your child checked out’. That would be alarming too, something along the lines of that.”

[Potential AN Message, Marketing]

“And maybe [the school nurse] should include ‘talk to your physician’ if they do[have AN].”

[Potential AN Message, Messaging]

School Based Screening and The School Nurse

Participants indicated their respect of the school nurse and her advice. Yet, participants shared that some parents may feel skeptical of the school nurse’s results, may not take health screening information seriously and indicated they would follow-up to either confirm the school nurse’s finding or to “prove her wrong.” This skepticism appeared to be non-specific to obesity.

“I love the school nurse and all, but for me personally what ever comes home from the school I will probably go and double check with my physician.”

[Health Screening Identification, Response/Follow-up]
“I would take her [daughter] to the doctor just to make sure if she [the school nurse] said was correct on the paper(AN).”

[Health Screening Identification, Response/Follow-up]

“If it were mine, I want to take them and find out the truth. They can tell me [the school] but don’t mean its true. I am going to take them to their doctor.”

[Potential AN Messaging, Preference]

“Yes [I would follow-up], so I can show her [the school nurse] a letter that the information she gave is incorrect.”

[Anticipatory Health Screening, Reaction/Denial]

“Yeah they are going to want to go to the doctor immediately [with AN screening information] to make sure and prove that the school nurse was wrong. That is, my doctor said No.”

[Potential AN Messaging, Response/Follow-up]

**Resources**

As participants responded to AN screening information by desiring the school nurse to communicate the next steps, participants reported their intention to making changes to the family and the child’s nutrition and physical activity habits upon receiving health screening information on AN.

“Better diet certainly.”

[Lifestyle Changes, Nutrition]

“Definitely be more active and better diet.”

[Lifestyle Changes, Nutrition]
“Shut off the video games and go bike riding more often, walk more.”

[Lifestyle Changes, Physical Activity]

Nutrition

Participants discussed their food preferences. Participants indicated making some healthier food choices in their diet including: turkey meat, yogurt, cheese, salads, frozen fruit and light brands as a replacement for unhealthier options. Others indicated making less healthy food options such as choosing fried foods like chips and chicken.

“I went to the store and got whole grain pasta for spaghetti and I did turkey hamburger [since my husband told me that I cook fatty.]”

[Nutrition, Food Choice]

“I love yogurt and my boys love yogurt and even in the summer I freeze it and it is like ice cream.”

[Nutrition, Food Choice]

“I am sitting here thinking now like I got to go to the grocery store and get spinach and vegetables.”

[Nutrition, Food Choice]

“I can go a few days and then I am like give me some fried chicken!”

[Nutrition, Food Choice]

“We revert back we need our chips we need our fried chicken.”

[Nutrition, Food Choice]
Nutrition Barriers

Participants expressed several barriers to healthy eating. Access to healthy, nutritious foods and the cost to eat healthy were identified. The availability of convenience foods were indicated as another challenge that may prohibit families from making healthy food choices.

“For me to get vegetables and fruits in my kids diets daily it is being done by frozen foods and canned foods (yes, yes. agree) because fresh fruits and vegetable are not really reasonable.”

[Nutrition, Economic]

“I am in the low, low income circle and the availability of fresh fruits and vegetables and to be able to afford it to be able to afford non processed foods [is challenging].”

[Nutrition, Economic]

“A lot of times it is easier to get fast food or junk to kids vs. cooking everyday.”

[Nutrition, Cooking Habits]

“It is so much easier to keep things as they are, eat McDonalds every night.”

[Nutrition, Food Choice]

Familial Influences

Participants emphasized the need for parents to take more responsibility for shaping their child’s eating habits, such as providing healthful foods for their family and monitoring what the child eats. Furthermore, parent behavior, such as using food to please their children and to stop their child from whining was identified. Participants also indicated that cooking behaviors and cooking skills of parents should be improved upon, so healthy eating habits in the home can be established. Frying was identified as one popular cooking method for food
preparation. Participants perceived that parent influence on child eating behaviors is confounded by laziness among parents, convenience of foods, and working parents.

“You be better buying it for them like that and putting it out there for them. That is the only way that they will actually get it.”
[Nutrition, Parent Role]

“I think that parents just don’t take it seriously they don’t take feeding their kids healthy seriously to me.”
[Nutrition, Parent Behavior]

“But you know it starts in the home and if I feel like if their parents didn’t teach them to eat healthy how are they going to teach their kids how to eat healthy? Like you said [referring to another participant’s response] it all starts in the home first. If nobody trained them then they can’t train their kids on how to eat healthy”.
[Nutrition, Parent Behavior]

“If they holler most of the time we tell them to go get it cause we don’t want to hear them holler ‘oh mommy please!’ So if they ask me, go get it. They want a piece of candy, go get it. Anything to keep them from crying.”
[Nutrition, Child Behavior]

“I have tried different measures but when she's sitting there screaming and crying [that] she's hungry, as a mother, I can't tell her that she can't eat.”
[Nutrition, Child Behavior]

“But with some people that is all they know how to do is fry fry fry [foods]”
[Nutrition, Cooking Behaviors]
“For me last night, I was conscious about my cooking habits cause my husband said we are all going to die from my cooking cause I cook fatty.”
[Nutrition, Cooking Behaviors]

“But you know what I'm going to say I'm a stay at home mom. But I'm lazy. I couldn't imagine well I'm not going to say I'm lazy. I personally couldn't imagine cooking every meal, everyday.”
[Nutrition, Parent Role]

“They're not eating the proper meal. Some parents are so lazy and don't feel like cooking [so they eat] processed food.”
[Nutrition, Parent Role]

“Well a lot of parents work and a lot of parents aren’t home enough to monitor what their kids eat, to me, but that’s not their fault.”
[Nutrition, Parent Role]

**Physical Activity**

Participants described physical activity and outdoor activity among their children and circle of friends. Participants indicated that there have been changes in physical activity habits among children today compared to their generation. When parents were growing up, children played outside more.

“First of all, I'm going to say is safety [in this generation].. You used to be able to go outside and stay out until the lights came on and then you come home and check in.
[Physical Activity, Generational]
“Not the exercise like it used to be when I was growing up, kids don’t play I don’t think they ride bikes like we did in my time. [Today there are] video games and TV.”

[Physical Activity, Generational]

“You know my husband talks about when he was a kid they would go and run in the fields and play for hours they would be gone all day.”

[Physical Activity, Generational]

**Physical Activity Barriers**

Particularly in urban neighborhoods, safety outdoors was concerning to parents. Participants indicated that speeding cars and the type of people living or socializing around their neighborhood were reasons for caution when sending children outside to play. Other barriers to physical activity included the lack of economic resources and childhood obesity which limits the type of activities children can perform. .

“I know in my neighborhood there are a lot of connections between 161 our [road] is a short cut...we get [cars] that fly down [our road]. So we get a few people who go 35 when it is a 25 mile and hour street.”

[Physical Activity, Safe Environment]

“You just have to worry about cars, that would be the safety issue in my neighborhood.”

[Physical Activity, Safe Environment]

“Not a safe neighborhood, you just can’t let your kids out and run around anymore like you could 20 years ago”; “You have to keep an eye on [the kids] more while they are outside”

[Physical Activity, Safe Environment]
“Safety issues you know I know in this community you know you have x amount of sex offenders so you can’t really afford to have your kids out of your site or not know where they are at you.”

[Physical Activity, Safe Environment]

“Now although we have the Columbus PD, but if you go into Bexley you know you see a presence [of the police]. You know there is a safety net there. [Here] you actually have to sit out or you know be within a 10 feet radius and knowing where your child is.”

[Physical Activity, Safe Environment]

**DISCUSSION**

Formative research sessions explored parent attitudes and perceived barriers to the health screening process with an emphasis on BMI and AN. Furthermore, the intention of collecting formative research data was to determine the most ideal message to communicate AN screening information that will potentially elicit parent response. Yet, even though AN was found to be less well known among focus group participants, they reported feeling more alarmed to its meaning compared to obesity alone. These data suggest that the communication strategy of health screening information, presented by the school nurse, should emphasize the co-morbid risks and complications of developing excess body weight in children. Previous focus groups sessions with school nurses (Chapter 6) confirmed that school nurses present health screening information on obesity to reflect its adverse health implications as opposed to the cosmetic concern of obesity. These divergent views among families and school nurses suggests a breakdown in communication occurs at the start of the health screening process. The frame of the health assessment letter is a critical step in the delivery of health screening information, as the message should not only educate the family of their child’s screening results, but also to increase parent urgency to follow-up.
Health screening letters, from the school nurse, that discussed overweight and obesity in the forefront seemed to draw out a less than favorable response among parents. Their perceptions of their child’s weight status elicited a reaction that was defensive. Parents even reported feelings of denial. Participants provided several factors that may impact and shape parental perceptions of excess body weight among their child. Having heavy family members and heavy individuals in their social circle may create a fatalist feeling, that the development of obesity in their child is inevitable. Furthermore, parents shared their belief of their child’s weight to be “baby fat” and acknowledged the need for time and growth to see if the child grows out of his or her weight. Cultural acceptance of excess body weight, particularly among African Americans and Hispanics, appeared to also direct parent perceptions and attitudes of their child’s weight status. From a cultural perspective, having a larger body frame is considered to be healthy and more accepted. Standards that are used to evaluate overweight and obesity were also criticized by participants, indicating that such references were not representative of certain sub-populations of children, specifically minorities. As one African American participant shared, “we have dealt with that [obesity] our whole life. Doctors saying that every body is too big you know, in our whole entire families. It goes in one ear and out the other, be cause we always heard that. They label us the same when culturally we are different. This statement reiterates that cultural influences impact parent attitudes towards obesity standards and what is the correct weight standard for their culture. Such attitudes about screening standards as being applicable to diverse ethnic populations, combined with the criticisms minorities may face about their weight status, may in part explain a lack of urgency to follow-up to health screening information. As one participant points out: “With obesity, I don’t think it is any new information to a parent. So if
In general, the urgency of parents to follow-up to the school nurse’s BMI screening appeared to be less than favorable. Given the evidence suggesting a lack of response and the many perceptions and influences that may affect the ability for the parent to accept BMI screening information, this is a logical assumption. The lack of follow-up to BMI screening information is particularly concerning, for several reasons. First, after a huge investment of the school nurse’s time, valuable health screening information is not being properly utilized. As school nurses identified in previous focus groups sessions (Chapter 6), time is a precious resource for the school nurse, given the vast nature of her scope of practice. The lack of feedback from parents to health screening information prompts the school nurse to conduct follow-ups on her referral. Given the number of children referred for BMI in a screening cycle, combined with lack of time, the burden of follow-up is amplified. Secondly, it is through health screenings that not only are adverse health risks evaluated, but also serve as the basis for the intervention and treatment regimen. The failure of both the parent and the PCP to follow-up on this important health information creates a preventable health disparity.

In comparison to information on BMI, parent perceptions and attitudes of AN screening information were generally more favorable. Parents perceived AN to be representative of a tangible health concern. A more favorable response to AN may be accounted for by reported family history of diseases such as diabetes and heart disease. One unique parent response indicated a feeling of devastation if risk for diabetes and heart disease was found among their children. “I would be devastated that my kids would be getting ready to go thru what I went thru my whole life. I would be devastated.” Perhaps it is the influence
of the family’s adverse health history and the feelings of devastation that may result in increased receptivity to health screening information on AN. Given the more positive response among parents, AN has the potential of a communication strategy to underscore the severity of excess body weight in childhood due to its association with co-morbid health risks. The potential frame of the conversation to focus on the health implications of AN, may assist the school nurse in overcoming communication barriers to screening information on excess body weight that are influenced by a multitude of parental and cultural attitudes. Furthermore, it is safe to speculate that AN screening information is more likely to elicit a response from parents.

Yet, it is important to note that despite having expressed that information on AN creates more alarm compared to obesity, participants reported that no matter the frame of information communicated, there will always exist a certain groups of parents that will be resistant to urgency. Participants particularly emphasized that young, single mothers are faced with unique challenges and barriers that may prohibit them from engaging in their child’s health. Furthermore, as one unique comment indicated, the context of information that focuses on diabetes and cardiovascular disease health risk through the platform of AN may be too overwhelming and a discussion on obesity is more appropriate. “I can handle overweight. If you say to me diabetes or some major disease, oh yeah, were worried. That's just the way I think. I mean, you can't be putting in those words, just give me something that I can handle. The overweight, I will look into that.”

Participants were given a series of 3 pre-conceived messages describing AN. The intention was for parents to identify a message for AN and were allowed to offer suggestions on how the message can be improved upon. Participants were able to identify a culturally
sensitive message that provided an adequate description of AN. Participants selected the following message, ‘AN is a skin condition where the skin’s surface may look darkened and velvety or rough. It may mean that your child has high levels of insulin in the blood, which is one risk factor for developing type 2 diabetes and/or cardiovascular disease.’ Participants indicated that the AN message discussed this skin marker as a tangible health threat that was both alarming and attention grabbing. However, respondents shared their feeling of the message’s content and were able to provide suggestions on how to further develop the message’s integrity. Participants emphasized the need for AN screening information to be communicated in the simplest form possible, including the use of less complex words to describe medical terms. Yet it was important from the perspective of the school nurse that the description of AN and its association to adverse health risks not be compromised. Participants also desired for the message to be carefully phrased, as they felt certain parents may be over-alarmed by the AN information. As a result of their suggestions the above message was modified to read as follows: “A skin condition where the skin’s surface may look darkened and velvety or rough is named AN(ay-can-tho-sis nyg-ruh-cans). It may mean that your child has high levels of insulin in the blood, which is one risk factor for developing type 2 diabetes and/or heart problems” It appeared from their suggestions, that a modified AN message would likely elicit urgency and a potential response among parents, particularly if the school nurse provided follow-up guidelines and resources for additional information.

Additionally, respondents provided suggestions regarding the communication of AN screening information. It is evident that such suggestions may increase parent receptiveness to health screening information on AN. In addition to identifying an appropriate health screening message for AN, respondents were able to provide suggestions for supplemental
resources on AN that would be most helpful in increasing overall knowledge of parents and to initiate response to this information. The strategies suggested by focus group participants include the use of a color photograph and the inclusion of on-line resources.

Participants appeared to feel strongly that the school nurse provide firm directives and supplemental resources for follow-up. School nursing scope of practice, encompasses education, and for obesity and AN, education should emphasize prevention and intervention strategies that are inclusive of a nutritious diet and physical activity. Yet, when providing educational guidelines on these topics, it is important for school nurses to be mindful of the lack of access and availability of nutritious foods and barriers to activity. Parent participants indicated that access to nutritious foods is hampered by economic constraints, convenience and ease of processed foods. The lack of skill parents have to prepare healthful foods may also be a barrier to obtaining a highly nutritious diet. Furthermore, the ability for children to be active in urban neighborhoods is confounded by the lack of safe spaces to play due to busy roadways and the types of people living within their neighborhoods.

**Recommendations for School Nursing Practice**

Overall, the information obtained in these focus group sessions have potentially aided in establishing best practices for school health screening and referral for AN, based on the parent perspective. It appeared that parents were accepting of the AN health screen and parents would welcome the information on a health screening letter, provided the message was clear, free of large medical terms, and were accompanied by photographs and firm directives and resources for follow-up. These data as collected and interpreted are preliminary suggestions to develop an AN screening program. Therefore, further field
testing to triangulate qualitative research data are recommended. Yet, provided the success with the identification of AN in previous pilot screenings (Chapter 4) and indication of a favorable response to AN screening information has provided further evidence in support of the implementation of AN screening in school based setting.

The addition of a new screening parameter such as AN to the existing BMI and blood pressure screenings is valuable for the identification of early health risks among children. The information and conclusions from these focus group sessions may have significant impact on the school district of focus. First, the information presented in the screening program for AN is intended to increase awareness among parents of this skin marker and its relationship to obesity and resulting co morbid conditions in childhood. It is anticipated that when AN is screened for and effectively communicated to parents that urgency will be raised and follow-up will ensue. The follow-up is a return on the school nurse’s time investment. Secondly, the process and use of focus group sessions to approach best practices for AN screening, referral and follow-up may serve as a template for other health screening programs (ie: scoliosis, vision, hearing, dental). Further discussions around such screening programs should be generated with families to determine the most ideal frame to communicate health screening information that will increase urgency and response to health screening information provided by the school nurse. Thirdly, the act of screening for AN creates an opportunity to evaluate the health screening process and referral system. Particularly for BMI screenings in school and to a lesser extent AN, the CDC has called for more research on the effectiveness of school based screening programs to impact and reduce childhood obesity. Lastly, through awareness and promoting the urgency of an AN diagnosis, there
is a potential to impact and reduce the local prevalence of childhood obesity and resulting co-morbid conditions.
Chapter 6: School Nurses’ Attitudes, Perceptions and Barriers to the School Based Screening Process: An Emphasis on BMI

INTRODUCTION

School nurses have been identified as the “health care safety net” for children and adolescents. As the medical lead in the school setting, the school nurse is often the first line of defense for children suffering from acute and chronic health disparities. The school nurse’s scope of practice is well rounded and encompasses episodic care, direct care and management to children with chronic disease and disabilities. Further their role includes the promotion of health and a healthy school environment, screening and referral and connecting children and their families to health and mental health resources. Healthy People 2010, a set of evidence based health objectives designed to meet 2 overarching goals for Americans, Increase Quality and Years of Healthy Life and Eliminate Health Disparities, have recommended at minimum there be one nurse for every 750 students in the US. Based on evidence comparing statewide distribution of school nursing services, only 12 states have been successful at reaching the 1:750 ratio, with the majority of states employing 1 nurse for every 1,000-3,000 children. As the complexities of student health care needs and the incidence of chronic and often debilitating health conditions continue to rise among children, the failure to equip schools with school nursing staff to accommodate difficult health challenges may not only be a detriment to the health of children, but also to their ability to learn.
Screening is the initial strategy for identifying the presence of biomarkers that may be indicative of risk that may lead to the development of diseases or adverse health conditions. NASN and the AAP- CSH have reinforced the need for early identification of adverse health risks with the prospect of intervention and referral to promote optimal health outcomes.\textsuperscript{24} Scoliosis, vision, and hearing have long been established, mandated health screenings conducted at the school site. Screenings for BMI, although controversial, have gained acceptance among schools in an effort to combat childhood obesity.

For any screening, the process by which the school nurse executes health assessments begins with reliable identification. For BMI screening, schools are urged to utilize the CDC standard reference for BMI percentile based on height, weight, gender and age and follow safeguards established by the CDC.\textsuperscript{26,27} Notification of the health screening result to the parent and referral to a primary care provider (PCP) is the prescribed follow-up. An intermediary step also could include the school nurse’s follow-up with the family to the initial referral. That is the school nurse confirms whether the family has made a connection with their PCP to address the health problem. The connection of the family and PCP heavily relies on the parent’s motivation and urgency about the health screening information. Family follow-up with primary care infers a transfer of responsibility to the PCP to conduct the appropriate evaluation. The Expert Committee\textsuperscript{22} has provided clear directives for the pediatrician when a child is identified as overweight or obese. The final step in the screening process is the communication of information back from the PCP to the school nurse on the referral outcome. Where appropriate the PCP’s care plan may include case management suggestions for the school nurse to monitor and manage the child’s health in between office visits, establishing a collaboration between the two healthcare providers.
In spite of the school nurse’s extensive efforts to intervene, a sense of urgency often subverts the screening process at the home or at the doctor’s office. Previous pilot screening for BMI and AN among 3rd and 5th grade children demonstrated a poor response among parents to the school nurse’s referral recommendation. National studies have shown reluctance among parents to accept a diagnosis of a weight problem in their child as a primary barrier to effective screening on BMI. Regardless of national directives that urge physicians to identify obesity, intervene and follow closely, they often fail to screen for the child’s BMI. Such barriers in the home and in primary care environments preclude child’s ability to receive optimal care.

The scope of practice of the school nurse around screening activities is centered on the evaluation of the child’s health status, education on the implications of the screening process and its results and the coordination of the child’s care with medical and community resources. The objectives for our focus group sessions remained within the school nurse’s scope of practice. We aimed to 1) determine the perception of the school nurse towards the health evaluation of overweight and obesity in childhood. Given barriers to the health screening process, as introduced in Chapter 4, we intended to 2) investigate how the school nurse’s screening activities are affected by parents and primary care providers. Furthermore, we aimed to 3) understand the perceived barriers to education and receptivity of health screening information by families and physicians, as well as the perceived attitudes and barriers towards the coordination of care with the child’s PCP.
METHODOLOGY

Focus Group Demographics

Three focus group sessions were conducted with school nurses serving either elementary, middle, or high schools in an urban school district in Columbus, Ohio during the months of May and June 2010. A total of 24 school nurses, with an average of 7.5 years of school nursing experience, participated in one of three focus group sessions. Participants were recruited by a school nurse representative from the school district through a mass e-mail communication school. Participation was a first come, first serve basis.

Developing Focus Group Questions

A research team with combined expertise in pediatric obesity, human nutrition, and school nursing were responsible for the development and revision of focus group questions until a consensus was reached (Appendix C). Focus group questions followed an in-formal, semi-structured interview format. Question types queried participant knowledge and perceptions regarding the health screening process, particularly around BMI and perceived barriers that impact their scope of practice and coordination of health care for children among families and primary care physicians. Probing questions, to seek further explanation and description on a particular concept or participant response, were conceived at the discretion of the focus group moderator.

Focus Group Procedures and Incentives

All focus group participants received an information sheet describing the research study. Participants completed a brief, anonymous demographic survey. Since all
information collected from the focus group participants was unspecified, focus group members were given the opportunity to grant passive consent based on their willingness to participate. All focus group sessions were digitally audio taped. Field notes were collected by the research team members. At the culmination of the focus group session, participants received a $25 gift card to a local grocery store. All procedures were approved by the IRB at NCH, Columbus, Ohio.

**Transcription and Analysis of Focus Group Dialogue**

Dialogue was transcribed verbatim from audio tape recordings for analysis. Field notes were collected by the research team and were used to corroborate transcribed dialogue. Participant identifiers that may have been used were omitted during the transcription process. Audio dialogue was erased upon completion of the transcription process. Research team members were trained and responsible for coding the focus group discussion. Open coding techniques, derived from grounded theory, were selected based on the premise that the coding strategy allows the researcher to capture and develop the backbone for the analytical frame of the interpretation. This includes remaining open to the data, capturing its fit and relevance, define emergent themes as they present themselves, yet allowing for the researcher to explore their own expert voice through the selection and wording of phrases through the coding process. Transcripts were divided into data fragments (n=679) with attention being paid to the convergence and divergence of emerging ideas. Resulting data fragments were coded for their content. Categorical topics were coded first to capture general data. Categorical topics were then sub-coded to extract themes and capture the core meaning of the
data. A data display (Figure 5) presenting the major themes were developed to display overall patterns and assist with guiding data analysis and interpretation.
Figure 5: Emergent Themes among School Nurse Focus Group Sessions
RESULTS

Themes

- **Approach to Communicating Health Screening Information**
- **School Nurse Perception of Families to Respond to Health Screening Information**
  - Family History
  - Hierarchy of Needs
  - Parent Attitudes and Orientation to Time
  - The Role of the Peer System
- **Referral Barriers**
  - Pediatrician
- **School Nurse Scope of Practice Barriers**
  - Transient Gap in Care and Inaccessibility of Parents
  - Technical Support
  - Nutrition Education and Nutritious School Food Options
  - School Nurse’s Expectation for Follow-Up
- **Continuity of Care**
- **School Nursing Judgment**
  - Isolation

**Approach to Communicating Health Screening Information**

School nurses approach the communication of BMI screening information in a frame that emphasizes the adverse health consequences of carrying excess weight in childhood, instead of focusing on BMI as a primary concern. Even more helpful to the school nurse’s approach in communicating health information, is the identification of additional health concerns such as hypertension, joint problems or even known family history. School nurses perceived that framing the communication to reflect health risk presents the information as a more concrete health concern than BMI alone. From the perspective of the school nurse, this approach is likely to create acceptance among families to BMI screening information. Furthermore, school nurses reinforce, in their recommendations for overweight and obese children, the need for follow-up with the child’s primary care physician (PCP).

“That is the information that we send. We don’t address the cosmetic type things”

[Communication with Parents, Approach to Health Screening Information]
“…if you have something else besides the BMI you can say, ‘your child’s BP [blood pressure] is high right now’, it is a concrete thing. Then they are more apt to go to the doctors then if you just have to talk to them about this [BMI].”

[Communication with Parents, Approach to Health Screening Information]

“…your child’s BMI is elevated and I notice when they come in from recess that they have particular joint pain in certain places every time and I wonder if that [BMI] might have something to do with it.”

[Communication with Parents, Approach to Health Screening Information]

“…it’s all about this weird BMI thing or the fact they look heavy, that isn’t going to promote compliancy as much as if you are going to say their lives are going to be cut shorter and they are going to have diabetes like their grandma did.”

[Communication with Parents, Approach to Health Screening Information]

**School Nurse Perception of Families to Respond to Health Screening Information**

Despite framing BMI health screening information as potential for the development of health risks, school nurses perceived parent response to be poor. School nurses assumed that parents are not taking the initiative to follow-up. School nurses recalled few parents who have actually responded directly to them regarding the screening result. Participants shared that among those that have followed-up in the past, the reaction is mixed, with some parents expressing anger and some parents expressing their appreciation for the health screening information.

“Yeah I find it fascinating that I don’t get more calls”

[BMI Screening Process, Parent Response]
“The majority, nothing. I have a couple that have I sent to the center, but I will be honest with you the majority don’t [follow-up] at least for me.”

[BMI Screening Process, Parent Response]

“I got one back (response) in the 8 years that I have been there and I had one person called saying thank you for making me aware and that was it.”

[BMI Screening Process, Parent Response]

“I have had some parents who are upset about it. I have had others that have been very responsive and thankful, ‘I wasn’t aware, what resources do you have to help?’ It is still a mixed bag it is not real well received across the board.”

[BMI Screening Process, Parent Response]

“I had a mother just recently a couple of weeks ago in my private school that I have called me and said that she would appreciate if I wouldn’t weigh her child anymore since her child is very athletic and big boned...”

[BMI Screening Process, Parent Response]

School nurses identified several potential factors that may prohibit the acceptance and appropriate response among families who receive BMI health screening information. From the perspective of the school nurse, these factors included: family history and “norms” as the frame of reference, hierarchy of needs, attitudes and orientation to time.

**Family History**

School nurses indicated that family history may impact acceptance of health screening information among parents of children with health risks. School nurses described
their accounts with parents, who attributed their child’s excess body weight and failing health to having family members with the same or similar health conditions. From the school nurse’s perceptive, when parents perceived their child’s health status to be affected by family history, they adopt a fatalist view. School nurses also perceived families to utilize what is “normal” among their family members as a frame of reference to compare their child.

“Exactly. That is what they tell us [it runs in my family]”
[SN Perception of Home, Family History]

“My grandmother had it, my mother has it, I am going to have it”
[SN Perception of Home, Family History]

“We are a big family, we are all big and that is just how we are and we don’t need you involved in this.”
[SN Perception of Home, Family History]

“They just accept that like it is part of you know their life and so that is the norm for them...they feel like they can’t prevent it.”
[SN Perception of Home, Family History]

**Hierarchy of Needs**

School nurses perceived families to make prioritized decisions about their family’s wellbeing. School nurses particularly emphasized that parents have difficulty making ends meet and are concerned with meeting the day to day needs of their family. From the school nurse’s perception these more eminent life factors, appeared to prevail over a rational response and follow-up to health screening information on BMI.
“You know that is low [follow-up to BMI] on Maslow’s hierarchy of needs, which I always refer back to cause it helps me understand why…it just gives you an idea why this is not important to them and there are bigger factors in life.”

[SN Perception of Home, Hierarchy of Needs]

“I just feel like I try to look at their point of view. They are trying to hold down two jobs and they got 5 kids and you know that [BMI] is low on Maslow’s hierarchy of needs”

[SN Perception of Home, Hierarchy of Needs]

“I think it is pretty universal through our school district, the parents have a lot of issues just making it.”

[SN Perception of Home, Hierarchy of Needs]

“A lot of them are just in survival mode…they’re trying to figure out how they are going to make it to the next minute.”

[SN Perception of Home, Hierarchy of Needs]

“They do not have the time, energy, money or anything like that to figure out how to take their kid to the doctor for their weight when they have way more other things in their mind to deal with.”

[SN Perception of Home, Hierarchy of Needs]

**Parent Attitudes and Orientation to Time**

School nurses perceived that parents are defensive of, feel threatened by or are uncomfortable receiving health screening information on their child’s weight status. School nurses also perceived that parents are unable to rationalize the long term health consequences when obesity has developed in childhood; their orientation to time appeared to be skewed in a manner that focuses on the present, not the future.
“And I think that the parents are defensive when we bring it up [BMI].”

[SN Perception of Parent Response, Parent Attitudes]

“They feel threatened [to receiving information on BMI screenings]”

[SN Perception of Parent Response, Parent Attitudes]

“Yeah I think it can be a threat to their culture what we are doing. Their children are looking at them and saying ‘hey mom, I heard this’ and that can be threatening a lot of the time”

[Health Management, Interaction with the Family]

“The heart problems, those are the people next door type of thing.”

[SN Perception of Parent Response, Parent Attitudes]

“...I bet it isn’t going to happen to me if it is a probability.”

[SN Perception of Parent Response, Parent Attitudes]

The Role of the Peer System

School nurses shared their unique circumstances of working with a group of Parent Consultants (PC). The PC role is to assist faculty and staff with the facilitation of general building activities that involve, or are of interest to, other parents and families. The school nurse’s opportunity to utilize the PC’s time to promote and assist with notifying parents about health related information and educational sessions was acknowledged.

“I offered a nutrition lecture and had one family come and I had my family consultants help with that.

[SN Scope of Practice, Work with PC’s]
“They really are allowed to accept a lot of responsibility in the building, so I have had a lot of success with that. But I think it is a unique situation.”

[SN Scope of Practice, Work with PC’s]

“I did have the parent consultant group put out the presentation and the opportunity for them to talk to parents about BMI, so that was very positive.”

[SN Scope of Practice, Work with PC’s]

**Referral Barriers**

Based on the school nurse’s perspective, barriers to the health referral process were implicated on the level of the family, the pediatrician and internally at the school site.

**Family**

The inability of the nurse to easily access the family appeared to create a barrier to communication and is a challenge to the school nurse’s health referral process. School nurses explained their attempts to connect with the family, which are hindered by non-working telephone numbers.

“I try to catch parents at dismissal when they bring them in the morning. I mean anytime you can catch them. It is a real struggle to have phone communication. It is a huge barrier.” [Communication with Parents, Barriers to Connecting with Parents]

“A working phone [lack of one is a barrier]”

[Communication with Parents, Barriers to Connecting with Parents]
“We struggle sometimes. It takes us 4, 5, 6 calls just to get a hold of a parent because their number has changed so often they are disconnected. You are trying everything to get a hold of this parent. It is very difficult to have a personal conversation.”

[Communication with Parents, Barriers to Connecting with Parents]

Furthermore for the family, there is difficulty in accessing health care resources. School nurses feel that this barrier impairs the family’s ability to engage in appropriate follow-up for their child’s health. This in turn, results in insufficient feedback from the parent in response to the school nurse’s health care referral. Resources that are available often are not local and are not utilized by parents. School nurses perceived transportation and costs as significant barriers for families in accessing health care. Furthermore, school nurses indicated that many families do not have an identifiable, structured medical home. Families rely on emergency room services (ER) as their means for health care. School nurses perceived that a lack of knowledge among families to the importance of identifying a PCP may contribute to this deficit. The inability for families to identify and use appropriate resources to address their child’s health concern may be one impetus for a lack of follow-up by the family.

“I think for my population being in the north end to go down to Children’s Hospital or to even go up to Westerville because of transportation. I think if there were more satellites [for the Healthy Weight and Nutrition Center] within the city that might help.”

[Community Resources, Availability/Accessibility]

“Yeah a lot of ER, urgent care”

[Health Management, Medical Home]
“And then you find out that they have no physician. That is a huge barrier that we should have talked about. They need a referral to the Healthy Weight and Nutrition Center”

[Health Management, Medical Home]

“They do, in fact [use the ER.] Today one of my students said I have this really bad neck pain I will just go to the ER. I am like ‘Stop, what is the ER going to do, that I didn’t already do?’ But it is out there that is there thing, I am just going to go to the ER.”

[Health Management, Medical Home]

**Pediatrician**

Surprisingly, school nurses identified pediatricians as another barrier to the BMI referral and follow-up process. Within the scope of the pediatrician’s practice, school nurses perceived circumstances such as time and the PCP’s practice ability which may disable the PCP from following-up to the school nurses screening result. School nurses acknowledged that PCP’s are overwhelmed by the volume of patients they care for in such a short window of time. Therefore, the opportunity to address the school nurse’s referral concern, about the child’s excess weight, may not be a priority.

“I think in the clinics right now they have their numbers set so high that the physicians I think are overwhelmed by the number of patients that they see”

[Health Management, PCP Office Barriers-Time]

“So I think that their time constraints do not allow them to put the time into the education of the problem with obesity that it should”

[Health Management, PCP Office Barriers-Time]
“They don’t have time they see patient after patient I mean it is like a factory...when I started [at Children’s Hospital] we saw 8-10 patients a half a day now it is like 24 -25 patients...the doctor doesn’t have the time.”

[Health Management, PCP Office Barriers-Time]

School nurses implicated that PCP’s are inconsistent in supporting the school nurse’s guidance and may dismiss the concerns. School nurses reported that PCP’s often fail to affirm the BMI health screening result as evaluated by the school nurse. School nurses perceived this lack of cohesion between health care professionals as a challenge to fully engage families and to gain compliance from both the PCP and family.

“I had a parent that took the child to the doctor and the doctor said he was fine”

[Communication b/t School Nurse/PCP, Referral Follow-up-Physician Barriers]

“I mean this kid is 100 pounds overweight and the doctor says you are fine? No! I just don’t understand that either.”

[Communication b/t School Nurse/PCP, Referral Follow-up-Physician Barriers]

“I think when it comes to the BMI’s and things we can’t we try to make that a serious thing, but it is hard to do that at the same level. When the physician is blowing it off like it is not important, it is really difficult to talk to families and engage all of them.”

[Communication b/t School Nurse/PCP, Referral Follow-up-Physician Barriers]

“You don’t have to pay attention to this. I think they really need to be a little more cohesive in that area.”

[Communication b/t School Nurse/PCP, Referral Follow-up-Physician Barriers]
**School Nurse Scope of Practice Barriers**

The school nurse’s ability to successfully execute her full scope of practice is hindered by several barriers including a transient gap in care, technical support to bolster efficiency, and the incongruence between educating around nutrition and school food options that lack nutritional quality.

**Transient Gap in Care & Inaccessibility of Parents**

School nurses identified the rate of student turn-over in the school and the school district as one challenge to their scope of practice. This creates difficulties to accessing children and their families in order to conduct follow-ups.

> “The transfer between schools is unbelievable [which creates a barrier to connecting with parents]”
> [Communication with Parents, Barriers to Connecting with Parents]

> “I may be looking for their health assessment, find out they are no longer here and they are at East [high school]. By the time I get the sheet out over to East they might be at Northland high school.
> [SN Scope of Practice, Barriers to Care]

**Technical Support**

School nurses indicated that the lack of or inaccessibility of technical and office support may hinder their ability to efficiently perform their scope of practice.

> “I don’t feel like we have the technical support to do the job that we would like to do. My computer is so old and it takes so long to do data entry and honestly there are some days that I don’t get it all in and it is kind of hard.”
> [SN Daily Practice, Resources (lack)]
“Sometimes it is worth the extra effort or the extra time of your own. You know, we are all using our own cell phones to do this lots of times and you know the technology, the fax machine is on the 2nd floor of your building or the copy machine is over on the 1st floor.

[SN Daily Practice, Resources (lack)]

“And its because of time and sometimes you think, ‘I could do that but I got to go here and make a copy, get the printer, get the fax machine,’ and you are running all over the building for one project.”

[SN Daily Practice, Resources (lack)]

**Nutrition Education and Nutritious School Food Options**

School nurses identified incongruence between nutrition education efforts in school and the food options available to children, which makes teaching and education around nutritional choice challenging. School nurse opinions were divided. School nurses did acknowledge recent improvements in school food options, including the availability of healthy vending options and a variety of healthful food offerings at breakfast and lunch. Yet, school nurses recognized that food options that lack nutritional quality are still available and despite the variety offered, children are selecting unhealthy food options.

“You know a lot of the stuff we are telling them that would be good to stay away from we are offering it to their children at school.”

[School Nutrition- Information Conflict]

“At the same time if we are putting it on there too [on the lunch menu] then it can’t be that bad. If we are serving it then it can’t be that bad!”

[School Nutrition- Information Conflict]
“You look at the menu that we are sending home and serving for lunch, you kind of get a conflict of information. You have pizza today and cheeseburgers here or a choice of cheeseburgers and pizza and then your chicken sandwiches, breaded chicken.”

[School Nutrition- Information Conflict]

“I am at the high school and there is a lot of pizza. Usually it is a pizza every day or pizza fries. The peanut butter and jelly is good or it is hot cheetos or something.”

[School Nutrition- Options]

“And even with breakfast there is still work that needs to be done on the high school level. There are still the honey buns and the pop tarts and the muffins and no one chooses the yogurt, hardly and that is one of the true breakfast foods that is there.”

[School Nutrition- Options]

“The options are there I mean they can choose cereal and milk but you know most of them will get the honey bun or pop tarts (or eat on the run).”

[School Nutrition- Options]

“I think that we are on the right track. It is just going to take some time for Columbus City to get these lunches right and breakfasts right and they need to only offer nutritious food.”

[School Nutrition- Options]

“Take away the pizza take away the French fries and the honey buns things like that.”

[School Nutrition- Options]

**School Nurse’s Expectation for Follow-Up**

The school nurse’s referral process prepares her for follow-up feedback from the PCP. Essentially the school nurse seeks continuity in the child’s health care. For the follow-
up to the referral for an overweight or obese child, school nurses expected the PCP to report a wide range of information. The most notable was providing the school nurse with the child’s care plan, complete with the treatment goals and the date of the next appointment for ongoing follow-up. Furthermore, school nurses emphasized their expectation that the pediatrician would refer the obese child to sub-specialized care, specifically the healthy weight clinic or a dietitian, where indicated.

“What kind of care plan.”
[Communication b/t SN and PCP, SN Follow-Up Expectations]

“What the goals are for that child, have a list of specific goals.”
[Communication b/t SN and PCP, SN Follow-Up Expectations]

“It would be nice to get something in writing from the doctor what are they doing so we can reinforce.”
[Communication b/t SN and PCP, SN Follow-Up Expectations]

“Hook them up with dietician have them work with a dietician consistently.”
[Communication b/t SN and PCP, SN Follow-Up Expectations]

“The Center for Healthy Weight and Nutrition is all I think about anymore
[Communication b/t SN and PCP, SN Follow-up Expectations]

Continuity of Care

School nurses acknowledged the importance of creating continuity between school nurses and PCP’s for management of the child’s health. School nurses emphasized the need for establishing rapport with the PCP, which may be challenging as children may interact
with many providers for their care. Furthermore, school nurses expressed the need for ongoing communication and information sharing (bilateral feedback) to create a seamless care system. School nurses suggested that a liaison such as a health coach or nurse practitioner may help to facilitate this connection. Continuity of care may enable the school nurse to have better interaction with the child and family to assist them with meeting goals set by the pediatrician.

“It is huge and if that communication could happen, look at what could happen out there for the care and continuity of our kids.”

[Communication b/t SN and PCP, Continuity of Care-Recognition]

“[Continuity of care is important] so we can have the same things, to have continuity in the message”

[Health Management, Continuity of Care]

“Its because we see that child 5 days out of the week, if they come, so if we had goals or basically what their treatment plan was then we can just follow up with them.

[School Nurse Scope of Practice, Management]

“[Continuity of care is important] so then we can support what the PA recommends, could maybe help with follow up in the perfect world.”

[Health Management, Continuity of Care]

“I think it would be nice if we can get them to go to the doctor, if they can have the same doctor.”

[Health Management, Continuity of Care]

“To have a rapport with them (the pediatrician) instead of just the yellow clinic or the red clinic.”

[Health Management, Continuity of Care]
“There maybe a different doctor every time they go. So it isn’t one doctor following them.”

[Health Management, Continuity of Care]

Despite their willingness to establish rapport and a communication network with the PCP, the potential reality of case managing and monitoring children with chronic obesity appears to be overwhelming for the school nurse. Their ability to manage obese children is hampered by the number of children in their school building who already have developed overweight or obesity in early childhood. Practically speaking, case managing every overweight or obese child presents a near-impossible challenge for the school nurse.

“I know I am being cynical but if you guys got a referral return on all the BMI’s and you were asked to be part of the treatment plan on everyone of these kids, do you think you would have time to do it?’

[Health Management, Ability to Manage a Large Number of Patients]

“That is what I am saying the volume is so big”

[Health Management, Ability to Manage a Large Number of Patients]

“It is huge. We are talking probably thousands [of kids who are overweight/obese]”

[Health Management, Ability to Manage a Large Number of Patients]

“Maybe I would do a portion of it a blood pressure here and there or something, but I know I don’t have time to address 75 kids BMI treatment plan”

[Health Management, Ability to Manage a Large Number of Patients]

**School Nursing Judgment**

Time appeared to be the school nurse’s most valuable resource. The lack of time as resource appeared to play a significant role in the ability of the school nurse to execute tasks
within her scope of practice. Specifically, lack of time forces the school nurse to make nursing judgments that prioritize health concerns based on those that are most urgent. It appeared, when time was implicated as the driving factor, overweight and obesity in childhood was less of a priority for the school nurse to address. For example, time appeared to impact the ability for the school nurse to conduct follow-up of the health screening results, manage the health of the obese child and reinforce nutrition and health concepts through nutrition education.

“I mean, theoretically we would like to do a lot of that [teaching and education] but the reality is a lot different than what you might think from a day to day basis. We just have so many things that we are dealing with and juggling so many balls at one time that it is impossible.”

[Teaching and Education, Time]

“Well I am willing to do just about anything that is required to, you know, to meet those needs as long as I have the time to do it.”

[SN Daily Practice, Time as a Resource]

“You have to pick priorities, but I am not saying I don’t want to have a role in that.”

[SN Daily Practice, Time as a Resource]

“It takes time and you’ve got all these other things, state mandated things, we have to do and you know we are just busy all day long.”

[SN Daily Practice, Time as a Resource]

“And time when you are making the 6 calls unfortunately the ones with the BMI are the last ones on my list. I am more concerned about the kids who are sick or glasses or things which really impact them immediately. Those kind of top my list before I get down to the kids where I am following up on referral calls.”
“Well it is really next to impossible to do it and you know really there are some things that are more critical in terms of the learning process than just the BMI being elevated, like glasses and immunizations. Those are huge areas for me.”

School nurses also appeared to use their nursing judgment when screening for BMI or making a referral. School nurses reported not sending BMI letters home to specific sub-groups of children, such as children who may have BMI’s in the range ≥ 85th percentile, but appear to have athletic builds. Furthermore, school nurses appeared to be aware of the economic strain and lack of access that families have to resources that address health concerns. Thus, school nurses reported caution when making referral or follow-up recommendations.

“There are kids in high school that are a very athletic build and work out that are solid and I don’t see that as a problem.”

“It is hard to send the letter [obesity screening letter] home when they are an athlete.

“You just have to learn to be flexible [with the family’s circumstances] and work around what you can do and what you can’t do. ”

“I think too when we are talking about so many kids don’t have insurance, you don’t want to stress these parents out running to the doctor when they don’t really need to go.”
“We don’t want them to miss school. We understand the hardship. We don’t make referrals that we don’t think they really need to see a doctor for. If they can just over the counter it at home, hey we go with it!

Isolation

In general, school nurses perceived that PCP’s are not seriously addressing the problem of childhood obesity among their patients. Among parents, school nurse’s perceived that families do not seek routine health care for their children and in many instances the school nurse assumes the responsibility of the child’s health care by becoming a source of primary care and a source of “parenting” for the child.

“Physicians at some point can stop and say, ‘hey I can’t take anymore appointments,’ but for us you know if I planned nothing for my day, just went into work with no goal for the day, I would still be busy!”

“I don’t think they [pediatrician] spend time or that is my perception I don’t think they spend time educating.”

“I think they [pediatrician] address the issue, but not stress the issue.”
“The routine checks, the routine physicals you know the first couple of years of life they are good, but after that they fall way off.

[Health Management, Routine Care]

“I mean we act as primary care in a lot of respects. ‘Why are you at school today if you are sick?’ They are in the door and they are in our office. ‘My mom said I had to come to school and you had to check me.’

[SN Daily Practice, Scope of Practice]

“Parents in my opinion I think are not fully parenting, so school nurses we really are [there]. We sow their torn clothes and listen to them when they have cut themselves, purposely cut themselves.”

[Scope of Practice, SN Role]

Furthermore school nurses reported that PCP’s may not fully understand the school nurse’s scope of practice. This may lead the school nurse into further isolation. School nurse’s perceived PCP’s to have a skewed knowledge or a misinformed understanding of the school nurse’s training, professionalism and ability to address and manage health problems within the nurse’s scope of practice.

“I would imagine that doctors don’t have an idea of what we really do.”

[Communication b/t School Nurse and Pediatrician, Pediatrician’s Understanding of SN Scope of Practice]
“I think also there are some perceptional problems between the doctors and what they think school nurses do. I don’t think they value the nurses at a school nursing level and how professional we are sometimes.”

[Communication b/t School Nurse and Pediatrician, Pediatrician’s Understanding of SN Scope of Practice]

“A lot of them have poor opinions on what school nurses do even with our schooling and what kind of background we come from.”

[Communication b/t School Nurse and Pediatrician, Pediatrician’s Understanding of SN Scope of Practice]

“So many of them are surprised that we do BMI’s in the school and it is like we have been doing that for years! And they don’t even realize that we have been doing it.”

[Communication b/t School Nurse and Pediatrician, Pediatrician’s Understanding of SN Scope of Practice]

“I referred a high schooler for blood pressure and the doctor said that ‘you probably didn’t use the right size cuff.’ Well, you probably used a child size cuff on him. ‘I am like no!’ See they don’t understand that we are professionals.

[Communication b/t School Nurse and Pediatrician, Pediatrician’s Understanding of SN Scope of Practice]

“My family physician one day was like ‘well so how many kids do you see in a day maybe 10?’ Are you kidding me I see more kids then you probably see. Come to my office one day and just watch. ’I don’t think they understand that you [the nurse] talk to these families and when we send kids [referral] it is because we really think that they need to go.

[Communication b/t School Nurse and Pediatrician, Pediatrician’s Understanding of SN Scope of Practice]
DISCUSSION

Discussion among our focus group participants about the BMI screening, notification and referral process clearly implicated a broken system on multiple levels. Furthermore, these barriers seemingly impact the ability of the school nurse to execute their full scope of practice and provide optimal health care to children in schools. Starting with the initial process of notification, school nurses reported communicating BMI screening information to parents reflective of the health implications that are associated with carrying excess body weight in childhood. Other school based screening programs in the country, including the CARDIAC project of West Virginia\textsuperscript{100} and the Risk Assessment for Type 2 Diabetes in Children\textsuperscript{111} program of Texas also have reported approaching excess body weight through a platform of risk for developing diabetes and cardiovascular disease. Equally, these programs have shown success over the past decade, with the CARDIAC project\textsuperscript{100} indicating that parents are more accepting of comprehensive health screenings for cardiovascular disease, compared to BMI screenings only.\textsuperscript{140} Furthermore, addressing diabetes in the forefront, the Risk Assessment for Type 2 Diabetes in Children\textsuperscript{111} have seen remarkable increases in the use of the acanthosis nigricans ICD-9 code among PCP. Over a 6 year period the number of claims rose from 2,500 to 32,000, suggesting that the increased awareness of adverse health conditions associated with obesity in childhood, over time, has sparked parent and physician response.\textsuperscript{112}

In our focus groups sessions, school nurse participants shared their perceptions of family response to health screening information, which is a subsequent step of the school nurse’s notification. Family history and frame of reference was one of several factors perceived by the school nurse to impact a family’s response. School nurses implied that a
family history of excess weight or even states of disease often evoke a fatalist view among parents to their child’s health status. In essence, parents may feel that the development of an elevated BMI or disease is inevitable for their child, given the family’s health history. Furthermore, the presence of excess weight among the child’s other family members may cement the parent’s frame of reference and skew their perceptive of what a “normal” weight should be for their child.

Several studies have documented that parents are unable to properly identify excess body weight on their child when classified as overweight or obese.\textsuperscript{28,134} For example, among parents of preschool aged children and children in 5\textsuperscript{th} grade, only 5\% and 26\% of parents, respectively, were able to correctly categorize their child’s weight as underweight, normal weight, overweight or obese. Despite 8\% of the sample being obese, no parents in either grades reported obesity in their child.\textsuperscript{140} There have also been accounts of parents citing mistrust or having a skeptical attitude about national growth standards used to define overweight and obesity in childhood.\textsuperscript{140} In fact, previous focus group sessions conducted with a group of parents from Columbus City Schools, confirmed these perceptions (Chapter 5). Parents shared their concerns about standards for weight and BMI as not being accurate for children, particularly among minority children. Parents even questioned the factors that are not considered, such as bone structure, when establishing BMI standards. Combined, the potential inability for parents to recognize the severity of a high BMI in childhood along with lifestyle factors requiring more attention may significantly impair the family’s urgency to respond to the nurse’s health screening recommendations.

Surprisingly school nurses shared these same sentiments. School nurses in our focus group sessions reported making their own judgments when conducting BMI screenings and
for making referrals for children whom they perceived to not warrant the overweight or obese category. Specifically, these judgments were made for particular sub-groups of children, such as those with an athletic build, but classified as overweight or obese. School nurses even admitted to not sending referrals for children who fell into those sub-groups. One unique school nurse respondent acknowledged these judgments; however, reported being compliant with the policy for BMI referral. “I did have a girl that looks perfectly normal and she is you know 87% and therefore I am required to send a referral.”

School nurses also acknowledged that families are confronted with challenges and circumstances such as making ends meet, worrying about day-to-day survival and working two jobs, which may force them to prioritize the immediate needs of their family. These factors and challenges were also reported to impact school nurse judgment in the referral making process, as not to overwhelm the family with an unnecessary referral. However, this was non-specific to BMI. Furthermore, school nurses perceived parents as unable to rationalize the long term consequences of carrying excess weight in childhood.

School nurses in the study district described their unique circumstances of utilizing PC’s to promote awareness and motivation among other parents in the school building. School nurses acknowledged the help of PC’s to create a general awareness about BMI screenings in schools. The need to engage the peer system was one distinctive response shared by a school nurse participant. “You have to motivate that whole peer system and put that type of pressure on the whole group to do it, because it is very much a shared system.” Perhaps the presence of PC’s in the school building and their ability to share information with other parents may be one influential factor to motivate parents to respond to health screening information.
Follow-up to health screening recommendations may also be hindered by the lack of medical and community resources to address the school nurse’s referral concern. This impacts both families and school nurses when help is inaccessible or unavailable. School nurses particularly emphasized that families often seek medical care at the emergency room. For families, this will result in inconsistent medical care. For school nurses this creates further barriers to the potential for the PCP to follow-up. Difficulty with transportation and the lack of convenient, neighborhood- based medical resources were also identified as potential referral barriers for both the family and potentially for the school nurse.

School nurses perceived that families neglect routine, well-child care, only seeking medical help when required to do so. Potentially this places the responsibility of identifying acute or chronic health problems in the hands of the school nurse. As one respondent suggested, “I mean we act as primary care in a lot of respects ‘why are you at school today if you are sick?’ They are in the door and they are in our office. ‘My mom said I had to come to school and you had to check me’. Although the nurse is the health authority in the school, the parent/guardian is the ultimate decision maker of the course of care for their child. Consent from the parent/guardian is required by the Family Educational Rights and Privacy Act (FERPA) to release the child’s health records, obtained by the school nurse, to the PCP. Yet, from the perspective of the school nurse, parents are often unavailable or inaccessible for communication. Not only does this create broken communication between school nurses and families, but also it may contribute to the impairment of the school nurse’s scope of practice and her ability to administer the appropriate care for the child. Non-working telephone numbers and the migration of children and their families from school to school were identified by the school nurse as factors that make it difficult to conduct follow-
ups and engage families in the child’s health care. Both chronic and acute diseases severely impact the ability of a child to learn in school. Therefore, the inability to reach the family not only makes care a time consuming process for the school nurse, but also directly affects the well being of the child on a daily basis. These findings were confirmed in previous studies of school based screening (Chapter 4) for BMI and AN. Among 59 of the highest risk children identified in the school nurse’s screening, the school nurse was unable to establish communication with 20 families as they had no working telephone numbers or were unable to be reached after multiple attempts at contact (Chapter 4).

Pediatricians have been urged by the Expert Committee\textsuperscript{22} to screen for BMI and provide comprehensive follow-up care to the child identified as overweight or obese. Despite these directives, national studies have demonstrated poor performance among pediatricians to screen for and address overweight and obesity in practice.\textsuperscript{22} Pediatricians have reported the lack of time to counsel for overweight and obesity, poor counseling outcomes,\textsuperscript{142} lack of parent involvement and lack of support services to provide the appropriate care for their patients.\textsuperscript{23} School nurse participants in our focus groups identified the PCP as an overarching barrier who often limits the ability of the school nurse to execute her scope of practice and provide continuity in the child’s health care. School nurses perceived the amount of time allotted for the PCP’s office visit to significantly hinder the capacity to address the issue of overweight and obesity in childhood and therefore provide reliable feedback to the school nurse’s referral. The inundation of chronically and acutely ill patients that require care by the PCP was recognized by the school nurse participants as a valid concern. School nurses perceived PCP’s as overwhelmed with the potential volume of patients that may be or who are already identified as overweight and obese. School nurses
also shared this sentiment regarding their personal nursing judgment. For example, in 2007-2008, Columbus City Schools identified 12,568 kindergarten, 3rd and 5th grade children were identified as overweight or obese, resulting in an equal number of referral letters recommending follow-up by the PCP. This would roughly equate to 193 children per school nurse for overweight and obesity, alone. The time required to follow-up with this volume of children, combined with the challenges of accessing parents, may force the school nurse to make nursing decisions to prioritize based on the urgency of such health conditions. School nurses admitted that follow-up to screenings for overweight and obesity were fairly low on their list of priorities. It appeared that the school nurses perceived obesity as a health concern that does not immediately impact the child’s capacity to learn. School nurses indicated that follow-up referrals such as vision or immunization would require more urgent attention.

School nurses indicated that the concern of the PCP regarding the BMI result is was often inconsistent with the school nurse’s concern and screening result. School nurses discussed their anecdotal experiences with PCP’s, many of whom disregarded BMI screening information and advised families not to be concerned. Potentially the inconsistency in the two messages may cause parents to place blame on the school nurse and their screening practice. As our previous focus groups indicated (Chapter 5), parents trust their PCP and rely on their medical expertise to drive decision making in the child’s care. A study of parents of overweight and obese children living in West Virginia indicated a similar lack of concern by PCP’s when faced with excess body weight in their patients. As a result, the family’s sense of urgency about overweight and obesity was dampened.
It appeared that school nurses may feel isolated in their position as health care providers. School nurses perceived their role to stretch beyond nursing to include acting as a primary health care provider as well as a source of parenting. From the perception of the school nurse, not only do parents fail to provide routine health care for their child, but also pediatricians often inadequately identify and address chronic health conditions, such as overweight and obesity. As a result, the school nurse is charged with a tremendous responsibility to identify and attend to health concerns among children. Feelings of isolation appear to also be confounded by the pediatrician’s attitude and opinions on the school nurse’s scope of practice and professionalism. School nurses expressed feelings of being undervalued by the PCP and perceived that PCP’s do not fully understand the level of care the school nurse is capable of providing. Yet, not all responses were negative. As one school nurse points out, “I have had doctors say, ‘thank you so much for calling or taking the kid to the ER’ because the parent was not available. The nurse or the doctor said, ‘wow, that is really cool that the school nurse is willing to do something like that’.”

Despite their perceptions of PCP attitudes toward their scope of practice, school nurses appeared to be optimistic about the prospect of establishing a continuity of care with the PCP. To achieve it, school nurses indicated an expectation that the PCP must follow-up on their referral. Feedback should include the care plan for the child, complete with treatment goals and the date of the next appointment. This type of information may be useful for the school nurse to implement, reinforce and monitor the child in between clinic visits. School nurses also acknowledged the need for more support staff and better resources to feasibly execute continuity of care. School nurses suggested the need for a case manager or nurse practitioner to act as a liaison to successfully facilitate care. Yet, despite their willingness to
establish continuity of care with the PCP and their support staff, school nurses voiced that the reality and magnitude of overweight and obese children that would require extraordinary management and time. Furthermore, school nurses identified internal school building barriers such as the lack of technical assistance to aid in providing a seamless referral and monitoring process. The lack of technical assistance readily available for the school nurse, further expends more of the nurse’s time. From a practical standpoint, it appears that the school nurse perceived continuity of care for the overweight or obese child as nearly impossible, given the volume of children and lack of time.

Locally in Columbus, reliable mechanisms for early identification through health screenings have been established by CCS. Yet school based screening information is only effective when acted upon. In our focus groups sessions, school nurse’s indicated their perceived barriers among families and pediatricians that impede the school nurse’s scope of practice. This lack of family or physician response to overweight and obesity in childhood is perceived by the school nurses as diluting the success of the screening, referral and counseling process. The lack of parent and pediatrician engagement places the child at a serious disadvantage for receiving quality, comprehensive care, as recommended by national guidelines. Based on these national guidelines, not only should the pediatrician’s care plan include prevention and intervention counseling but, where appropriate, referral to tertiary care to address co-morbidities and establish weight maintenance. After a huge investment of time and effort on the part of the school nurse, the fact that crucial health screening data are not being effectively used is a public health concern. This creates an unnecessary and preventable health disparity with serious implications for the child’s future health.
Chapter 7: Concluding Discussion

Our most effective public health tool to identify health risks early in the course of disease progression is screening. The premise of screening serves a dual purpose. For obesity, not only do they aid in identifying health risks that may potentially lead to adverse health outcomes, but also provide urgency for the correction of such co-morbidities through improved nutritional status and lifestyle behaviors. Yet screening for health conditions such as obesity have been slow to adopt in a primary care setting. For children, school is an ideal place to conduct health screenings as children spend as little as 1/3 of their day in the school building. Furthermore, schools are outfitted with qualified nursing professionals who are highly trained to provide care and counseling to children with chronic and acute illness, among other responsibilities.\(^{24,107}\) However, despite their value, health screenings, particularly for BMI and AN, remain controversial when implemented in a school based setting.\(^{26,27}\) Yet, although cautions to the conduct of BMI and AN screenings at school have been raised by the CDC,\(^ {26,27}\) the IOM,\(^ {109}\) AAP CSH and NASN\(^ {24}\) have called to action, the school nurse, to conduct high quality screenings for BMI. Other school districts such as Texas\(^ {31}\) and West Virginia\(^ {100}\) have reported their successes with implementing AN screening programs as a mechanism to identify hyperinsulinemia and insulin resistance. At this time, guidance from the IOM, AAP or NASN have not yet been provided for AN screening in schools. Yet, general guidelines for the conduct of successful school based screenings have been established by the AAP.\(^ {106}\) The AAP’s guide for successful screening in schools serves as framework reference for recommending and implementing biomarkers
for screening in a school based setting, while identifying research gaps in the screening process. The detailed criteria for successful screening in schools recommended by the AAP include: *a threat for disease associated with adverse outcomes*, disease or condition is responsive to early intervention, *parameters for screening demonstrate reliability, sensitivity and specificity*, *those performing the screening are well trained*, *screening initiatives are directed to those most likely to benefit*, *mechanism for referral and treatment*, cost/benefit ratio, *appropriate site to conduct screenings*, and *program effectiveness*. The aims of this dissertation manuscript and appendices address most of the AAP criteria and provide further rational for the implementation of AN screening as an augment to BMI information in a school based setting.

**Aim 1:** Determine the association of the presence or absence of acanthosis nigricans to demonstrate metabolic changes that signify developing health risk.

* A threat for disease associated with adverse outcomes

**Aim 2:** Determine the utility of acanthosis nigricans with BMI as a health screening strategy.

* Appropriate site to conduct screenings

* Screening initiatives are directed to those most likely to benefit

**Aim 3:** Explore parental attitudes, perceptions and actions to the screening, notification and referral process specifically around acanthosis nigricans health screenings.

* Program effectiveness
**Aim 4:** Determine the perception of the school nurse towards obesity in childhood and the attitudes and perceptions that school nurses have towards the health evaluation.

**Mechanism for referral and treatment**

**Program effectiveness**

**Appendix D: Educational Training for School Nurses: Acanthosis Nigricans**

**Those performing the screening are well trained**

**Parameters for screening demonstrate reliability, sensitivity and specificity**

Obesity in childhood drives metabolic changes, including the development of insulin resistance. The chronic constellation of metabolic disorders that are driven by excess adiposity and insulin resistance is known as the metabolic syndrome. Yet, often the metabolic syndrome-like factors remain hidden unless overtly screened for by the school nurse or the pediatrician. The occult nature of burgeoning health risks among obese children warrants the discovery of sensitive and specific biomarkers to augment information on excess body weight in childhood. The identification of such biomarkers is crucial, especially for the pediatric patient, so the intervention and treatment is timely and occurs before or early in the disease process. Unlike BMI, AN demonstrates the presence of metabolic change driven by hyperinsulinemia and insulin resistance. As a clinical marker, AN represents the need for further, more invasive scrutiny. The data presented in this dissertation manuscript clearly supports the urgency for health screenings, particularly for AN among obese, pre-pubertal children.
Investigation of the utility of AN as a biomarker for metabolic change demonstrated that a clustering of health conditions, driven by obesity and insulin resistance, were highly prevalent among obese, pre-pubertal children. Using the metabolic syndrome as a framework, the health risks status of children with AN were evaluated, as the presence of such chronic metabolic disorders in childhood represents the leading edge of cardiovascular disease risk. Even more alarming is the finding of such health conditions among pre-pubertal, elementary aged children. Adverse health risks detected among obese children indicated that the development of such co-morbid conditions show no sign of slowing even among a cohort of very young children. The advance of undesirable health outcomes in the first decade of life bears a great burden on the child’s health through adolescences and adulthood. As a result, the disease process is accelerated and may potentially lead to morbidity and even mortality earlier than expected. Furthermore, the identification of a sub-set of children with metabolic syndrome- like risks require urgent lifestyle intervention. The cornerstone of the intervention regimen is the correction of nutrition and activity behaviors through the consumption of a highly nutritious diet and the inclusion of moderate physical activity each day, to reverse the co-morbid burden and progression of disease. Dietary and physical activity intervention, in primary care, should focus on the evidence-informed messages established by the Expert Committee.  

The data investigating the metabolic syndrome and its components among an ethnically diverse sample of obese children, implicated that ethnic differences in the manifestation of metabolic abnormalities exist. Obese, African American children exhibited a cluster of health conditions that were suggestive of dysfunction in glucose metabolism compared to Caucasian children who were more likely to manifest health conditions
consistent with dysfunction in lipid metabolism. From a clinical perspective, these data emphasized the need for individualized, comprehensive risk identification strategies, instead of a one-sized-fits-all approach to the health management of the obese child.

Yet, despite primary care directives urging pediatricians to screen for obesity and AN among children, pediatricians have failed to take the lead. As a result, other public health initiatives for BMI screening have been conducted. Screening and surveillance for BMI has recently been mandated among select states in the US.\textsuperscript{25,27} Therefore, screening for AN is the next and most logical step in risk identification to augment information on BMI. AN was pilot tested among elementary aged children to augment screening information on BMI and blood pressure information. Among a sample of 177 3\textsuperscript{rd} and 5\textsuperscript{th} grade overweight, obese and morbidly obese children, 38% were identified to have AN. However, AN was more likely to be found among obese and morbidly obese children and children of African American ethnicity compared to overweight and Caucasian children, respectively. Findings of AN among young, elementary aged children are alarming and suggested that metabolic changes associated with risk for diabetes and cardiovascular disease are silently underway. Additionally, these data provided justification as to which populations would most likely benefit from screening for AN.

More importantly were the number of children who presented with multiple risk factors. One-fifth of all overweight, obese and morbidly obese children were found to have all three health risks, high BMI, elevated blood pressure and AN. Screening for multiple, health threats such as BMI, elevated blood pressure and AN, created a composite health risk profile that provided the school nurse and the family with valuable information on the child’s current health status. As a result, the presence of clustered health risks, indicated the need
for the school nurse’s communication and required the urgency of families and pediatrician’s to respond.

Screening, notification and referral programs, yield very powerful information regarding the child’s health status and need for further scrutiny. At the school level, screening, requires tremendous effort on the part of the school nurse; as the nurse’s effort to identify early health risks are only truly effective when the screening result is acted upon by the family and even the child’s PCP. Communication of the health screening result is the first step, and likely the most critical of the screening process. Yet, despite the nurse’s recommendation to follow-up with the pediatrician, only 10% of families contacted by the school nurse in the year 2 follow-up actually went to the pediatrician. Another 10% reported previously following-up with their child’s PCP. These data appeared to demonstrate that parental urgency to health screening information was poor. Furthermore, based on the findings in qualitative research sessions several sets of barriers that may drive the ineffectiveness of health screening results appear to begin at the notification stage. Parents recognized that cultural perceptions, family history and personal attitudes toward excess body weight standards, ignited feelings of denial and defensiveness to the school nurse’s communication of information on obesity. School nurses shared similar perceptions of the family and likewise indicated that cultural and familial attitudes may influence the ability of parents to accept BMI screening information. Furthermore, school nurses perceived parents as inaccessible or unavailable when communicating health screening information or conducting follow-ups. Follow-up to the BMI and AN screening indicated that among 59 of the highest risk children whose families were contacted by the school nurse, 20 were unreachable.
The nurse’s communication is further confounded by barriers with PCP, which may impede the family’s acceptance of school screening information which reports their child’s weight status. School nurse’s perceived the PCP to not understand her training and full scope of practice, thus appearing to lead to feelings of isolation by the school nurse. Nurse’s reported that PCP’s often disregard the child’s school health screening results. The inconsistencies in care are not only likely to interfere with the ability of the school nurse to foster a collaborative partnership with the child’s PCP, but also may impede the family’s acceptance of screening information on excess body weight reported by their child’s school nurse.

Yet, despite communication difficulties experienced for BMI screening information, AN appeared to be a more accepted health screen among parents. From the perspective of the parent, screening for and notifying parents of AN may over-ride specific barriers to communication that may hinder the acceptance of information on excess body weight. These specific barriers include parent perceptions of their child’s weight status and the parent’s own influence on their child’s health. Parents emphasized that information on AN is more alarming and represents a tangible health risk that would likely elicit a more favorable response among parents compared to BMI screening.

The lack of family or physician response and follow-up to obesity counteracts the school nurse’s efforts at screening and counseling. Furthermore, the child is at a serious disadvantage to receiving quality, comprehensive care that is recommended within national guidelines. So after the school nurse invests a great deal of time and effort, high quality screening information is not being effectively used to help the individual child. This creates an unnecessary and preventable health disparity with serious implications for the child’s
future health. AN presents itself as an ideal skin marker that augments information on BMI and places it within a frame that emphasizes the adverse health risks that develop as a result of excess body weight in childhood.

From the stand-point of research, the lack of follow-up to the nurse’s health assessment makes it difficult to demonstrate the effectiveness of the screening program to reduce the prevalence of adverse health conditions and ultimately the prevention of untimely co-morbid diseases. For both BMI and AN, the CDC strongly recommends further investigation to determine the success of such screening programs in schools. However, the lack of evidence available at this time does not indicate that screening for BMI and AN are not important, rather the lack of evidence makes it difficult to make a definitive recommendation for or against screening. Even though evidence implicating its effectiveness is lacking, time becomes the critical component. To wait for evidence in support of or against screening would likely lead to missed opportunities to identify adverse health risks among a cohort of young children. Furthermore, when risk is identified at the earliest stage of disease progression the likelihood of intervention success is greatest. As demonstrated in the research studies herein, obesity in early childhood is a determent to the child’s health as the co-morbid presence is silently developing. Therefore, at this time it would be prudent to continue the identification of obesity and other risk factors such as AN in a school based setting.

Despite the grave importance of early risk identification in a field setting, several barriers that prohibited the execution of high quality research were experienced throughout the course of the studies detailed in this dissertation manuscript. Although a two year pilot screening for AN was planned for in a school based setting, it took nearly 8 months to
complete the preparation for the conduct of research. One difficulty were FERPA and health information privacy and protection act (HIPPA). Although the intention of both acts are to protect and keep private educational and health information of children and their families in a school and hospital setting, respectively, these two systems work opposite of one another. This makes the sharing of information between school nurses and pediatricians challenging and requires the consent of the parent at multiple steps of the health screening process. For example, a referral from the school nurse’s screening to the PCP requires the parent to sign a release of information form so the health screening result may be shared with the provider. The same applies for the PCP. That is a release of information form must be signed by the family so the findings from the doctor’s assessment may be forwarded to the school nurse.

During the planning of the AN pilot, the fine line that divided clinical practice and research was made evident. At the time of the AN screening pilot, CCS were performing routine health assessments for BMI on children in pre-school, kindergarten, 3rd, 5th, 7th and 9th grade children as part of state mandated height and weight screenings. However, CCS did not provide families the option to opt out of the BMI screening portion. Therefore, CCS requested that the methodological framework for AN screening not include an option for parent consent. The inclusion of a consent option would entitle the parent the choice of not having their child participate in any of the health screenings. This caveat required compromise between CCS and the IRB at NCH; as well as consideration of both FERPA and HIPPA acts of privacy. As part of CCS’s commitment, the AN health screen was adopted under the umbrella of the school nurse’s scope of practice. Based on the review of the research plan by the IRB, approval was granted for the conduct of research, provided that all
data were reported in aggregate and was free of identifiers that could otherwise be linked back to the student.

While, CCS assumed the responsibility of AN screening, this step avoided the school nurses from becoming a part of the research study staff, specified by IRB. The school nurses time required to conduct AN screenings were provided in kind, with the exception of the diabetes school nurse educator who assisted in the year 2 pilot. The diabetes school nurse educator was required by the IRB to assume the position of study staff member. Additionally, the IRB required that families who were interested in participating in the follow-up portion of the screening were required to sign consent and child assent forms. IRB concluded that since the diabetes school nurse educator was making recommendations to families to schedule an appointment with a PCP and sharing protected health information, that she was technically apart of the research study. To recruit families for the research study, the diabetes school nurse educator was required to obtain verbal consent to provide the study coordinator with the family’s contact and health screening information. The decision to include the school nurse as part of the study staff was made despite the IRB being aware of the school nurse’s scope of practice that is inclusive of extensive follow-up and referral to primary care resources. Through this process it was learned that the school nurse’s contribution and time were valuable. The request for the school nurse to become part of the study staff required additional training (CITI training). This reallocation of time translated into less time allotted for the diabetes school nurse educator to contact families for follow-up.

It is also possible that the lack of congruency between FERPA, HIPPA and IRB may have impacted the ability for the family to follow-up. The complex logistics that were required to execute the contact and recruitment of each family may have been an
overwhelming process. The family was initially contacted by the diabetes school nurse educator who may have been unfamiliar, as the nurse was not the child’s primary school nurse. The diabetes school nurse educator reported spending 30-45 min on average with each successful contact. Among those families who agreed to continue to the next step, the family was contacted by the study coordinator to schedule a primary care appointment. Upon reaching the family, the study coordinator was to explain the research, obtain parent consent and child assent, determine a date and time that was convenient for the family to schedule an appointment and determine if that date and time were available through the central scheduling office. For those who decided to see their established PCP, the steps were equivocal with the exception of the study coordinator scheduling an appointment.

Completion of the recruitment and scheduling of an appointment often required multiple contacts between the family and study coordinator. Further contacts between the family and the study coordinator were made to confirm the scheduled appointment. Essentially a great deal of time and personal investment on the part of the family, the diabetes school nurse educator and the study coordinator was required to successfully execute follow up. It is important to reiterate that the school nurse contacted the children who were at greatest health risk. Only 10% of these families exhibited the personal investment and concern necessary to take action.

The over-arching basis for the development of high quality screening programs is the reliability of the screening tool to detect actual health risk and the ability to standardized training across screeners. For the school nurse, an AN educational training was developed in partnership with NCH, NASN and CCS. The training script is part of this dissertation manuscript (Appendix D). The overall goals of the training for the school nurse were to
increase knowledge about AN and educate participants with the skill set required to identify AN. Contractual obligations stipulated that the training will be produced by NCH and licensed to NASN, where the educational module will be disseminated to their membership base of over 10,000 school nurses. Piloting of the AN educational training was completed in May 2010. At that time all CCS Nurses were educated. Future research efforts should focus on a more extensive evaluation of the AN training program for school nurses. In particular, the determination of the trainings ability to provide highly sensitive and specific data on AN should be emphasized.

In close, health screenings are effective public health strategies to identify biomarkers that establish an individual’s risk while serving as the basis for intervention and treatment. The onset of obesity in childhood over the last decade has become a national public health priority. Screening efforts, largely in primary care practice and in school based settings have been increasingly focused on identifying children who are obese and who present with adverse health risks. Obesity in childhood presents itself as multi-factoral and multilayered health disparity with its causes inclusive of genetic predisposition, environment, including socioeconomic status, and food consumption behaviors marked by high calorie foods and a sedentary lifestyle. Lifestyle behaviors associated with obesity are the only factors truly amenable through prevention and intervention.

Obesity is essentially the median that connects poor diet habits and the development of disease. When focusing on behaviors that guide nutritional choice, the impetus for the development of co-morbid conditions such as hypertension, dyslipidemias and diabetes is macronutrient surplus and the selection of foods that are low in essential nutrients. Fundamentally, it is the persistent screening efforts that are pivotal for identifying
chronically ill individuals who are in urgent need lifestyle change with prospect of mitigating
disease. In the young child, the development of co-morbid risks driven by excess body
weight is untimely and poses as a detriment to the child’s current and future health status.
Information on obesity, derived from health screens, should be coupled with education that
emphasizes the important link between optimal diet habits, lifestyle behaviors and the onset
of disease. For the growing child, efforts that reinforce high quality dietary habits should
encompass both prevention and treatment strategies in prospect of mitigating the co-morbid
burden at the earliest stage of disease progression.
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Appendix A: Use of the Metabolic Syndrome in Pediatrics: A Blessing and a Curse

ABSTRACT

The clustering of traditional cardiovascular disease risk factors is known as the metabolic syndrome. The metabolic syndrome was first characterized as a distinct entity by Dr. Gerald Reaven in 1988. The intent was to identify individuals at greatest risk for cardiovascular disease mortality and those in urgent need of lifestyle intervention. Since then the metabolic syndrome has evolved into a diagnosable entity recognized by the National Cholesterol Education Program, Adult Treatment Panel III, World Health Organization and the International Diabetes Foundation. However, the metabolic syndrome as a diagnosis faces considerable controversy, particularly when applied to the pediatric population. Due to the changes in growth and development, the adult criteria for the metabolic syndrome cannot be applied to children and adolescents. In fact, currently no all inclusive definition for the metabolic syndrome exists for pediatrics. Despite its controversies, the identification of the metabolic syndrome and its component disorders in childhood and adolescence offers important information about risk for cardiovascular disease. Emerging evidence points to the presence of early functional and morphological changes to the heart and blood vessels among obese children with the metabolic syndrome phenotype. Yet, the plasticity of the cardiovascular system during childhood and adolescence allows for the reversal of cardiovascular damage, but only if risks are identified early and treated aggressively. Recent
national recommendations and screening directives offer pediatricians a comprehensive guide to risk prevention, assessment, and treatment.

**Introduction**

The prevalence of overweight and obesity in the pediatric population has increased alarmingly over the past decade. Correspondingly, evidence from autopsy studies points to the advent of atherosclerotic cardiovascular disease in childhood. In the obese patient, the cardiovascular disease process is accelerated by the presence of traditional (hyperlipidemia, hypertension, diabetes), intrinsic (family history, environmental risks) and nontraditional (inflammation, adipokines) risk factors. As atherosclerosis advances, particularly in the obese patient, the functional and physiological integrity of the heart and vasculature are compromised. Cardiovascular damage in childhood develops silently, without warning, and obesity is an important driver. Therefore, screening of overweight and obese children at the earliest stage possible becomes essential as findings of hypertension, hyperlipidemia and impaired glucose tolerance serve as an alert to the clinician that cardiovascular damage has ensued.

Of even greater concern than single, abnormal risk factors is the clustering of traditional cardiovascular disease risk factors which increase the risk of cardiovascular disease mortality 2-fold.\textsuperscript{1,2} In pediatrics, this warrants an aggressive response to reduce health risks.

**The Metabolic Syndrome**

Metabolic Syndrome is characterized by the constellation of chronic disorders including obesity, hypertension, dyslipidemia, and glucose intolerance; all of which are
independently associated with increased cardiovascular mortality. The current conceptual model for the metabolic syndrome was postulated by Dr. Gerald Reaven in 1988. In Reaven’s Banting Lecture, he described the relationship between hyperinsulinemia, glucose intolerance, hypertension, and free-fatty acid metabolism and their association with cardiovascular disease. Reaven hypothesized that the state of insulin resistance was the driver for metabolic change and represented the common pathophysiological link between these seemingly disconnected metabolic events.

In adults, metabolic syndrome is defined using one of three sets of diagnostic criteria from the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III), the World Health Organization (WHO) or the International Diabetes Foundation (IDF). A more detailed overview of each definition and their distinctive set of diagnostic criteria can be found in Table 1. Conceptually, the clinical conditions utilized to make a diagnosis differ among the three definitions. Fundamentally, the components used in the definitions are similar as they feature a measure of body fatness, hypertension, dyslipidemia, and glucose intolerance.

The lack of a consensus definition for the metabolic syndrome in the adult population has created confusion and sparked controversy. There is a lack of agreement on the fundamental etiology of the metabolic syndrome. Also, evidence fails to suggest the most appropriate cut point measures for metabolic syndrome components. Some have even argued that the use of cut points is inappropriate. Finally, there is a lack of evidence demonstrating that the clustering of components of the metabolic syndrome represents a synergistic risk rather than the additive risk associated with each individual component. Researchers have learned that the degree of metabolic risk is different across diverse ethnic populations,
making the development of a single, all inclusive definition of the metabolic syndrome difficult. Waist circumference is an excellent example. In African-American men, the cardiovascular risk rises faster than visceral fat accumulates as compared to Caucasians and Hispanics. However, among the Asian population current threshold measures of waist circumference underestimate metabolic risk. Lowering the threshold values of waist circumference to 89.8cm and 82.3cm among Asian men and women, respectively, has been shown to increase the sensitivity and specificity of detecting cardiovascular disease risk.

Studies of African-Americans demonstrate a difference from other ethnic groups in the relationship between dyslipidemia and hypertension. Levels of triglycerides and insulin resistance have been found to be inversely correlated in this population. That is, as insulin levels rise with insulin resistance, triglycerides fall. Clinically, these findings suggest that markers of dyslipidemia (within the normal range) may be insensitive and fail to identify the insulin resistant individual at risk for cardiovascular disease.

The inability for threshold values to identify metabolic risk among diverse ethnic populations merits a more comprehensive inspection, particularly in the obese patient. One coherent metabolic factor cannot be relied upon to determine global metabolic risk. However, the principal basis of the metabolic syndrome holds true and clinicians must be aggressive at assessing all the associated metabolic factors in order to find individuals at heightened risk for cardiovascular disease and in most urgent need of lifestyle intervention.

The fundamental hypothesis of the metabolic syndrome is that risk imparted by the cluster is greater than the sum of its parts. Yet some evidence refutes this claim. Iribarren, et al, demonstrated that after adjusting for each of its individual components, the metabolic syndrome was no longer associated with cardiovascular disease mortality. Further studies
have evaluated the eleven year risk of incident cardiovascular disease and have confirmed that when all five metabolic syndrome criteria are considered, metabolic syndrome as an entity does not result in greater risk for cardiovascular disease over the sum of the individual components.  

However, other researchers have found that the metabolic syndrome results in increased cardiovascular disease risk and potentially, higher morbidity and mortality. For example, having metabolic syndrome imparts a 2-fold greater risk of incident cardiovascular disease mortality over those without the syndrome. Furthermore, as demonstrated by the Framingham Offspring and San Antonio Heart Study, the predicted risk for coronary heart disease in individuals with metabolic syndrome was elevated (11.8% and 9.8%, respectively) compared with individuals without the metabolic syndrome (7.0% and 6.8%, respectively). From a clinical perspective, higher cardiovascular disease mortality among individuals diagnosed with the metabolic syndrome necessitates a more aggressive approach to its evaluation and treatment.

What Is the Metabolic Syndrome in Children?

Metabolic syndrome in children is even more variable and controversial than in adults. Currently, there is no consensus definition for the metabolic syndrome in pediatrics. In fact, a recent review has confirmed over 40 unique definitions used to characterize metabolic syndrome in children and adolescents. Depending on the definition, the prevalence of metabolic syndrome among obese children and adolescents ranges from 26% to 49.7%. Such inconsistencies make it difficult to compare results across studies and contribute to the controversy of utilizing the metabolic syndrome as a clinical entity in
pediatrics. As Brambilla points out, there are several fundamental problems with the metabolic syndrome in children and adolescents, particularly cut-points, puberty, and the role of nontraditional risk factors.

Age, sex, and ethnically-specific cut points for the individual components of the metabolic syndrome are not well characterized in children. The value of waist circumference to evaluate cardiovascular disease risk is subject to debate in the pediatric population, despite evidence demonstrating that visceral fat is a powerful marker of the metabolic syndrome. Percentile values for waist circumference are poorly established across age groups. Furthermore, the currently established values may not be suitable for all ethnic groups.

Perhaps the greatest confounding factor for the application of metabolic syndrome in the pediatric population is the role of puberty. During puberty natural changes to the metabolic milieu occur. The combined actions of insulin-like growth factor (IGF-1) and growth hormone induce a state of insulin resistance. Evidence suggests that this process is independent of body fatness. Thus, it can be difficult to distinguish insulin resistance due to normal pubertal changes versus metabolic changes associated with obesity and the metabolic syndrome.

Goodman, et al, have further illustrated the problem of applying the diagnosis of metabolic syndrome in clinical pediatric practice. Analyzing data from a cohort of 1098 teenagers over a three year period, the diagnosis of metabolic syndrome in adolescents was found to be highly dependent on the criteria applied, as well as being extremely variable over time. The group fluctuated between meeting and failing to meet criteria as they aged, despite the continued presence of clustered risk factors. Goodman, et al, argued that the principle
reason for such diagnostic instability was the reduction of the criteria for metabolic syndrome to a single set of dichotomous risk factors.\textsuperscript{28} Each component of the syndrome is characterized by its cut-points, signifying that the value is either normal or abnormal. This requires a single set of well-researched cut-points to differentiate normal from abnormal levels, presumably based on future health risk.

In pediatrics, due to fluctuations in growth and pubertal development, such strict cut-points do not exist. This problem is further confounded by an array of different definitions of what clustered components should constitute metabolic syndrome. However, irrespective of the utility of classifying metabolic syndrome as a clinical diagnosis, it is important to note that Goodman, et al,\textsuperscript{28} confirmed that the clustering of metabolic risk factors was evident throughout adolescence, indicating ongoing risk.\textsuperscript{28}

What if the metabolic syndrome diagnosis was not based on a series of dichotomous outcomes and arbitrary cut-points? Would an approach that is more fluid and age-appropriate alter the utility of the diagnosis? Potentially, a continuous risk score could improve the clinical utility of the metabolic syndrome diagnosis.\textsuperscript{29} According to Eisenmann,\textsuperscript{29} a continuous outcome approach to component variables can evaluate the shifting associations of metabolic risk factors unlike dichotomies which impair the ability to distinguish among interactions over time.

The initial task in the development of a metabolic syndrome model for children and adolescents is to determine what risk factors should be included in such a design. Is there really a rationale for simply adopting the adult variables? Insults to the cardiovascular system are associated with obesity and insulin resistance in childhood and adolescents. Adipose tissue is a metabolically active organ releasing a number of inflammatory
biomarkers including: TNF-α, IL-6, and CRP which are associated with the atherogenic process.\textsuperscript{30, 31} Obesity and inflammation are responsible for the progression to the insulin resistant state. Consequently, the triad of obesity, inflammation and insulin resistance is associated with the metabolic syndrome in children. Children and adolescents who are morbidly obese are more insulin resistant and present with higher levels of inflammatory biomarkers including IL-6, ICAM, and E-selectin, compared to lean counterparts.\textsuperscript{32, 33} Furthermore, among obese children and adolescents, the presence of inflammatory biomarkers such as IL-6 and CRP correlate with the presence of traditional cardiovascular disease risk factors.\textsuperscript{34, 35}

Possibly, the focus of a continuous risk score should be weighted toward measures of insulin resistance and chronic inflammation rather than toward glucose and diabetes, since insulin resistance and chronic inflammation appear to be the underlying drivers for the development of disordered metabolism. Eisenmann\textsuperscript{29} has recommended that each risk factor selected be regressed onto demographic variables (age, sex, ethnicity, etc.) to give a standardized curve for each of the variables. A patient’s deviations from the norm, designated by z-scores, would be summed from each variable to form a composite score.\textsuperscript{29}

For children and adolescents, with steady changes in both physical growth and hormonal output, a continuous risk score may be the only way to assess diverse risk factors as a cluster. A continuous approach, as reflected by a composite risk score, offers a sensitive and less error-prone method to monitor metabolic fluctuations throughout critical periods of growth and development. A composite approach to the assessment of metabolic syndrome and its components allows the pediatrician to observe the development of metabolic risk at its earliest stages and intervene.
This harkens back to Reaven’s original intent in describing the relationship between hyperinsulinemia, glucose intolerance, hypertension, and free fatty acid metabolism, and their association with heightened risk for diabetes and cardiovascular disease. Reaven’s concept of metabolic syndrome has been far overshadowed by the quest for a sound, workable definition with which to diagnose the syndrome in adults and children. The original intent, however, was to identify individuals most at risk for cardiovascular disease. This remains the overriding value of the metabolic syndrome as a clinical concept.

Where Does Metabolic Syndrome Fit in Pediatrics?

In essence, the clustering of metabolic syndrome components in children and adolescents suggests that: 1) the body’s metabolic milieu reacts early to the presence of excess body fat, 2) the clustering of metabolic risk factors serves as a foundation for heightened cardiovascular risk compared with peers who do not have the metabolic syndrome phenotype; and therefore, 3) the collective and individual metabolic risk factors represent a high-risk finding among children and adolescents that merits intervention. The clustering of metabolic risks becomes clinically important, regardless of whether the components meet the definition criteria for metabolic syndrome.

In the overweight or obese patient, finding one metabolic risk factor should alert the clinician to perform further assessments for other metabolic risk factors. Why is this so important? Emerging evidence examining metabolic syndrome in adolescents points to early morphological and functional changes in the cardiovascular system. Excess weight in combination with a clustering of traditional cardiovascular risk factors compromises the anatomical, functional, and geometric integrity of the cardiovascular system. Early
functional and morphological changes to the arterial wall, measured by intima medial thickness and flow mediated dilation, are associated with the metabolic syndrome diagnosis in overweight and obese children. Furthermore, as Chinial, et al, recently demonstrated, adolescents fulfilling either an adult or a pediatric definition of metabolic syndrome showed the presence of significantly abnormal right atrial dilation, increased left ventricular and left atrial diameters, and greater left ventricular wall thickness and mass. This reflects a much greater workload on the cardiovascular system in those positive for metabolic syndrome. Further, in contrast to previous researchers, Chinali, et al, showed that these changes were amplified by clustering, with collective effects greater than the sum of the individual risk components. It appears that having the metabolic syndrome phenotype as an adolescent poses an immediate risk, not simply a future one.

Family history, race, socioeconomic status, along with eating and physical activity behaviors contribute to the future health of the child. The assessment of such factors, in addition to metabolic risk, can be used to compose a risk factor profile of the child and assist the clinician in choosing the right course of treatment to mitigate future cardiovascular disease risk.

An Expert Committee developed a set of practice-ready guidelines to aid pediatricians in their care for overweight and obese children and adolescents. They place an emphasis on intervention and global assessment of the child’s health including: body mass index percentile, family health history, a targeted history, a targeted physical examination, blood pressure, and laboratory analysis. The recommended goal is that individual risk be identified as early as possible in the child’s life.
Early risk identification ultimately leads to the establishment of early intervention and treatment to reduce co-morbid risk and to control weight. As with the risks that lead to compromised health, the intervention may be multifaceted and should directly address the specific health risks and needs of the patient. For some patients this could include weight reduction, improved nutrition, and increased physical activity. However, for the very high risk adolescent patient, including those with extreme obesity where lifestyle intervention has proven ineffective at controlling co-morbid risks, pharmacological or surgical intervention may be necessary.

The benefits of controlling blood pressure, LDL and triglyceride levels, glucose, and insulin need to be weighed against the potential risks of using medications in patients who are still growing and developing. At present, additional research is needed to clarify these decisions.

Bariatric surgery has demonstrated effectiveness in sustained reversal of the obesity related comorbidities that accompany morbid obesity, both in adults and adolescents. Recently, Inge et al.\(^47\) showed regression of type 2 diabetes mellitus in eleven morbidly obese, diabetic adolescents who underwent gastric bypass surgery. Pre-surgery, all patients received oral hypoglycemic agents, with one patient receiving insulin and oral therapy. Despite pharmacological management, fasting glucose levels remained elevated.\(^47\)

One year after the bariatric procedure, weight loss was substantial, ranging from 33-99 kg. In all subjects, weight loss did not place the adolescents below the obese category for adults (BMI \(>30 \text{ kg/m}^2\)). However, cardiovascular risk factors, including parameters of diabetes, showed substantial reversal. Significant improvements of fasting glucose levels were noted, with a 41\% reduction from pre-operative measures. Even more dramatic was the
discontinuation of diabetic pharmacological agents in all but one patient. In addition to the improvement in fasting insulin levels, hypertension, triglyceride and cholesterol markers were improved as well.\textsuperscript{47} Along with atherogenesis and plaque formation, markers of intima media thickening and flow mediated dilation of vessels have been documented to occur in children as young as age five.\textsuperscript{48} The process of cardiovascular damage is accelerated in the obese patient. In the extremely obese patient with BMI $>40 \text{ kg/m}^2$, bariatric surgery has proved to be effective for reversal of extensive cardiovascular damage.\textsuperscript{39}

Ippisch, et al,\textsuperscript{49} recently reported dramatic reductions in left-ventricular (LV) hypertrophy and mass, diastolic function, and cardiac workload after bariatric surgery in adolescents. Improvements in cardiac markers directly correlated with the decrease in the patient’s BMI. Significant changes in abnormal LV geometry also were demonstrated. In total, only 36\% of patients pre-operatively had normal LV geometry, compared with 79\% post-operatively. Similarly, before bariatric surgery, 28\% of adolescents presented with concentric LV hypertrophy, a risk marker for myocardial infarction in adults. Post-operatively this number dropped to 3\%.\textsuperscript{49}

The ability of the cardiovascular system to recover from such an abnormal physiologic and anatomic state emphasizes the plasticity of the cardiovascular system during adolescence.\textsuperscript{49} Together the information provided by Chinal, et al,\textsuperscript{39} Inge, et al,\textsuperscript{47} and Ippisch, et al,\textsuperscript{49} illustrate the increased risk inherent in obesity and the potential benefits of bariatric surgery for reversing metabolic and cardiovascular abnormalities in adolescents.
Metabolic Risk in Childhood: A Curse and A Blessing

The earlier a child develops obesity related metabolic risk, the more likely the child will carry that risk into adulthood. Freedman reports of children who remained obese beyond the first decade of life, 80% went on to become overweight adults.\textsuperscript{50} Metabolic predictors also track consistently from childhood to adulthood. For example, a diagnosis of metabolic syndrome in childhood increases the likelihood of having metabolic syndrome and diabetes in adulthood by 9-fold and 11-fold, respectively.\textsuperscript{51}

Examining metabolic changes among elementary school age children reveals a startling trend in the development of cardiovascular disease risk at increasingly younger ages. Among a group of obese school-aged children from urban Mexico, 90% had insulin resistance. In addition, 14% of the children screened were identified as pre-hypertensive or hypertensive.\textsuperscript{52} Advanced cardiovascular disease risk has also been found among overweight school aged children in urban Chicago, including impaired fasting glucose (21%), elevated triglycerides (11%), and elevated blood pressure (11%).\textsuperscript{53} In Eastern Kansas, a significant group of elementary school-age children had elevated blood pressure and triglycerides (18% and 37% respectively).\textsuperscript{54}

Without invasive screening, health risks such as insulin resistance, elevated blood pressure, hyperlipidemia, and glucose intolerance remain occult and the child appears healthy. Acanthosis nigricans, a skin marker for obesity and elevated insulin, is an increasingly utilized obesity health risk marker that does not require costly equipment, time, and analysis. Characteristics of acanthosis nigricans are darkening and thickening of the skin around the neck and other skin folds. Acanthosis nigricans is readily identified by trained personnel.
Ten years ago, the state of Texas initiated screening for acanthosis nigricans to identify health risks associated with obesity.\textsuperscript{55} The state mandated screenings are concentrated in over 20 regions of the state along the Pan-Am border. Over 700,000 students are screened annually for acanthosis nigricans.\textsuperscript{56} Current data from the 2005/2006 school year indicate that 13% of all children and adolescents in this region screened positive for acanthosis nigricans.\textsuperscript{56} In previous years, acanthosis nigricans was found to be most prevalent among 5\textsuperscript{th} grade children (20%). Among ANTES children who screened positive for acanthosis nigricans, 29% also had elevated blood pressure.\textsuperscript{55}

In urban Columbus, Ohio a similar acanthosis nigricans screening pilot study was undertaken. Preliminary data from 2007/2008 acanthosis nigricans screening in elementary and middle schools found a prevalence of acanthosis nigricans of 15.7%, 26.7% and 16% among 3\textsuperscript{rd}, 5\textsuperscript{th} and 7\textsuperscript{th} grade children, respectively.\textsuperscript{57} When overweight and obese subpopulations were examined, the prevalence was much higher with acanthosis nigricans found in 42.4%, 63.6% and 31.5% of 3\textsuperscript{rd}, 5\textsuperscript{th} and 7\textsuperscript{th} graders, respectively. Furthermore, in those 3\textsuperscript{rd} and 5\textsuperscript{th} grade children having acanthosis nigricans, 20% also had elevated blood pressure, classified as pre-hypertensive or hypertensive.\textsuperscript{57}

Identifying and treating cardiovascular risk factors in a child may prove to be a blessing. In children the cardiovascular system remains plastic and damage reversible, if early and appropriate interventions are established effectively. Furthermore, childhood offers a time to shape optimal nutrition and physical activity to establish a lifelong commitment to behaviors supportive of health.

Although there are many controversies that surround the application of metabolic syndrome in pediatrics, the presence of a cluster of metabolic risk factors suggests that
excess body weight is resulting in changes in the cardiovascular system. This echoes Reaven’s original intent when describing the metabolic syndrome; to find advancing risk for cardiovascular disease and to intervene with lifestyle changes to lessen adverse outcomes. The call to health care providers is to focus on mitigating risks in very young children.

Recent national guidelines and directives underscore the role of primary care clinicians to screen for metabolic risk factors early in life, institute treatment, and close follow-up. An Expert Committee for the Assessment, Prevention and Treatment of Childhood Overweight and Obesity offered a six step approach for the care of the high risk child.46 Screening labs were based on the degree of obesity, age, and health risk profile. Additional recommendations for lipid screening were offered by the American Academy of Pediatrics Committee on Nutrition. The panel acknowledged the long-term consequences of obesity in the first decade of life when coupled with a high-risk family history. Their recommendations encourage pediatricians to begin screening such children beginning at two years of age.58

**Concluding Remarks**

Two decades after Reaven’s Banting Lecture, the metabolic syndrome has evolved from a hypothesis to a diagnosis. Metabolic syndrome as a clinical entity faces scrutiny in both the adult and pediatric populations. In the quest to secure a single, all inclusive definition of metabolic syndrome, the original intent of its existence has been obscured: to identify individuals at significant risk for cardiovascular disease and those in urgent need of lifestyle intervention. In the pediatric population, the presence of the metabolic syndrome suggests that a change in metabolism, fueled by excess weight, is underway. Further, the
clustering of risk factors suggests a more extreme form of early metabolic changes that may lead to significant compromise in the functional and physiological integrity of the cardiovascular system. Pediatricians should focus on a comprehensive weight management intervention strategy as the co-morbid burden, reflected in metabolic syndrome markers, can be reversed if health risks are identified early in the clinical course of disease and are aggressively treated.
Appendix B: Parent Focus Group Objectives & Questions

KNOWLEDGE
Objective 1: Test parent knowledge of acanthosis nigricans

Question 1: What do you think the arrows of the photographs above are pointing to? What do you think this means?

Moderator:
The above pictures that we showed you are photographs of children who have something called “acanthosis nigricans”.

Question 2: Now that I have told you what those photographs mean, have you ever heard of the term “acanthosis nigricans”? If so, what do you know about it and where have you heard about it?

Moderator:
Acanthosis nigricans is a darkening and thickening of the skin around the neck and means that a child is at risk for developing diabetes and or cardiovascular disease at some point in their life.

HEALTH RISKS AND SCREENING

Objective 2: Probe participant knowledge on the link between obesity, diabetes and cardiovascular disease

Question 3: Do you consider childhood overweight and obesity to be a health problem in our society? What do you think are the health issues that could develop in a child who is overweight or obese?
Objective 3: Determine anticipated parent response and attitude to school based health screenings.

Question 4: As the school nurse completes her required school based screenings, mandated by Ohio law, and noted that your child had symptoms that put him or her at risk for *overweight or obesity* (according to Center for Disease Control and Prevention guidelines), what would be your reaction to this information?

Question 5: As the school nurse completes her required school based screenings and noted that your child had symptoms, like acanthosis nigricans, that put him or her at risk for *diabetes and cardiovascular disease*, what would be your reaction to this information?

***Potential Probe Question:*** So would you rather prefer to receive health screening information that talked about your child’s obesity or your child’s risk for diabetes and cardiovascular disease? Why?

MESSAGING

Objective 4: Determine the most ideal message frame and language to present information on acanthosis nigricans in the health screening letter.

Moderator

Here are some examples of messages that talk about acanthosis nigricans. These are potential messages that parents could receive from the school nurse that could be included in the nurse’s health assessment letter. We need your help in selecting the best message or developing a better message.
Message #1: *Acanthosis nigricans is a darkening or thickening of the skin folds. It is a screening tool to help identify possible increased levels of insulin in the blood.*

Message #2: *Acanthosis nigricans is a darkening or thickening of the skin around the neck. It is a screening tool to help identify children who may be at risk for developing type 2 diabetes and/or cardiovascular disease sometime in their life.*

Message #3: *Acanthosis nigricans is a skin condition where the skin’s surface may look darkened and velvety or rough. It may mean that your child has high levels of insulin in the blood, which is one risk factor for developing type 2 diabetes and/or cardiovascular disease.*

**Question 6:** If your child’s health screening for acanthosis nigricans revealed that they are being referred for further evaluation and the nurse included this message in her health screening back to you, which message do you think is most effective to include in the health screening letter? When you hear this message, what do you think of? How would you react? What suggestions would you make to improve this message, if any?

**Question 7:** What other types of information about acanthosis nigricans do you think would be helpful for parents to learn more about this skin condition and what to do? What types of local resources would you want the school nurse to recommend?
Objective 5: Determine intended response and action parents may take upon receiving AN screening information from the school nurse.

Question 8: If your child’s health screen revealed that they are begin referred for further evaluation since they had a body mass index percentile that classified them as overweight or obese, according to the Center for Disease Control and Prevention guidelines, would you take the school nurse’s recommendation to follow up with a pediatrician? Why or why not?

Question 9: If your child’s health screening for acanthosis nigricans revealed that your child is being referred for further evaluation, would you take the school nurse’s recommendation to follow up with a pediatrician? Why or why not?

Question 10: How would you use the school nurse’s health screening information on acanthosis nigricans to adjust your family’s lifestyle?
Appendix C: School Nurse Focus Group Objectives & Questions

Objective 1: Determine school nurse knowledge about childhood overweight treatment and awareness of local neighborhood resources to assist them in promoting a healthy lifestyle, weight loss or weight maintenance for overweight children.

Question 1: Daily diet and activity are the two key components of a healthy lifestyle for weight management. In what capacity could the school nurse impact these two factors at school and at home?

Question 2: What local neighborhood resources do you think would help overweight children meet their treatment goals in 1) developing a healthy lifestyle 2) promoting weight loss?

Objective 2: Determine the attitudes and perceptions of school nurses about the school nurse/doctor referral relationship as it pertains to BMI screenings.

Question 1: When referring an overweight child to the pediatrician what are your expectations for the pediatrician’s follow up care for the overweight child?

Question 2: When referring an overweight child to the pediatrician what are your perceptions of the pediatrician’s actual follow up care for the overweight child?
Objective 3: Determine the barriers school nurses feel that preclude the success of a school nurse/doctor relationship

Question 1: As the health provider in schools what barriers do you think prevent school nurses and doctors from communicating information about the health of overweight children?

Question 2: How do these barriers affect your scope of work or the way you practice?

Question 3: As a school nurse, how would you work together with the pediatrician to overcome these barriers?

Objective 4: Determine the attitudes and perceptions school nurses have about the family’s sense of urgency and their response to BMI screenings conducted in the school or the primary care setting.

Question 1: As the school health provider what are your perceptions regarding how families 1) feel about receiving information about their child’s body mass index, 2) respond to health screening information on BMI when their child is identified as overweight?

Objective 5: Determine the opinions of school nurses on screening for overweight vs. screening for diabetes/CVD risk and the effect of these screenings on 1) parental urgency and follow up and 2) doctor urgency and follow up.

Question 1: If the conversation about the overweight child’s health was framed in a way that their risk for diabetes and CVD was emphasized rather than BMI, do you think that
screening information would change 1) how parents feel about their child’s weight and health, 2) how parents respond to this information.

**Objective 6:** Determine the barriers school nurses may have that preclude the success of a school nurse/parent relationship

**Question 1:** As the school health provider what barriers do you think prevent school nurses and parents from communicating information about the health of an overweight child?

**Question 2:** How do these barriers affect your scope of work or the way you practice?

**Question 3:** As the school nurse, how would you work together with the family to overcome these barriers?

**Objective 7:** Determine the feasibility and structure of case management/coordinated care that would be ideal for the school nurse.

**Question 1:** In response to your referral for overweight, what types of information from the child’s medical visit would be most helpful and most informative to you?

**Question 2:** Staying within your scope of practice, what types of follow up directives from the pediatrician would be most feasible for you to execute?
AN is a skin manifestation indicating metabolic change. The intention of this educational program is to:

**Slide 2: OVERALL PROGRAM GOAL**

1) *Increase school nurse knowledge about acanthosis nigricans*
2) *Educate participants with the skill set required to identify acanthosis nigricans*

**Slide 3: OVERALL PROGRAM OBJECTIVES**

*Participants will be able to:*

1) *Discuss the implications of increasing rates of overweight and obesity in school aged children.*
2) *Describe the characteristics of acanthosis nigricans*
3) *Discuss acanthosis nigricans and its relationship to increased risk for type 2 diabetes mellitus and cardiovascular disease*
4) *Describe the technique for school nurses to properly identify acanthosis nigricans*
5) *Describe the school nurse role for referral and follow-up after the identification of acanthosis nigricans*

**Slide 4: OBJECTIVE 1: DISCUSS THE IMPLICATIONS OF INCREASING RATES OF OVERWEIGHT AND OBESITY IN SCHOOL AGED CHILDREN**
Slide 5: Defining Overweight and Obesity

The incidence of childhood overweight has captured the attention of our nation. The increasing trends in overweight and obese children and adolescents are alarming, with disproportionate impact on some age and ethnic groups. In children, Body Mass Index (BMI) is the clinical tool used as a proxy to measure body fatness in children.\(^1\) Height and weight are used to calculate BMI. In children, the BMI must be plotted on a growth chart specific for age and gender to account for changes in growth trajectory in childhood and adolescents. According to guidelines set by the Center for Disease Control and Prevention, children with a BMI percentile at or above the 85th percentile to the 94th percentile are classified as overweight. Children with a BMI percentile at or above the 95th percentile are classified as obese. Recently the CDC has updated their growth charts to include the 97th percentile. The utilization of the CDC guidelines and growth charts for BMI is considered the standard for determining BMI percentile in children and adolescents.\(^1\)

Slide 6: Trends in Child and Adolescent Overweight

Charted trends of the incidence of childhood overweight based on the National Health and Nutrition Examination Survey (NHANES) has indicated an alarming increase over the past 50 years.\(^2,3\) It is during the 1980’s that we begin to see a steady climbing of rates of childhood overweight among children in all age categories. Yet, it is between 2001-2004, among children ages 2-5 years, where the sharpest increase is reported.\(^3\) Data beyond 2004 currently indicate no significant increase in the incidence of overweight and obesity among all age groups. Yet, it is too soon to tell if the trends have stabilized and the obesity epidemic
is halted, as more evidence is needed longitudinally.\textsuperscript{3} We can expect to see the report of more current trends beyond 2006 by 2011.

**Slide 7: BMI of Ohio 3\textsuperscript{rd} Graders**

Currently the rates of childhood overweight and obesity on a national level hover around 20\%. Data for the State of Ohio clearly indicate that the prevalence of overweight and obesity among Ohio’s children are well above the national norm. In 2006, an assessment of BMI among Ohio’s 3rd graders, collected and reported by the Ohio Department of Health,\textsuperscript{4} indicate that the prevalence of overweight and obesity was 36.6\%, with an overwhelming number of children (20.6\%) classified as obese. This is compared to children classified as overweight (17\%). These data also indicate that overweight and obesity among children living in rural, Appalachian regions of the state equal, or even surpass the rate of overweight and obesity among children living in an urban environment.\textsuperscript{4}

**Slide 8: Columbus City Schools District BMI Screening Program**

Comparing Columbus City Schools BMI screening data to national and statewide data, rates of overweight and obesity not only surpass the national average, but also the state of Ohio average. An assessment of children in 3rd grade during the 2007-2008 school year show that 42\% of children were overweight or obese, with an overwhelming percentage of children (25\%) classified as obese.\textsuperscript{5} Therefore, it is important to note the propensity for these children to be obese. The concern for obesity in childhood is confirmed by studies that have indicated that children classified as obese not only become obese adults,\textsuperscript{6} but also carry
more adverse health risk and are metabolically different then those children who are
overweight.  

One of the most important strengths of the Ohio statewide data and Columbus City
Schools data is the standardization of the protocol. All school nurses are trained with the
same methodology, use the same calibrated equipment for measuring height and weight and
use CDC standards to calculate BMI.

Slide 9: BMI Trends

Based on the collective data from national, statewide and local studies several trends
of childhood overweight and obesity have emerged. First, across the range of BMI
percentile, the percentage of children who are obese is highest compared to the percentage of
children who are overweight. Secondly, the epidemic of childhood obesity is affecting
children of younger age groups. Lastly, children living in urban settings and children living
in rural settings appear to be equally affected by the epidemic of overweight and obesity in
childhood.

Slide 10 & 11: Contributing Factors of Childhood Obesity & The Social - ecological
Model

The causes of childhood overweight and obesity are complex. The CDC divides the
causes of obesity into 4 broad categories: 1) genetics, such as family history of obesity and
chronic diseases, 2) nutrition and sedentary behaviors, including the selection of fast food
options, high calorie nutrient poor snack food, sugar sweetened beverages and decreased or
absence of recess and physical education in schools, 4) environmental barriers and influences
including working parents/guardians, unsafe neighborhoods and 5) socioeconomic disadvantage, which is also implicated in the demographics of the child’s environment.  

One public health tool that may help visualize the link between the various causes of obesity is the social-ecological model, which is comprised of 4 layers and includes the influences of: individual, family, community/ culture, and society at the interface of genetics, behaviors, environment and socioeconomic status as described by the CDC. The epidemic of childhood overweight and obesity is multifactorial and multilayered and is a challenge for assessment, prevention and treatment approaches.

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**Slide 12: Health Consequences of Overweight and Obesity in Childhood**

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**Slide 13: Consequences of Obesity in Childhood**

Overweight and obese children and adolescents are developing complications that have previously been thought of as diseases of adults, particularly type 2 diabetes (T2DM). In general, the incidence of T2DM is increasing nationally. T2DM now accounts for up to of 45% of newly diagnosed cases of diabetes in children and adolescents, with the incidence dependent on the ethnicity of the population. Furthermore, children who develop overweight or obesity in childhood go on to be obese adults. In fact if obesity is developed within the first decade of life there is an 80% chance that the child will become an obese adult. Other health implications that are associated with overweight and obesity in childhood include: the development of sleep apnea, psychological implications, orthopedic problems, liver cirrhosis and poly-cystic ovarian syndrome, among others.
When screening children for overweight or obesity the intention is not to focus on the cosmetic implications of excess body weight, but to find other health risks and conditions, as a consequence of overweight and obesity in childhood. One of the ways that can describe the now common finding of clustered health risks such as hypertension, dyslipidemia, and glucose intolerance all too often associated with overweight and obesity in childhood, is through the metabolic syndrome. Although we cannot diagnose the metabolic syndrome in children due to constraints with growth and puberty and the lack of standard cutpoints and components, it may be used as an indicator that the health of the child is being compromised. The clustering of these risk factors in childhood, as a result of excess body weight, may be an ideal opportunity to find early stages of disease progression in children and to intervene urgently with lifestyle modifications that focus on improving nutritional quality and increasing physical activity. The mere development of chronic health risks and conditions among overweight and obese children underscores the importance of early identification and screening to identify impending metabolic changes that may progress to disease. The high prevalence of the metabolic syndrome in overweight and obese children and adolescents suggests that screening to identify impending metabolic changes is warranted to find early stages of disease progression that forms in childhood.

Slide 14: The Metabolic Syndrome: Historical Perspective

The metabolic syndrome is a constellation of chronic metabolic disorders and may include elevated waist circumference, insulin resistance, dyslipidemia, hypertension and glucose intolerance. In 1988 Gerald Reaven characterized a cluster of metabolic risk factors including hypertension, glucose intolerance, and dyslipidemias and their association.
with cardiovascular disease. In Reaven’s Banting Lecture,¹⁵ he spoke of individuals with cardiovascular disease presenting with clinical derangements in glucose and lipid metabolism and hypertension. Through his findings, Reaven hypothesized that insulin resistance was the common metabolic pathway that linked three otherwise unrelated metabolic events, with the ultimate endpoint leading to coronary heart disease.¹⁵ It was the early work of Reaven that scrutinized the broad role of insulin and its effect on metabolic pathways beyond its well characterized relationship to glucose and diabetes.

**Slide 15: The Metabolic Syndrome in Adults**

There are currently three widely accepted definitions for the metabolic syndrome in the adult population, with The National Cholesterol Education Program (NCEP) the most often cited. The NCEP definition for metabolic syndrome is composed of three or more of the following risk factors: abdominal obesity, dyslipidemias, hypertension, glucose intolerance.¹⁶ The diagnostic criteria for the World Health Organization definition of metabolic syndrome requires the presence of glucose derangements including impaired fasting glucose or glucose intolerance plus two or more following risk factors: abdominal obesity, dyslipidemias, hypertension, and microalbumenuria.¹⁷ Lastly, the International Diabetes Foundation characterizes metabolic syndrome as having abdominal obesity plus any two following risk factors: hypertension, dyslipidemias or raised fasting plasma glucose.¹⁸ Cut points assigned to each diagnostic criteria can be found in the reference section.
Slide 16: The Metabolic Syndrome in Children

Currently there is no consensus definition for the metabolic syndrome in children. In fact, based on a recent review, there are over 40 unique definitions for metabolic syndrome that have been applied to a pediatric population. The lack of consensus is primarily due to: 1) the lack of sufficient and standardized clinical cut-points used for each “component”, 2) puberty imparts a state of natural insulin resistance and may confound the insulin resistance that is attributed to obesity in childhood and 3) emerging evidence suggests the inclusion of non-traditional risk factors in the pediatric metabolic syndrome definition. These risk factors may include: inflammation, hormones derived from fat, and anatomical measures of cardiovascular change that assess the function and dispensability of the arteries.

Slide 17: Health Screenings

Health screenings aid in identifying factors that may implicate risk for developing a medical condition or disease now or in the future. For the overweight or obese child this may mean the development of type 2 diabetes or cardiovascular disease. Screening and referral for health conditions identified in the assessment process is just one of many core roles of the school nurse. School based health screenings are endorsed by the National Association of School Nurses (NASN) and the American Academy of Pediatrics (AAP) Council on School Health.

Slide 18: OBJECTIVE 2: DESCRIBE THE CHARACTERISTICS OF ACANTHOSIS NIGRICANS
Slide 19: Acanthosis Nigricans

Acanthosis nigricans is characterized by a darkening (pigmentation change) and/or thickening (textural change) of the skin, often found to appear on the nape of the neck. However, acanthosis nigricans has been documented to appear in other areas of the body including the axilla (armpit), knuckles, groin and in between skin folds. For the purposes of this training we will refer to the acanthosis nigricans that manifest on the back of the neck. Chronic high levels of blood insulin stimulates the skin cell to produce the classic darkening and thickening that is associated with the acanthosis nigricans lesion.

Slide 20: The School Nurse and Screening for Acanthosis Nigricans

Clinically, acanthosis nigricans is a marker for insulin resistance among individuals who are overweight or obese. During the state of insulin resistance, blood insulin is elevated. (hyperinsulinemia). Therefore, the clinical application of screening for acanthosis nigricans among overweight and obese children and adolescents may be important to identify a subset that are insulin resistant, potentially hyperinsulinemic and may have evidence of metabolic changes that are associated with risk for diabetes, cardiovascular disease and the metabolic syndrome.

Slide 21: Acanthosis Nigricans as a Screening Tool

Acanthosis nigricans is not intended to be a diagnosis. When assessing for acanthosis nigricans the intention is to use acanthosis nigricans as a screening tool or one factor that suggests that the child or adolescent may be at risk for developing diseases such as T2DM, cardiovascular disease and the metabolic syndrome. For example, the American Academy of
Pediatrics\textsuperscript{26} and the American Diabetes Association\textsuperscript{27} recognize acanthosis nigricans as one of many risk factors to screen for in children who are identified as overweight or obese. For the overweight or obese child with acanthosis nigricans the AAP and ADA both recommend further assessment and screening of the child’s health with laboratory testing.\textsuperscript{26,27} Current assessment recommendations in primary care for a child with acanthosis nigricans will be discussed in subsequent sections.

**Slide 22: Prevalence of Acanthosis Nigricans among Children and Adolescents**

The development of acanthosis nigricans in children is dependant on degree of excess body weight and their ethnicity. Acanthosis nigricans is found more commonly among obese and severely obese children and adolescents and among high risk ethnicities including African Americans, Hispanics, and Pima Indians. Depending on the population sampled, prevalence rates vary and clearly have increased over the last two decades. Currently, the prevalence of acanthosis nigricans among the total population range from 4.9-19.4\%.\textsuperscript{28} This is in comparison to 1989 where just .5-13.3\% of the population screened positive for acanthosis nigricans.\textsuperscript{29} Among obese and severely obese children the prevalence of acanthosis nigricans is as high as 70\%. Among children with type 2 diabetes mellitus, the prevalence is even higher, over 90\%. Among children who are of high risk ethnicity the prevalence of acanthosis nigricans can be as high as 34\%.\textsuperscript{23,28,30}
Slide 23: Case Study

Consider if these cases happened in your school:

A mass screening for height, weight and acanthosis nigricans is being conducted in your school. You notice that one particular child has a darkening around the neck and looks like acanthosis nigricans. What is your next step?

________________________________________ DISCUSSION _______________________________________

Slide 24: Case Study

You determine that the child has a BMI $\geq$ 97th percentile and you confirm that the darkening on the back of the neck is acanthosis nigricans. What is your next step?

________________________________________ DISCUSSION _______________________________________

Slide 25: Case Study

What is the evidence based standard of care for the pediatrician as a follow up?

________________________________________ DISCUSSION _______________________________________

Slide 26: OBJECTIVE 3: DISCUSS ACANTHOSIS NIGRICANS AND ITS RELATIONSHIP TO INCREASED RISK FOR TYPE 2 DIABETES AND CARDIOVASCULAR DISEASE

Slide 27: What Could Acanthosis Nigricans Mean Below the Skin’s Surface?

Acanthosis nigricans is a good indicator of insulin resistance among overweight and obese children and adolescents. $^{22,23,24,25}$ Screening for acanthosis nigricans along with
measures of body fatness such as body mass index, may offer the school nurse the opportunity to identify a sub-set of children that require further health assessments by their primary care provider. However rare, acanthosis nigricans may also be present among normal weight individuals. The significance of this clinical marker in normal weight persons may be indicative of internal malignancy and requires immediate evaluation by a health care provider.  

**Slide 28: Acanthosis Nigricans and Health Risks**

**Hypertension**

Commonly, the onset of acanthosis nigricans in childhood is linked with the presence of hypertension. In one school based screening study in Texas, nearly 1/3 of 5-19 year old Mexican- American children and adolescents with acanthosis nigricans were also hypertensive. Among an ethnically diverse sample of overweight or obese elementary age children in Columbus, Ohio, (n=69) over 1/5 \(^{th}\) of 3\(^{rd}\) and 5\(^{th}\) grade children with acanthosis nigricans were classified as pre-hypertensive or hypertensive.

**Dyslipidemias**

Although evidence is still emerging regarding the relationship between acanthosis nigricans and dyslipidemias such as elevated triglycerides and low high density lipoprotein cholesterol (HDL-C), one study conducted by Guran et al. to date confirms that obese children who screen positive for acanthosis nigricans have significantly higher levels of triglycerides compared to children without acanthosis nigricans.
As mentioned, acanthosis nigricans is a reliable marker of hyperinsulinemia and insulin resistance among children and adolescents with the skin marker. However, the current evidence is conflicting on the association between acanthosis nigricans and the onset of glucose intolerance and impaired fasting glucose in the pediatric population. Some studies have shown that AN is a reliable marker of hyperinsulinemia, insulin resistance and impaired glucose tolerances. Others have reported that children and adolescents with acanthosis nigricans do not have any significant increases in glucose intolerances compared to children without acanthosis nigricans. Yet, it does appears that children and adolescents with acanthosis nigricans have more risk factors for T2DM, including high risk ethnicity and family history of diabetes compared to children without the skin marker. For example, among Hispanic children and adolescents, acanthosis nigricans was more prevalent in children who had family members with diabetes and who were born to mothers with gestational diabetes. Based on the compilation of data, further evidence is needed among children and adolescents to clarify the associations between acanthosis nigricans and metabolic changes that are associated with T2DM.

Recent evidence indicates that children and adolescents with acanthosis nigricans are developing multiple health risks that are consistent with the components of the metabolic syndrome. This evidence also shows that such metabolic changes are beginning to occur among young, grade school aged children.
Slide 30: Review: Acanthosis Nigricans and Health Risks

Evidence is building to suggest that children with acanthosis nigricans present with more significant health risks and show signs of developing diabetes and cardiovascular disease compared to children without acanthosis nigricans. For example, evidence is inconclusive as to whether acanthosis nigricans predicts the onset of T2DM. Yet, the lack of evidence associating children who have acanthosis nigricans health risks such as T2DM does not mean that the child is healthy. It merely makes it difficult to recommend screening, but does not necessarily mean that screening is not an effective strategy. In fact, these data underscore the importance of screening to identify more global changes in metabolism including screening for hidden risk factors such as insulin resistance, dyslipidemia, hypertension and the metabolic syndrome. The question then becomes: What is the intention of the screening? In the case of acanthosis nigricans, it is not to diagnose, but to merely alert the school nurse that referral for more testing by the primary care provider is warranted. Referral and early intervention by a pediatrician is the best way to identify impending health risks and initiate changes to lifestyle habits to help mitigate future health risk. Subsequent sections of this training will discuss the referral and intervention process school nurses should follow for a child with acanthosis nigricans.

Slide 31: Acanthosis Nigricans as Part of School Based Health Screenings

BREAK
Slide 32: Acanthosis Nigricans Screening in a School Based Setting

In recent years, acanthosis nigricans screening has gained popularity in school based settings. One hallmark school screening program was initiated in 1999 by the state of Texas. The Acanthosis Nigricans: The Screening and Education Study (ANTES) focused on 11 educational service center regions in Texas that border Mexico. In 2001, the state of Texas enacted legislation that mandated acanthosis nigricans screening in these regions. Each year over 700,000 students age 5-19 are screened by a school nurses for acanthosis nigricans, body mass index (BMI) and blood pressure. The name ANTES has recently been changed to the Risk Assessment for Type 2 Diabetes in Children.

Slide 33: Latest Findings from Texas

Screening information from the 2005-2006 school year shows that 13% of children and adolescents in this region have acanthosis nigricans. In previous reports the prevalence was highest among 11 year olds (20%). In all regions tested, ¾ of the children who screened positive for acanthosis nigricans were obese. Looking at other screening factors, depending on the region, 23.6%-40.3% of children with acanthosis nigricans were classified as hypertensive. Depending on the region, 35-60% of children who screened positive for acanthosis nigricans were both obese and hypertensive.
Slide 34: Acanthosis Nigricans Pilot Screening in Columbus

In 2008/2009 a screening for acanthosis nigricans was conducted among a sample of 3rd and 5th grade children who attended a large urban school district. Among 124 overweight and obese children, nearly 40%, screened positive for acanthosis nigricans. Of the 36 children with acanthosis nigricans, 97% or 35 children had a BMI > 95th percentile. When considering ethnicity, nearly 60% of obese African American children had acanthosis nigricans compared to obese Caucasian children where the prevalence of acanthosis nigricans was 31.5%. These data are consistent with evidence from other screening programs demonstrating that acanthosis nigricans predominates among children identified as obese and among children of high risk ethnicities.

Slide 35: Other Acanthosis Nigricans Screening Programs/Pilots

Screening for acanthosis nigricans has also been practice among school nurses in the state of West Virginia. The CARDIAC study is a school based screening study focusing on 5th grade students and the assessment of cardiovascular disease risks. Acanthosis nigricans is one of many risk factors used to assess health status among West Virginia 5th graders. In a report on the association between acanthosis nigricans and the metabolic syndrome, among a sub-sample of 676 children with acanthosis nigricans, 50% met the criteria for the metabolic syndrome based on having three or more of the following risk factors: insulin resistance, high BMI, elevated blood pressure and dyslipidemias.

Slide 36: Current Recommendations and Controversies of Acanthosis Nigricans in Practice
There are several positions offered regarding acanthosis nigricans screenings in an office based care center and within the community. The current position of the CDC states: "CDC is aware that some groups are interested in AN screening of children in school settings to identify those at high risk to develop type 2 diabetes. Although some studies have observed that half the children with type 2 diabetes had AN, insufficient evidence exists for us to conclude that having AN will lead to type 2 diabetes. Therefore, at this time, CDC scientists strongly discourage AN screening of children in school or community settings". While the evidence at that time failed to show AN as a predictor of type 2 diabetes in children, later references support the screening in children.

In general The American Diabetes Association (ADA) has recognized acanthosis nigricans as one of several risk factors to assess for when determining if a child should be screened for glucose intolerances (impaired glucose tolerance, impaired fasting glucose). The ADA indicates that overweight and obese children and adolescents who present with any two of the following risk factors of acanthosis nigricans, a family history of T2DM in a first degree or second degree family member and/ or a high risk ethnicity should be screened for glucose derangements (impaired glucose tolerance, impaired fasting glucose) every 2 years beginning at the age of 10. The American Academy of Pediatrics has recognized that screening for acanthosis nigricans is a critical component of the pediatrician’s physical assessment of a child or adolescent identified as overweight or obese. In conjunction with BMI screenings, acanthosis nigricans may afford the best...
opportunity to identify individuals at greatest risk for developing T2DM and cardiovascular diseases. Furthermore, these children may be in most urgent need of lifestyle modification that focus on adequate nutrition and physical activity education. The expert committee on the assessment, prevention and treatment of childhood and adolescent overweight and obesity recommends that children who present with acanthosis nigricans be further evaluated with laboratory testing. These recommendations include lipid screening, and in some children screening for changes in glucose metabolism and markers of liver function. The Expert Committee recommendations, including specific laboratory screening tests, will be discussed in later sections of this presentation.

**Slide 39: New Evidence**

New evidence is beginning to emerge to demonstrate that glucose intolerances are just one of several metabolic changes that occur in children and adolescents who are overweight and obese. More commonly in overweight and obese children and adolescents, elevated triglycerides, and low HDL cholesterol appear more frequently and develop earlier in the disease process. These metabolic changes have been linked to high levels of insulin in the blood. In fact, it appears that even though type 2 diabetes has risen dramatically in children in recent years, glucose intolerance in most cases tends to occur less frequently and manifest much later in the disease process. It is important that as future positions about acanthosis nigricans are developed that they be based on the most recent global evidence of how to identify potential for hyperinsulinemia.
Slide 40: Review: “Current Recommendations and Controversies of screening for
Acanthosis Nigricans in Practice”

While the CDC\textsuperscript{40} did not recommend acanthosis nigricans screening in schools in 2005, more recent references have indicated its validity. In testing for type 2 diabetes in children, the ADA (2010) recommends assessing for AN: “Signs of insulin resistance or conditions associated with insulin resistance [include] (acanthosis nigricans, hypertension, dyslipidemia, polycystic ovary syndrome, or small for gestational age birthweight).\textsuperscript{27,41}

In addition, primary care guidelines for overweight and obese children with acanthosis nigricans screenings have been provided by the Expert Committee.\textsuperscript{26}

In conjunction with BMI screening, AN may be a helpful tool in identifying children and adolescents who \textit{may be at risk} for T2DM and cardiovascular disease and in urgent need of lifestyle intervention. The intention of screening for acanthosis nigricans is not to make a diagnosis of type 2 diabetes in children, but rather to alert the school nurse and the child’s primary care provider that further scrutiny of the child’s health is warranted.

Slide 41: \textit{OBJECTIVE 4: DESCRIBE THE TECHNIQUE FOR THE SCHOOL NURSE TO PROPERLY IDENTIFY ACANTHOSIS NIGRICANS}

Slide 42: Identification of Acanthosis Nigricans

\textbf{Location}

When the acanthosis nigricans skin lesion is present, 99\% of the time acanthosis nigricans will present on the back of the neck.\textsuperscript{30} Although acanthosis nigricans lesions can be found on other areas of the body (including the front of the neck, the axilla, knuckles,
groin, and between skin folds), the prevalence of finding acanthosis nigricans on the back of the neck makes this location the most ideal for screening at school.

**Texture**

Acanthosis literally means “coarse”. Changes to the skin texture are one of two physical characteristics of the acanthosis nigricans skin lesion, especially in severe cases. Skin textural changes that are associated with acanthosis nigricans can vary based on the severity of the lesion. In less severe cases, skin textural changes may be absent. However, in other cases the skin may feel rough or coarse to the touch. In more severe cases, the texture change of the acanthosis nigricans lesion may be visibly raised and extremely coarse with notable creasing. It is important during the examination for acanthosis nigricans, that both tactile (touch) and visual senses are used to detect any textural changes on the skin.

**Pigmentation**

Nigricans literally means “dark”. Acanthosis nigricans, in its most advanced stage, can appear darkened and is velvety in appearance. Among, lighter pigmented races, changes in skin color may be absent while textural changes may present first. In other cases the color may appear yellow, grayish or even resemble light bruising.

Below are several examples of the acanthosis nigricans skin lesion ranging from less severe to more severe.
Slide 43: Texture

In this patient textural changes are less severe but still relatively obvious. Notice the creasing with pigmentation changes on the back of the neck and moving forward to the front of the neck.
This is another case where the textural changes are less severe but still relatively obvious. Notice the creasing with pigmentation changes on the back of the nape of the neck.
In this patient textural changes are very apparent and severe. Creasing is obvious and the texture of the skin is quite course and appears thickened and raised.
Similar to photograph 3, textural changes are quite obvious. Notice the skin creasing with a rough and raised texture of the skin on the back of the neck.
In this patient the pigmentation changes are most intense near the back of the neck. Moving forward, the pigmentation of the lesion becomes more faint, yet obvious.
In this patient the pigmentation changes at the front of the neck are intense, but look similar to the natural skin color. In this case it is especially important to consider the thickening and coarseness of the skin when evaluating the lesion.
In this patient the pigmentation changes are quite faint and appear almost grayish in color or similar to a healing bruise. As in the previous photograph it is important to also inspect for textural changes.
In this patient the pigmentation changes are quite faint and appear almost yellowish in color or similar to a healing bruise. As in the previous photograph, it is important to also inspect for textural changes.
The acanthosis nigricans pigment when contrasted against the natural skin pigment is noticeably darker. The lesion not only spans the back of the neck but approaches the front of the neck.
The pigmentation of the acanthosis nigricans lesion is quite similar to the patient’s natural skin pigmentation. In this case it is important to not only look for subtle pigmentation changes but also to inspect for textural changes to the skin.
Slide 53: Acanthosis Nigricans Screening Tips for School Nurses

1. Adequate Lighting

   Lighting should be adequate when screening. This is necessary to detect any subtle skin changes or to distinguish acanthosis nigricans from other skin disorders that may look similar.

2. Provide Privacy

   Privacy during assessment is imperative. The visual inspection may be done behind a screen or curtain to provide privacy for the student.

3. Bend Neck Forward

   It is important to bend the neck forward prior to screening. The neck in its normal, anatomical position creates creases and creviced areas with pronounced shadowing. This shadowing may make the skin appear much darker and the screener may give a false positive screen.

4. Look for Color Differences in the Crevices of Skin

   As seen in the photographs below, acanthosis nigricans often forms skin creases and crevices with noticeable pigmentation changes. It is important when deciding whether a student has acanthosis nigricans to identify those creases and inspect for color differences.
In this case, notice the creasing on the child’s neck and the skin color remains natural. Notice the area surrounding the crevice or crease is noticeably darker than the natural skin tone.
In this case, notice the creasing on the patient’s neck and the skin color remains natural. Notice the area surrounding the crevice or crease is noticeably darker than the natural skin tone.
In this case, notice the creasing on the patient’s neck and the skin color remains natural. Notice the area surrounding the crevice or crease is noticeably darker than the natural skin tone.
In this case, notice the creasing on the patient’s neck where the skin color remains natural. Notice the area surrounding the crevice or crease is noticeably darker than the natural skin tone.
Acanthosis Nigricans Screening Tips for School Nurses

5. Pull Hair Up Toward Neckline

Especially in female students and male students with long hair, it is important to pull the hair up toward the neckline or have the student tie the hair back prior to screening for acanthosis nigricans.

6. Feel for Textural Changes

Since the acanthosis nigricans lesion also produces a thickening of the skin, it is important when screening to use both tactile and visual senses. In some cases, the thickening of the skin is more pronounced than the darkening.

7. Follow Up and Clean Neck with a Swab

If you see a suspicious lesion you may choose to perform a more thorough assessment by cleaning the neck with soap and water or an alcohol swab. Commonly acanthosis nigricans is mistaken for a “dirty neck”. It is important that the neck is clean.

Coordinated School Health and Health Screening

Moreover, coordinated school health programs are vital. School nurses play a pivotal role in the care of young children. It is the position of the National Association of School Nurses ‘that all children should have the right to coordinated school health programs’. The coordinated school health model, proposed by the Center for Disease Control and Prevention, has charged school nurses to support a comprehensive approach to school health.
healthy school environment. Chronic diseases such as obesity in childhood should be one of many foci.

**Slide 61: Coordinated School Health Programs**

The creation of a coordinated school health approach requires the cooperation and partnering, including but not limited to school nurses, administrators, teachers, parents and the community at large. As the health official in the school, school nurses are in the position to take action by serving as the liaison between the school, family and community. The creation of school district and/or building wellness policies can dictate the responsibilities and action of each party involved. Furthermore, the coming together of school, family and community allows for resource sharing and the best possible chance for a child to receive the care, attention and resources required to support optimal health and wellbeing. Aligned with the coordinated school and community health approach, establishing a working partnership with local pediatricians may be one way to engage parents to take an active role in their child’s health and encourage follow up to health referrals made by the school nurse.

**Slide 62: OBJECTIVE 5: DESCRIBE THE SCHOOL NURSE ROLE FOR FOLLOW-UP TO THE IDENTIFICATION OF ACANTHOSIS NIGRICANS**

**Slide 63: Referral Process for Acanthosis Nigricans**

The referral process is a necessary follow-up to the student screenings by the school nurses. For acanthosis nigricans:
1) Screenings should be performed in conjunction with height, weight and BMI identification.

2) The overweight or obese child or adolescent with acanthosis nigricans should also be screened for blood pressure by the school nurse. A child or adolescent with an elevated blood pressure at or above the 90th percentile should have the blood pressure taken again on the same day. The child or adolescent with a blood pressure at or above the 95th percentile should have a second measurement on a subsequent day to confirm the finding. To assure accuracy during follow-up screening for an elevated blood pressure, use the right sized arm cuff based on the thickness of the child’s arm and assure that the child has been resting in a chair with his/her feet flat on the floor for a minimum of 5 minutes. Blood pressure readings should be compared against the appropriate national percentile guidelines for age, height percentile and gender.46

**Slide 64: Referral Process for Acanthosis Nigricans**

3) Appropriate notification of health screening findings to the family.

4) Recommendation for referral for further evaluation by a pediatrician. Acanthosis nigricans is like any other screening tool. A child identified as overweight or obese with acanthosis nigricans merit further investigation by a pediatrician.

5) As an easy reference for the pediatrician is the ICD-9 Code for Acquired Acanthosis Nigricans, 701.2, and should also be included in the referral. Since the inception of the ANTES program in 1999, school nurses have tracked the number of claims made by pediatricians for *Acquired Acanthosis Nigricans.* In 1999
approximately 2500 claims were made. In 2005, there were nearly 32,000 claims of acanthosis nigricans. 39

**Slide 65: What Follow-up Guidelines are Recommended for Primary Care?**

The American Diabetes Association 41 currently recommends screening with a fasting blood glucose test when a child is overweight and has 2 additional risk factors including acanthosis nigricans, high risk ethnicity, polycystic ovarian syndrome, or cardiovascular disease risks such as high blood pressure or abnormal fasting lipids. 41

**Slide 66: What Follow-up Guidelines are Recommended for Primary Care?**

For an overweight or obese child at any age a fasting lipid profile may be warranted. Biannual tests for liver function (ALT and AST) may be ordered for children at or above the 85th percentile with risk factors or for children at or above the 95th percentile irrespective of risk factors. 26 Starting at the age of 10, an overweight or obese child with 2 additional risk factors should be screened for fasting blood glucose, biannually, based on the American Diabetes Association criteria and cut-points. 41 BMI percentile, presence of acanthosis nigricans, and elevated blood pressure will give the parent/guardian and primary care provider a comprehensive view of the potential for health risk in the child or adolescent.

**Slide 67: Referral Review**

The school nurse may take the lead in identifying children and adolescents who are at risk for other conditions associated with overweight and obesity. Screening for acanthosis nigricans is part of a comprehensive assessment to identify children and adolescents who
should be referred for further evaluation by a primary health care provider or clinic if they do not have a medical home.

**Slide 68: Resources**

*Center for Healthy Weight and Nutrition (CHWN), Nationwide Children’s Hospital*

The CHWN website at http://nationwidechildrens.org/center-for-healthy-weight-nutrition provides school nurses and clinicians with educational resources based on the Expert Committee Guidelines for Primary Care. In addition, NASN has a web page dedicated to the issue of overweight and obese children at:


*Risk Assessment for Type 2 Diabetes in Children*

The website sponsored by the University of Texas Pan Am at rfes.utpa.edu provides information on the acanthosis nigricans screening program including previous legislative reports for the ANTES program.

**Slide 69: Program Review**

**Objective 1:** Discuss the implications of increasing rates of overweight and obesity in school aged children.

1) Rates of childhood obesity have increased alarmingly.

2) Coinciding is a rise in co-morbid conditions that are associated with the metabolic syndrome, diabetes and cardiovascular disease.
3) Early identification through screening is one strategy for the school nurse to identify children at risk of co-morbid conditions.

**Slide 70: Program Review**

**Objective 2:** Describe the characteristics of acanthosis nigricans

1) Acanthosis nigricans is one screening tool that may identify a subset of children that require further evaluation by primary care providers.

2) Acanthosis nigricans is not a diagnosis for type 2 diabetes, but occurs more frequently among children who are obese and of high risk ethnicity.

**Slide 71: Program Review**

**Objective 3:** Discuss acanthosis nigricans and its relationship to increased risk for type 2 diabetes mellitus and cardiovascular disease

1) Hyperinsulinemia drives metabolic changes.

2) More evidence is needed to draw better conclusions among acanthosis nigricans and health risks.

3) Evidence related to the effectiveness of screening for acanthosis nigricans is in progress.

4) Acanthosis nigricans as a risk factor is supported by the ADA and AAP.
Slide 72: Program Review

**Objective 4:** Describe the technique for school nurses to properly identify acanthosis nigricans

1) Have adequate lighting  
2) Provide privacy  
3) Bend neck forward  
4) Look for color differences in skin crevices  
5) Pull hair up toward neck line  
6) Feel for textural changes  
7) Follow up and clean with neck swab

Slide 73: Program Review

**Objective 5:** Describe the school nurse role for follow-up to the identification of acanthosis nigricans

1) Screening for acanthosis nigricans is part of a comprehensive health assessment.  
2) Children with acanthosis nigricans require follow-up by the pediatrician or primary care provider.