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I, Darlene Kinney, hereby submit this original work as part of the requirements for the degree of Doctor of Philosophy in Health Education.

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College Students Use and Perceptions of Wearable Fitness Trackers and Mobile Health Apps

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College Students’ Use and Perceptions on Wearable Fitness Trackers and Mobile Health Apps

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Abstract

AN ABSTRACT OF THE DISSERTATION FOR THE DOCTOR OF PHILOSOPHY
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AT THE UNIVERSITY OF CINCINNATI, CINCINNATI, OH

TITLE: College Students’ Use and Perceptions on Wearable Fitness Trackers and Mobile Health Apps

DOCTORAL COMMITTEE MEMBERS: Dr. Laura A. Nabors (Chair), Dr. Ashley Merianos, and Dr. Rebecca Vidourek

Study One Abstract

Background. Approximately half of all college students are not meeting the Center for Disease Control’s exercise recommendations. This study investigated college students’ use of wearable fitness trackers (WFTs) and their perceptions of WFTs impact on confidence and motivation for increasing physical activity. Reasons for non-use of WFTs were also explored. Methods. A 25-item survey was developed and administered to college students at a Midwestern University. Descriptive and inferential statistics were conducted using SPSS software. Results. Use of a WFT was reported by 22.5% (n = 80) of participants (N = 356.) The two most common WFTs were Fitbit and Apple Watch. Most participants wore their WFT either “every day without fail” or “most days” and half wore their WFT “all day and while sleeping”. A majority of participants reported using their WFT to help them increase their physical activity. Regression analyses were significant for participants reporting a perceived high increase in physical activity and or a perceived high number of steps participants were more likely to report high motivation for physical activity. Females were 2.3 times more likely to use a WFT than males.
Conclusions. This study documents key information on college students’ use of WFTs and demonstrated possible usefulness of WFTs in helping to increase confidence and motivation for physical activity. Further studies are needed to determine potential usefulness of WFTs as an element of interventions for improving levels of physical activity among college students.

Study Two Abstract

Background. Approximately half of all college students are not meeting the Center for Disease Control’s exercise recommendations. This study investigated college students’ use of mobile health apps (mHealth apps) and their perceptions of mHealth apps’ impact on motivation for increasing physical activity. Reasons for non-use of mHealth apps were also explored. Methods. A 25-item survey was developed and administered to college students at a Midwestern University. Descriptive and inferential statistics were conducted using SPSS software. Results. A total of 67 participants (84%) reported using their WFT’s related mHealth app. The only significant factor related to increasing motivation for engaging in physical activity was number of mHealth apps synced with participants’ WFTs. The regression model was significant ($p = .026$) and predicted approximately 13.4% of the variance in motivation for engaging in physical activity. Conclusions. This study documents key information on college students’ use of mHealth apps. Further studies are needed to determine potential usefulness of mHealth apps as an element of interventions for improving levels of physical activity among college students.
Dedication

In honor of my mother’s memory and to adhere to my promise to her that I would complete my education and make a difference in this world… I dedicate this dissertation to Cheryl Jean Febbi.
Acknowledgements

Great feats are never accomplished in isolation. There are several people that have helped me in one way or another to complete this dissertation in the face of many personal and professional challenges. Firstly, my Academic Advisor, Dr. Rebecca Vidourek who provided me with unwavering guidance throughout my graduate work. As a professor and an advisor Dr. Vidourek taught me much about being a health educator but also about being a professor and an advisor through her mentorship. I truly appreciate the genuine care and commitment that she demonstrated consistently while maintaining a rigorous professional standard.

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# Table of Contents

**Abstract** ......................................................................................................................................................................................... ii  
Study One Abstract ............................................................................................................................................................................... ii  
Study Two Abstract.............................................................................................................................................................................. iii  
Dedication ............................................................................................................................................................................................. v  
Acknowledgements ............................................................................................................................................................................. vi  
List of Tables ......................................................................................................................................................................................... ix  

**Study One: College Students’ Use and Perceptions of Wearable Fitness Trackers** ............... 1  
Introduction ....................................................................................................................................................................................... 2  
Review of the Literature ....................................................................................................................................................................... 3  
Theoretical Orientation .......................................................................................................................................................................... 5  
Study Aims ............................................................................................................................................................................................ 6  
Research Questions and Hypotheses .................................................................................................................................................... 7  
Methods .............................................................................................................................................................................................. 8  
Data Analyses ...................................................................................................................................................................................... 12  
Results ............................................................................................................................................................................................... 13  
Discussion .......................................................................................................................................................................................... 21  
Limitations .......................................................................................................................................................................................... 25  
Conclusions .......................................................................................................................................................................................... 25  
References ......................................................................................................................................................................................... 27  
Tables ................................................................................................................................................................................................. 32  

**Study Two: College Students’ Use and Perceptions of Mobile Health Apps to Enhance the Health Benefits of Wearable Fitness Trackers** ............................................................................. 42  
Introduction ....................................................................................................................................................................................... 43  
Theories related to mHealth Apps and Behavior Change .................................................................................................................. 44  
Review of the Literature ....................................................................................................................................................................... 44  
Study Aims ............................................................................................................................................................................................ 50  
Research Questions and Hypotheses .................................................................................................................................................... 50  
Methods .............................................................................................................................................................................................. 51  
Data Analyses ...................................................................................................................................................................................... 54  
Results ............................................................................................................................................................................................... 55
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussion</td>
<td>58</td>
</tr>
<tr>
<td>Limitations</td>
<td>60</td>
</tr>
<tr>
<td>Conclusions</td>
<td>61</td>
</tr>
<tr>
<td>References</td>
<td>62</td>
</tr>
<tr>
<td>Tables</td>
<td>65</td>
</tr>
<tr>
<td>Appendix A – Approval Letter</td>
<td>69</td>
</tr>
<tr>
<td>Appendix B – Classroom Recruitment E-mail</td>
<td>72</td>
</tr>
<tr>
<td>Appendix C – Survey Administration Script</td>
<td>73</td>
</tr>
<tr>
<td>Appendix D – Survey Information Form</td>
<td>74</td>
</tr>
<tr>
<td>Appendix E – Survey</td>
<td>77</td>
</tr>
<tr>
<td>Appendix F – Survey Test-Retest Information Form</td>
<td>82</td>
</tr>
</tbody>
</table>
List of Tables

Study One List of Tables: College Students’ Use and Perceptions of Wearable Fitness Trackers

Table 1. Demographic Characteristics of Participants. 37
Table 2. College Students’ Use of Wearable Fitness Trackers. 38
Table 3. Information College Students’ Use from Wearable Fitness Trackers. 39
Table 4. WFT Users’ Confidence Level to Increase Physical Activity. 39
Table 5. WFT Length of Use * Confidence Level to Increase Physical Activity. 40
Table 6. WFT Users’ Motivation Level to Increase Physical Activity. 41
Table 7. Relations among Demographic Factors and Use of Wearable Fitness Trackers 41
Table 8. Reasons* for Non-Use of Wearable Fitness Tracker. 41
Table 9. Length of use of WFT prior to Discontinuation. 42
Table 10. Reasons* for Discontinuation of use of Wearable Fitness Tracker. 43

Study Two List of Tables: College Students’ Use and Perceptions of Mobile Health Apps to Enhance the Health Benefits of Wearable Fitness Trackers

Table 1. Demographic Characteristics of Participants. 65
Table 2. College Students’ Use of Mobile Health Apps. 66
Table 3. Types of Information Used from Mobile Health Apps. 67
Table 4. Regression Model with Numbers of features, Sharing, and Mobile Health Apps Synced to WFTs as Predictors of Motivation. 68
Study One: College Students’ Use and Perceptions of Wearable Fitness Trackers
Introduction

The Centers for Disease Control (2015) defines physical activity as anything that gets an individual’s body moving and recommends adults to get at least 2 ½ hours of moderate-level aerobic activity per week. In support of this recommendation, The American College of Sports Medicine (Garber et al., 2011) recommends an individual achieve at least 7,000 steps per day and further states that achieving steps below this number may still be beneficial. According to the most recent survey on the health of college students, conducted by the National College Health Association (2016), just over half of male college students and 43.1% of female college students do not meet these recommendations. Research has shown that physical inactivity contributes to overweight and obesity as well as mental health issues and chronic health conditions such as heart disease, diabetes and some cancers (Reiner, Niermann, Jekauc, & Woll, 2013).

According to a nationwide telephone survey of 3,014 adults in the United States conducted by the Pew Institute (Fox & Duggan, 2013), a majority of adults (60%) routinely track their weight, diet or exercise. Demographically, men and women are equally likely to track this information and older adults are more likely than younger adults to track their weight, diet or exercise (Fox & Duggan, 2013). As well, Latinos are the less likely to track these behaviors (51%) than Non-Hispanic Whites (62%) and African Americans (59%). Interestingly, nearly half of those that track this information do so by simply being mindful and slightly over half either use paper (35%) or technology (21%) to track. Participants that were between the ages of 18 – 29 years were the most likely (16%) to track using an app, mobile phone or device, such as a wearable fitness tracker.
One advantage of wearable fitness trackers (WFTs) and mobile health (mHealth) applications (apps) is that they track daily activity that occurs naturally throughout the day during one’s usual routine. Additionally, they give instant feedback that may increase one’s awareness, motivation, and self-efficacy to move more during the day, thereby naturally increasing one’s level of physical activity (Patel, Asch, & Volpp, 2015; Piwek, Andrews, & Joinson, 2016; Stawarz, Cox, & Blandford, 2015). According to Ghandi and Wang (2016), sales of wearable fitness trackers grew from 78 million sold in 2015 to approximately 102 million sold in 2016 and sales are projected to grow to approximately 50 billion trackers sold by 2018. This projected increase in the use of WFTs calls for researchers and health educators to investigate their potential effectiveness in helping to increase individuals’ physical activity.

**Review of the Literature**

A review of the literature related to the use of WFTs revealed studies concerning the accuracy and reliability of the trackers; however, these studies did not typically focus on college-age youth who were in relatively good health (Evenson, Goto, & Furberg, 2015; Kaewkannate & Kim, 2016; Yang, Shin, Newman, & Ackerman, 2015). For example, studies focused on using WFTs as part of interventions related directly to improving the health and well-being of persons with a chronic condition such as mental illnesses (Aschbrenner, Naslund, Shevenell, Mueser, & Bartels, 2016), disability related to lumbar spine surgery (Mobbs, Phan, Maharaj, & Rao, 2016), and the prevention and treatment of cardiovascular disease (Hickey & Freedson, 2016). One study investigated the use of fitness trackers in post-menopausal women (Cadmus-Bertram, Marcus, Patterson, Parker, & Morey, 2015) while another study assessed the feasibility of fitness trackers in urban youth (Schaefer, Ching, Breen, & German, 2016).
**Research with College Students.** The literature review conducted for this study revealed one study directly related to college students and use of WFTs to increase physical activity. This study was a qualitative study (Ball, Bice, & Adkins, 2015) that recruited students, faculty and staff from two universities to obtain participants’ views on the overall impact of the Nike Fuelband SE on levels of physical activity. In an intervention commencing with one-on-one interviews, a total of 42 participants (25 years or older) were recruited, given a Nike Fuelband SE, and they received a one-hour training on the use of the Fuelband including: how to set goals, upload data, connect to the related website, and how to charge the tracker. While participating in this study, participants set a daily exercise goal based on Nike fuel points and were encouraged to wear the tracker all day over an 8-week period. Nike fuel points is how the Nike WFT calculates all body movement regardless of the user’s age, gender or weight (NikePlus, 2016). It is important to note that the authors did not employ any other behavior change techniques and participants were instructed to only use the fuel points feedback feature. At the end of the eight weeks participants were interviewed face-to-face to explore their experiences with the tracker. Areas of focus included participants’ awareness of physical activity, their motivation to exercise and their perceptions of the strengths and weaknesses of the tracker (Ball et al., 2015).

The majority (90%) of participants in their study reported that using the fitness tracker increased their awareness of their activity level. Ninety percent of participants liked the instant feedback of the LCD screen on the tracker and at the related website. Some of the participants reached their physical activity goals, while others did not. Some participants also mentioned that there were times when the device was inaccurate. Specifically, they felt the tracker was
incorrectly calculating more activity if they were performing mostly upper body activities (golf) versus fewer steps when doing mostly lower body (reclining bike) activities.

There were several shortcomings for Ball et al.’s (2015) study. For example, it would have been interesting to see whether participants felt the inaccuracies from the WFT feedback impacted their level of motivation to continue the use of their fitness tracker and to increase their physical activity. As well, Ball et al (2015) did not provide demographic information which would have provided information on the sample obtained for this study. Additionally, the study did not examine a large group of students’ perceptions and only focused on one feature (Nike fuel points) of one type of WFT. Consequently, research assessing college students’ use, attitudes and self-efficacy for using WFTs is needed, and the current study fills this gap in the literature.

Theoretical Orientation

Bandura’s (2001) Social Cognitive Theory (SCT) largely informs this study. Interestingly, the first tracker was the body weight scale; developed decades ago and advertised with the slogan, “He who often weighs himself knows himself well. He who knows himself well lives well.” (Chieh, 2011). This slogan, appears to agree with the self-regulating notion set forth by Bandura (2001); that in order for a person to be able to change their motivation and their actions, they need to be aware of their actions. This is a key tenant of the SCT of behavior change (Viswanath, Rimer, & Glanz, 2015). Wearable fitness trackers allow users to establish physical activity goals (Crawford, Lingel, & Karppi, 2015). Establishing goals (and later modifying the goals based on feedback provided by the WFT) addresses the SCT construct of intention (Viswanath et al., 2015) and intentions serve to inform or direct health behaviors. Additionally, the use of a WFT minimally provides immediate feedback to its user as to
whether or not they are on target to meet their goals. This allows for self-reflection and self-regulation, both of which are personal cognitive factors of SCT (Bandura, 2001). Many WFTs utilize a buzzing and LCD display of fireworks, a smile, thumbs up or verbiage that acknowledges the user meeting a physical activity goal (Crawford et al., 2015). This kind of feedback can be seen as a form of social reward. All of these attributes of WFTs may serve to increase one’s self-efficacy for engaging in physical activity. Bandura (1977) described the development of an individual’s self-efficacy as coming from four main sources; positive previous experiences (meeting one’s step goal on a given day), vicarious experiences (later discussed in relation to mobile health apps), social persuasion (tracker buzzing and LCD display of celebratory graphics), and emotional arousal (which may occur when the user receives feedback rewards).

**Study Aims**

Findings from this study provide information about how college students use WFTs and enhance researchers’ and health educators’ understanding of college students’ perceptions related to the use of WFTs to improve their level of physical activity. This increase in knowledge and understanding may help to inform health promotion interventions geared towards increasing physical activity amongst college students. The broad aims of this study are to:

1. Assess college students’ use of wearable fitness trackers (WFTs).
2. Determine college students’ perceptions of WFTs.
3. Determine relationships among college students’ use and their perceptions of WFTs as well as relations among these factors and demographic and health information provided by college students.
Research Questions and Hypotheses

The following research questions and hypotheses were examined:

1. To document key information about use of WFTs by college students (e.g., length of time for use; brand use; when used – time of day).

2. To understand the types of information used by college students from their WFTs.

3. To understand how WFT use impacts self-efficacy for physical activity.
   - H1: Students who have used their WFTs longer would report higher levels of self-efficacy for engaging in physical activity
   - H2: Students reporting using more information from their WFTs (e.g. steps, calories, heart rate, etc.) would report higher levels of self-efficacy for engaging in physical activity

4. To understand how WFT use impacts motivation for physical activity.
   - H1: Students reporting that the use of their WFT increased their level of physical activity would report higher levels of motivation to engage in physical activity
   - H2: Students reporting that the use of their WFT increased their daily number of steps (Nsteps) would report higher levels of motivation to engage in physical activity

5. Examine the relationship among demographic factors and use of WFTs.
   - H1: Females would be more likely to use WFTs than males
   - H2: White, Non-Hispanic students would use WFTs more frequently than students in other ethnic groups
   - H3: Students with higher BMI would be more likely to use WFTs than those with lower BMI

6. To document reasons for Non-Use of WFTs (e.g., not interested; too expensive; fit).
7. Examine the relationship between number of reasons for discontinuation of use of WFTs and length of time of use.

- **H₁**: Students reporting more reasons for discontinuation of use of a WFT would report shorter time using a WFT

**Methods**

**Participants**

Participants in this study were college students attending a large urban public research university including its' two regional campuses. The University is located in the Midwestern region of the United States. To obtain a representative sample size with the lowest potential sampling error (margin of error 5%) a sample size calculator was used and indicated a minimum sample size of 381 participants (Raosoft, 2014). This study was approved by a university-based institutional review board (approval letter in Appendix A).

**Setting**

The total enrollment of students recorded for fall 2016 was 36,637 for main campus, 2,883 for Clermont College, and 4,818 for Blue Ash College thereby making the total population 44,251 (UC Office of Institutional Research, 2016). The student demographics are similar across the three campuses with 57.7% of the students being female and 42.3% being male and the majority (80.4%) of students falling within the ages of 18 and 29 (UC Office of Institutional Research, 2016).
Instrument

A four-page survey (Appendix B) was developed by the researcher after informal discussions with adults using WFTs and an extensive review of literature. Consultation with three experts in health education was also used in the review of survey items. The survey consisted of four sections assessing use and perceptions of: (1) Wearable Fitness Trackers, (2) Mobile Health Apps, (3) Demographic & Health Information, and (4) Non-Use Questions. The focus of this paper is to address WFTs and the use of mobile Health applications (mHealth apps) is discussed in paper 2. Thus, survey sections focusing on WFTs, non-use, and the demographics sections are described in this study.

Section on Wearable Fitness Trackers. This section contained a total of thirteen questions related to the use and perceptions associated with WFTs. This section began with a brief description of what a wearable fitness tracker is and is not; “Wearable Fitness Trackers include any fitness tracker that you can either clip to your clothing or wear on some part of your body. This may be a Fitbit or a Fuelband or a similar tracker. This does not include trackers that are built into your smartphone.” Question 1 assessed whether participants used a WFT with the following response options: “yes”, “no”, and “used to”. If participants selected either “no” or “used to” they were directed to skip to and complete sections 3 and 4 of the survey. Question 2 assessed how long participants had been using a wearable fitness tracker with answer options ranging from less than one month to less than one year. Question three assessed what brand of WFT they were currently using with the top four brands as answer options and an “other” option that allowed participants to record what type of WFT they were using. Questions 4 and 5 assessed how participants used their WFTs in terms of daily use and if they wore it all of the time – even while sleeping.
Question 6 assessed participants’ primary reason for wearing a fitness tracker with several answer options provided (i.e. – “to lose weight”, “to improve workouts”, “to increase physical activity”) and an “other” write in option. Question 7 assessed what information participants used from the WFT with five data points (choose all that apply) that can be tracked by most wearable fitness trackers (steps, distance, calories burned, stairs climbed, active minutes) and an “other” write in options that may be available with WFTs not included in this study.

Question 8 asked participants to choose the one data point (given the same answer options as question 7) that was most important to them. Question 9 assessed participants’ confidence in their ability to be physically active since using their wearable fitness tracker – given the options of “not confident”, “slightly confident”, “moderately confident”, and “extremely confident”.

Prior to questions 10 – 13 participants were provided with a definition of “physical activity”; “may include purposeful activity such as taking a fitness class, running, bicycling, walking or it may simply be adding steps wherever you can into your day (i.e. – taking the stairs, parking further or even walking circles around your kitchen table just to meet a step goal you’ve set). Question 10 assessed participants’ perception as to whether or not the use of a wearable fitness tracker increased their physical activity with answer options including “not at all”, “a little bit”, “somewhat”, “quite a bit”, “very much”, and “not sure”. Question 11 assessed participants’ perception of their motivation to be more physically active since wearing the tracker – given the same answer options as question 10.

Question 12 assessed whether using a WFT increased participants’ daily number of steps – given the same answer options as questions 10 and 11. Finally, question 13 assessed
participants’ number of steps that they get on a regular basis – based on their tracker data with six answer options ranging from < 5,000 steps per day to ≥ 12,500 steps per day and with an “I don’t know” answer option.

Demographic Section. This section included standard demographic questions such as gender, age and ethnicity (Questions 1 – 3). Questions 4 and 5 assessed what campus the participants’ attended and the participants’ major. Question 6 assessed participants’ self-reported weight and height for determination of their Body Mass Index. Question 7 assessed participants’ chronic health conditions with eight common conditions provided for answer options and an “other” write option. Finally, question 8 assessed whether the participant was a student athlete.

Section on Non-Use Questions. This section starts with instructions to only answer these questions if participants did not use a WFT. Question 1 assessed participants’ reason/s for not using a WFT with seven answer options based on the literature review (instructed to choose all that apply) and an “other” write in option. Prior to questions 2 and 3 instructions were “If you “used to” use a wearable fitness tracker but have stopped using it please answer the following questions…” Question 2 assessed how long participants used a wearable fitness tracker with space for them to write a number of years, months, weeks, days. Question 3 assessed participants’ reasons for discontinuing the use of a wearable fitness tracker with ten answer options (choose all that apply) and one “other” write in option.

Procedures

To recruit classrooms an email was sent to faculty via the faculty listserv (Appendix B). The email asked for access to their classrooms at a time that was most convenient for them. If the faculty were willing to allow the researcher access to their class, they sent back information
about the class, day and time as well as the location of the class. The researcher arranged a time and went to the classroom to administer the survey. The researcher briefly introduced the purpose of the survey (Appendix B) explaining that participation was voluntary and information was anonymous. Students were also instructed to not put their names on the survey. An Information Sheet was also administered with the survey (Appendix C), which described the voluntary nature of the study and provided the contact information for the representatives for the Institutional Review Board. After reviewing this Information Sheet students then completed the survey (Appendix D) which took approximately 10 minutes and brought the survey to the front to place into a large manila envelope.

A test-retest reliability study was performed by having 37 participants complete the survey twice, two weeks apart. Prior to administering the survey the researcher explained the voluntary nature of the study and explained that the same survey would be administered again in two weeks. Participants were also given an Information Sheet (Appendix E) that described the study details including the contact information for the representatives for the Institutional Review Board. Students were instructed to place an identification number, the first initial of their last name, the first initial of their middle name, the first initial of their first name, and their birth day and year, on the top of their surveys at each administration of the survey.

Data Analyses

Data from surveys was entered into the Statistical Package for Social Sciences (SPSS, version 23). Research questions 1, 2, and 6 were exploratory in nature and nominal level measurements which were analyzed using descriptive statistics. Research questions 3 through 5 were analyzed using logistic regression analyses. Finally, research question 7 was analyzed using Spearman’s rank order correlation.
Test-retest data were assessed using percent agreement (Araujo & Born, 1985; Berchtold, 2016) for survey questions assessing WFTs. The initial test was administered to 37 participants and the retest was administered two weeks later (Polit, 2014) to minimize potential retest biases. All but four of the survey items showed satisfactory percent agreement (71% - 100%). One of the four items that fell below the acceptable percent agreement was related to information used from participants’ WFT (57% agreement). The other three items that were below acceptable percent agreement were questions regarding participants’ perceptions of increase in physical activity (57%), level of motivation (43%), and increase in number of steps (57%). This level of agreement may be attributable to a response shift where an individual’s self-evaluation has changed (Polit, 2014) over the testing period.

Results

Demographic Characteristics

A total of 356 undergraduate students (245 females, 110 males, 1 did not indicate gender) completed surveys. Demographic information is presented in Table 1.

A majority of participants \( n = 294, 83\% \) were white with the next largest ethnicities being Black/African American \( n = 41, 11.6\% \), Asian \( n = 17, 4.8\% \), and Hispanic/Latino/Spanish \( n = 9, 2.5\% \). Together, American Indian/Alaska Native \( n = 1 \), Middle Eastern/North African \( n = 4 \), and Native Hawaiian/Pacific Islander \( n = 2 \) constituted 2% of the total participants. Participant age ranged from 18 – 48 years with the average age being 21 years \( (SD = 4.75) \). Body Mass Index (BMI) was calculated from participants’ self-reported height and weight and then categorized as being underweight, normal weight,
overweight or obese. Most participants \((n = 195, 55\%)\) were of normal weight. Just under five percent were underweight \((n = 17, 4.8\%)\), twenty-two percent \((n = 77, 21.7\%)\) were determined to be overweight and 13\% \((n = 47, 13.2\%)\) were obese.

**Research Question 1: Key Information about the Use of Wearable Fitness Trackers (WFTs) by College Students**

Of the 356 participants 22.5\% reported currently using a WFT \((n = 80)\). Table 2 presents information on use of WFTs.

Insert Table 2 about here

The most common trackers used were Fitbit \((n = 48, 60\%)\) and Apple Watch \((n = 21, 26.3\%)\). Other trackers that participants reported using included Samsung Gear, Under Armour Health Band, Pebble Time Steel, and Kate Spade Fossil Band. The shortest length of time for use of a WFT was less than one month \((n = 5, 6.3\%)\). Just over half of participants \((n = 44, 55.1\%)\) had worn their WFT between 1 and 11 months, and the remaining participants reported using their WFT for a year or longer \((n = 31, 38.8\%)\). Most participants wore their WFT either “every day without fail” \((n = 35, 43.8\%)\) or “most days” \((n = 23, 28.7\%)\) and some only wore their tracker “when I remember” \((n = 13, 16.3\%)\). A smaller percentage wore their trackers just a “few days a week” \((n = 6, 7.5\%)\) or “a few times a month” \((n = 3, 3.8\%)\). Fifty percent \((n = 40)\) of participants wore their WFT “all day and while sleeping” and 43.8\% \((n = 35)\) reported wearing their tracker “only during the day” with even fewer participants \((n = 5, 6.3\%)\) wearing their tracker “only when working out.”
Research Question 2: Types of Information Use from Wearable Fitness Trackers by College Students

When asked why they use a WFT participants \((n = 80)\) were able to choose more than one reason. Most participants chose at least two but often 3 or more reasons for use and types of information used. Table 3 presents information regarding college students’ reasons for and use of information obtained from WFTs by college students including what information they considered to be “most important.”

A majority \((n = 57, 71.3\%)\) of participants reported using their WFT to help them increase their physical activity and 28.7% \((n = 23)\) used the tracker to help them to improve their workouts while 35% \((n = 28)\) reported using their tracker to help them to lose weight. As well, thirty-five percent \((n = 28)\) of participants reported using their tracker to monitor their sleep. Lastly, a write in “other” category was provided for participants to share additional reasons for use. These “other” reasons shared by participants included social reasons such as “to show off,” “looks cool,” “people ask about it,” and “to compete with friends.” Some participants also reported using their tracker as a stop watch, a watch, and for the calendar function. Number of steps and distance/miles, 88.8% \((n = 71)\) and 87.5% \((n = 70)\) respectively, were the two most frequently cited types of information participants used followed by active minutes, 62.5% \((n = 50)\) and calories burned, 63.7% \((n = 51)\). Several participants, 21.3% \((n = 17)\), reported using “other” types of information including “time,” “standing time,” and “Sleep quality.” When asked what they considered to be the most important information they use from their trackers, many \((n = 29, 36.3\%)\) reported “# Steps” as most important followed by “Calories burned” \((n = 15, \ldots)\).
18.8%). Given the “other” option, a few participants wrote in their most important information as “hours of sleep,” “heart rate,” and “silent alarms.”

**Research Question 3: WFTs Impact on Self-Efficacy for Physical Activity**

Table 4 presents participants’ confidence levels for increasing their physical activity levels with the use of a WFT.

Insert Table 4 about here

Of participants that reported using a WFT ($n = 80$) a majority rated their level of confidence to increase physical activity as either “moderately confident” or “extremely confident,” 61.3% ($n = 49$) and 23.8% ($n = 19$) respectively.

Hypothesis 1 (H$_1$) was that participants reporting longer use of a WFT would report higher levels of confidence (self-efficacy) for increasing physical activity. The contingency coefficient was non-significant and did not support this hypothesis. Table 5 presents percentages for categories of confidence by physical activity.

Insert Table 5 about here

Inspection of data in Table 5 suggested that irrespective of length of time using a WFT participants remained moderately confident that wearing this device would increase levels of physical activity.

Hypothesis 2 (H$_2$) was that participants who used more types of information from WFTs would report higher levels of confidence (self-efficacy) for engaging in physical activity. In order to run a regression model, a new variable was created from participants’ responses to types of information (WFT question 7) by counting how many different types of information each
participant used from their WFTs and the new variable was coded as low (1 – 4 types of information) and high (5 – 6 types of information). Regardless of how many different types of information participants used from their WFT, there was no significant impact on confidence to be physically active.

Five logistic regression analyses were used to examine the impact of the type of information used from wearable fitness trackers on confidence for engaging in physical activity. The dependent variable (confidence to engage in physical activity) was recoded as low (not confident / slightly confident) and high (moderately confident / extremely confident.) The five independent variables representing types of information from WFT were: number of steps, distance/miles, active minutes, calories burned, and number of stairs climbed (each variable was coded as “yes” or “no”). Results from the five analyses were not significant.

**Research Question 4: Impact of WFTs on Motivation for Physical Activity**

Table 6 presents information about participants’ level of motivation to engage in physical activity since beginning to a WFT.

Insert Table 6 about here

As shown in Table 6, a majority of participants reporting use of a WFT were “quite a bit” or “very much” motivated, 31.3% (n = 25) and 37.5% (n = 30) respectively. An additional 20% (n = 16) were at least “somewhat” motivated to increase physical activity.

Hypothesis 1 (H1) stated students who reported that the use of their WFT increased their level of physical activity would report higher levels of motivation to engage in physical activity. In order to conduct the logistic regression variables were recoded. Perceived increase in the level of physical activity was recoded into “low” (not sure/not at all/a little bit) and “high”
(somewhat/quite a bit/very much) and motivation was recoded as being low (not sure/not at all/a little bit) and high (somewhat/quite a bit/very much). Results were significant, $X^2 (1, 79) = 18.94, p < .001$. Participants who perceived the WFT to highly increase their physical activity were likely to report higher levels of motivation for physical activity ($B = 3.466, SE = .895$, Wald = 14.99, $Exp(B) = 32$). Specifically, participants who perceived their WFTs to highly increase their physical activity levels were 32 times more likely to report a high motivation level for physical activity.

Hypothesis 2 ($H_2$) stated students reporting that the use of their WFT would increase their daily number of steps ($N_{steps}$) would report higher levels of motivation to engage in physical activity. In order to conduct two logistic regression analyses, the dependent variable (motivation) was recoded into “low” (not sure/not at all/a little bit) and “high” (somewhat/quite a bit/very much). Perceived number of steps taken every day and the self-reported number of steps revealed from tracker data were not significantly correlated with one another. Thus, two separate analyses were conducted. Number of steps ($N_{steps}$) was recoded as low (not sure/not at all/a little bit) and high (somewhat/quite a bit/very much.) The logistic regression for $N_{steps}$ was significant, $X^2 (1, 79) = 11.264, p < .001$. Participants who perceived their WFT as highly increasing their daily $N_{steps}$ were likely to report higher levels of motivation ($B = 2.607, SE = .792$, Wald = 10.829, $Exp(B) = 13.556$). Those who reported a high increase in their daily $N_{steps}$ were 13 times more likely to be motivated. How many steps gotten on a regular basis using tracker data was recoded into low (I don’t know/less than 5,000 steps a day/5,000-7,499 steps) and high levels (7,500 to 9,999 steps /10,000-12,499 steps/12,500 or more steps). The second logistic regression for this type of tracker data was not significant.
Research Question 5: Relationship between Demographic Factors and Use of Wearable Fitness Trackers

Demographic factors were sex, BMI, and race. One logistic regression model was conducted in order to examine the impact of the aforementioned demographic factors. Sex (male, female), BMI (recoded to overweight [BMI of obese and overweight categories] and not overweight [BMI of normal weight and underweight categories]) and race (recoded to white and not white) were examined as independent variables. The dependent variable, use of a WFT was recoded into “yes” (yes or used to wear) and “no” (never wore) a tracker. The chi-square statistic for this model was significant, \( \chi^2 (3, 351) = 11.34, p = .01 \). Table 7 presents the results for the three variables in the equation (gender, BMI, and race).

Insert Table 7 about here

As shown in Table 7, BMI and race were not significant predictors. However, gender was significant, with females being about 2.3 times more likely to use WFTs than males.

Research Question 6: Reasons for Non-Use of Wearable Fitness Trackers

Table 8 presents information for reasons for non-use of WFTs.

Insert Table 8 about here

Nearly two thirds of participants \( (n = 236, 66.3\%) \) did not use a WFT. The two most common reasons for non-use were “not interested” and “too expensive,” 51.8% \( (n = 129) \) and 42.2% \( (n = 105) \) respectively. Additionally, 33.7% \( (n = 84) \) felt that they already knew how active they were and did not need a WFT for this purpose. Nineteen percent \( (n = 48) \) wrote in additional reasons for non-use which included “never got around to it,” “don’t know enough about them,” “not
allowed to wear them at work,” and “use a free app on my phone.” One participant also shared, “I don’t like having to overthink workouts and I like to be present and I think fitness trackers are a distraction.”

**Research Question 7: Length of use of WFT and Reasons for Discontinuation of Use**

Table 9 shows the length of time for use of a WFT before discontinuation of use.

Insert Table 9 about here

One quarter of participants ($n = 10$) reported use of their WFT for one year or longer before discontinuation. More commonly, participants reported use of a WFT for just “one to three months” ($n = 13, 32.5\%$) prior to discontinuation of use.

Table 10 shows participants’ reasons for discontinuing use of their WFT.

Insert Table 10 about here

The two most commonly cited reasons for discontinuation of use included “lost interest” and “could never remember to charge it,” 50% ($n = 20$) and 45% ($n = 18$) respectively. Other reasons for discontinuation included “it would only work sometimes,” ($n = 1$), issues related to battery life ($n = 4$), “wasn’t compatible with my phone.” ($n = 1$), and “was diagnosed with anorexia” ($n = 1$).

Hypothesis 1 ($H_1$) stated that students reporting more reasons for discontinuation of use of their WFT would report shorter time using WFT. To run a logistic regression a new variable was created from participants reported reasons for discontinuation of use (number of reasons for discontinuation) and coded as low ($0 – 2$) and high ($3 – 4$). Length of time of use of WFT before discontinuation was recoded into $< 1\text{ year}$ and $\geq 1\text{ year}$. The logistic regression analysis for number
of reasons for discontinuation of use and length of use prior to discontinuation was not significant.

**Discussion**

This study adds to the knowledge base related to the use of WFTs among college students by including information pertaining to WFTs impact on levels of confidence and motivation to engage in physical activity and by including information regarding reasons for non-use and discontinuation of use of WFTs. This is pertinent given that both the National College Health Association (2016) and Reiner et al. (2013) report that college students are not getting enough physical activity (Reiner et al., 2013). However, results revealed only 80 students had WFTs, which was disappointing given the potential of these devices to increase physical activity levels (Patel et al., 2015; Piwek et al., 2016). The next sections of this discussion provide information for the research questions guiding this study.

**Research Question 1: Use of Wearable Fitness Trackers (WFTs) by College Students**

The results of this current study indicated that 22.5% ($n = 80$) of total participants ($N = 356$) reported using a WFT to track their physical activity. This is consistent with findings from a study conducted by Fox and Duggan (2013) which indicated that 21% of adults who track their weight, diet and exercise do so using some form of technology such as a mobile health app, a smartphone or a wearable fitness tracker.

In addition to demographic information related to use, this study added to the existing knowledge base by including what brands of WFTs participants most commonly reported using (Fitbit and Apple Watch.) Most participants that used a WFT wore their tracker “every day without fail” ($n = 35$, 43.8%) or “most days” ($n = 23$, 28.7%) and half ($n = 40$) wore their trackers “all day and while sleeping.” Having a better understanding of how college students use
their trackers may help to inform health educators when developing programs designed to encourage increased physical activity among college students.

**Research Question 2: Why Students Use Wearable Fitness Trackers**

In the review of literature, there were no studies that considered why college students use WFTs. The single study that was done specifically with college students (Ball et al., 2015) focused on only one type of information (Fitpoints) from one type of tracker (Nike Fuel Band). Additionally, participants in that study were trained on how to use the tracker and told to only focus on the fuel points feedback feature. These instructions could have influenced the students’ perceptions and influenced the information they shared.

This current study contributed to the literature by building a better understanding of what behaviors college students tracked and what information college students relied on from their trackers. Results of this study indicated that participants often rely on their tracker for many reasons including increasing their physical activity, improving their current workouts, losing weight, and improving amount and quality of sleep. Information they used included: number of daily steps, distance/miles, active minutes, and calories burned were most frequently cited with number of daily steps and calories burned being considered “most important.”

**Research Question 3: WFTs Impact on Self-Efficacy for Physical Activity**

Ball et al. (2015) reported an increased level of awareness of physical activity with the use of a WFT. However, they did not assess participants’ confidence for engaging in exercise. I hypothesized that self-confidence to increase physical activity might increase the longer one used a WFT. Results did not support this hypothesis. However, regardless of length of time for use of a WFT, participants often reported being moderately confident that wearing a tracker would
increase their levels of physical activity. Hence, it may be that those who want to improve their activity levels and have confidence in technology buy WFTs.

**Research Question 4: Impact of WFTs on Motivation for Physical Activity**

Ball et al. (2015) did not assess participants’ level of motivation for increasing physical activity. This study hypothesized that participants who reported increased physical activity with the use of WFTs would report higher levels of motivation and that participants reporting attaining higher levels of daily steps (both in perception of increase and in actual data reported by their trackers) would report an increase in motivation to be more physically active. Logistic regression analyses supported both hypotheses with those who reported engaging in more physical activity being 32 times more likely to report high levels of motivation and those reporting a perceived increase in number of steps being 13 times more likely to report high levels of motivation. This seems to fall in line with the concept of success precipitates success. Additionally, how many steps gotten on a regular basis using tracker data was recoded into low (I don’t know/less than 5,000 steps a day/5,000-7,499 steps) and high levels (7,500 to 9,999 steps/10,000-12,499 steps/12,500 or more steps). The second logistic regression for this type of tracker data was not significant. Further study of the activity-motivation link is needed.

**Research Question 5: Relationship between Demographic Factors and Use of Wearable Fitness Trackers**

This study showed that women were 2.3 times more likely to track with WFTs than were men. Similarly, findings from a National survey of adults (Fox and Duggan, 2013) indicated that 62% of women tracked weight, diet or exercise and 58% of men tracked this information. Additionally, Fox and Duggan’s findings indicated that those with chronic conditions were more likely to track health-related information such as exercise. However, the findings of this study
did not indicate a significant relationship between BMI and use of WFTs. Results may have differed if more than one chronic condition, in this case weight status was examined. If all types of chronic conditions were assessed results may have been similar to Fox and Duggan’s findings. Lastly, Fox and Duggan found that 62% of White, Non-Hispanic, 59% of Black, Non-Hispanic, and 51% of Hispanic participants tracked weight, diet or exercise. Findings for this study were insignificant for race and use of WFTs. More research on the relationships between demographic factors and WFTs is needed in future studies.

**Research Question 6: Reasons for Non-Use of Wearable Fitness Trackers**

Of the 356 participants, a majority \( n = 236, 66.3\% \) reported having never worn a WFT. There have been no studies that considered why college students choose not to use WFTs. This study investigated reasons for non-use of WFT and found that the two primary reasons for not using a tracker included “not interested” \( n = 129, 51.8\% \) and “too expensive” \( n = 105, 42.2\% \). Some participants \( n = 48, 19\% \) wrote in “other” reasons for non-use including not being allowed to wear a tracker in their workplace, not feeling the need since their smartphone had a free tracker and two indicated that they feared that use of a WFT might cause them to be to overthink their workouts. These reported reasons for non-use may be able to help health educators better understand potential barriers to incorporating WFTs into programs developed to increase physical activity.

**Research Question 7: Length of use of WFT and Reasons for Discontinuation of Use**

This author’s literature search did not reveal studies that consider why college students discontinue use of WFTs. The results of this current study indicate 25% of participants who reported discontinuing use of their WFT did so after one year or more. It was more common for discontinuation of use to occur between one and three months of use. Common reasons reported
for discontinuation of use include losing interest \((n = 20, 50\%)\) and forgetting to charge the tracker \((n = 18, 45\%)\). It may be that college students do not maintain interest in trackers, because they regularly engage in physical activity and have a good sense of their daily activity. However, further research, with young adults will be needed to understand why young adults, both in college and who are working, discontinue use of WFTs.

**Limitations**

This study had several limitations. First, in the development of the survey, participants who selected “used to” use a WFT were instructed to go directly to the demographic and non-use questions. This did not allow for them to share how they used their WFT prior to discontinuing use and so valuable information was lost. Additionally, the fact that the sample was in college did not allow for generalization to other young adults not in college. This research relied on participants to accurately recall and report their current tracking behaviors, and self-report might not be accurate or may be inflated due to a social desirability bias. Self-report for discontinuation was retrospective and thus might be inaccurate. Moreover, this study was cross-sectional and does not assess use over time.

**Conclusions**

Physical inactivity on college campuses remains a problem as does overweight and obesity (National College Health Association, 2016). Wearable fitness trackers, most popular among those 18 – 29 years of age (Fox & Duggan, 2013), are gaining in popularity with sales projected to grow to approximately 50 billion trackers by 2018. To date, little is known regarding the use of WFTs as potential tools to help college students to increase their physical activity. This current study contributed key information regarding college students’ use and perceptions of the effectiveness of WFTs in increasing their self-confidence and their level of motivation to
increase physical activity. As well, this study contributed information regarding reasons for non-use and discontinuation of use of WFTs. Further research is necessary with larger populations over a longer period of time since health behaviors must be maintained.
References


### Table 1. Demographic Characteristics of Participants \((N = 356)\)

<table>
<thead>
<tr>
<th>Item</th>
<th>(n)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender(^a)</strong></td>
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<td></td>
</tr>
<tr>
<td>Male</td>
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</tr>
<tr>
<td>Female</td>
<td>245</td>
<td>69</td>
</tr>
<tr>
<td><strong>Race/Ethnicity(^b)</strong></td>
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<td></td>
</tr>
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<td>White</td>
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</tr>
<tr>
<td>Hispanic/Latino/Spanish Origin</td>
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<td>2.5</td>
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<tr>
<td>Black/African American</td>
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<td>11.3</td>
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<tr>
<td>American Indian/Alaska Native</td>
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<td>.3</td>
</tr>
<tr>
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<td>1.1</td>
</tr>
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<td>Native Hawaiian or Pacific Islander</td>
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<td>.6</td>
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<tr>
<td><strong>Campus</strong></td>
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<tr>
<td>Main</td>
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<tr>
<td>Regional 1</td>
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</tr>
<tr>
<td>Regional 2</td>
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<td><strong>Major</strong></td>
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<td>Business Related</td>
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<td>Science Technology Engineering Math (STEM)</td>
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<td>10.5</td>
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<td>Education</td>
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<tr>
<td>Criminal Justice</td>
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<td>5.1</td>
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<tr>
<td>Other</td>
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<td>14.1</td>
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<tr>
<td><strong>Calculated Body Mass Index(^c)</strong></td>
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<tr>
<td>Underweight (BMI &lt; 18.5)</td>
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<td>4.8</td>
</tr>
<tr>
<td>Normal Weight (BMI 18.5 – 24.9)</td>
<td>195</td>
<td>54.9</td>
</tr>
<tr>
<td>Overweight (BMI 25.0 – 29.9)</td>
<td>77</td>
<td>21.7</td>
</tr>
<tr>
<td>Obese (BMI 30.0 and above)</td>
<td>47</td>
<td>13.3</td>
</tr>
</tbody>
</table>

Notes.

\(^a\) One participant did not provide a response for gender

\(^b\) Two participants did not provide a response for race and 14 chose two race/ethnicity categories

\(^c\) 1 participant did not provide response and 19 provided incomplete information about weight
Table 2. College Students’ Use of Wearable Fitness Trackers

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Use of a Wearable Fitness Tracker (N=356)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>236</td>
<td>66.3</td>
</tr>
<tr>
<td>Used To</td>
<td>40</td>
<td>11.2</td>
</tr>
<tr>
<td>Yes</td>
<td>80</td>
<td>22.5</td>
</tr>
<tr>
<td><strong>Length of Time Using Wearable Fitness Tracker (N=80)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 Month</td>
<td>5</td>
<td>6.3</td>
</tr>
<tr>
<td>1 – 3 Months</td>
<td>14</td>
<td>17.5</td>
</tr>
<tr>
<td>3 – 5 Months</td>
<td>5</td>
<td>6.3</td>
</tr>
<tr>
<td>5 – 7 Months</td>
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<td>12.5</td>
</tr>
<tr>
<td>7 – 9 Months</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>9 – 11 Months</td>
<td>7</td>
<td>8.8</td>
</tr>
<tr>
<td>1 Year +</td>
<td>31</td>
<td>38.8</td>
</tr>
<tr>
<td><strong>Brand of Wearable Fitness Tracker Used</strong></td>
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<td></td>
</tr>
<tr>
<td>Fitbit</td>
<td>48</td>
<td>60</td>
</tr>
<tr>
<td>Garmin</td>
<td>3</td>
<td>3.8</td>
</tr>
<tr>
<td>Apple Watch</td>
<td>21</td>
<td>26.3</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td><strong>How often Wearable Fitness Tracker Worn</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Every day, without fail</td>
<td>35</td>
<td>43.8</td>
</tr>
<tr>
<td>Most days</td>
<td>23</td>
<td>28.7</td>
</tr>
<tr>
<td>A few days a week</td>
<td>6</td>
<td>7.5</td>
</tr>
<tr>
<td>A few times a month</td>
<td>3</td>
<td>3.8</td>
</tr>
<tr>
<td>When I remember</td>
<td>13</td>
<td>16.3</td>
</tr>
<tr>
<td><strong>When Wearable Fitness Tracker Worn</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Only during the day</td>
<td>35</td>
<td>43.8</td>
</tr>
<tr>
<td>All day and while sleeping</td>
<td>40</td>
<td>50</td>
</tr>
<tr>
<td>Only when working out</td>
<td>5</td>
<td>6.3</td>
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Table 3. Information College Students’ Use from Wearable Fitness Trackers

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>Reasons* for Using Wearable Fitness Tracker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lose weight</td>
<td>28</td>
<td>35</td>
</tr>
<tr>
<td>Increase physical activity</td>
<td>57</td>
<td>71</td>
</tr>
<tr>
<td>Improve workouts</td>
<td>23</td>
<td>28.7</td>
</tr>
<tr>
<td>Monitor sleep</td>
<td>28</td>
<td>35</td>
</tr>
<tr>
<td>Monitor heart rate</td>
<td>19</td>
<td>23.8</td>
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<tr>
<td>Monitor health conditions</td>
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<td>13.8</td>
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<tr>
<td>Other</td>
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<td>18.8</td>
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<tr>
<td>Information* Used from Wearable Fitness Tracker</td>
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<tr>
<td># Steps</td>
<td>71</td>
<td>88.8</td>
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<tr>
<td>Distance/Miles</td>
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<td>Active Minutes</td>
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<tr>
<td>Calories Burned</td>
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<td>63.7</td>
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<tr>
<td># Stairs Climbed</td>
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<td>36.3</td>
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<tr>
<td>Other</td>
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<tr>
<td>Most Important Information from Wearable Fitness Tracker</td>
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<tr>
<td># Steps</td>
<td>29</td>
<td>36.3</td>
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<tr>
<td>Distance/Miles</td>
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<td>13.8</td>
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<tr>
<td>Active Minutes</td>
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<td>12.5</td>
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<tr>
<td>Calories Burned</td>
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<td>18.8</td>
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<tr>
<td>Other</td>
<td>15</td>
<td>18.8</td>
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</tbody>
</table>

*Participants were able to choose more than one item
Table 4. WFT Users’ Confidence Level to Increase Physical Activity ($n=80$)

<table>
<thead>
<tr>
<th>Item</th>
<th>$n$</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not Confident</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>Slightly Confident</td>
<td>10</td>
<td>12.5</td>
</tr>
<tr>
<td>Moderately Confident</td>
<td>49</td>
<td>61.3</td>
</tr>
<tr>
<td>Extremely Confident</td>
<td>19</td>
<td>23.8</td>
</tr>
</tbody>
</table>

WFT: Wearable Fitness Tracker
<table>
<thead>
<tr>
<th>Length of use</th>
<th>Confidence Level to Increase Physical Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not Confident</td>
</tr>
<tr>
<td>&lt; 1 Month</td>
<td>0</td>
</tr>
<tr>
<td>% within how long using a WFT</td>
<td>20%</td>
</tr>
<tr>
<td>1 – 3 Months</td>
<td>0</td>
</tr>
<tr>
<td>% within how long using a WFT</td>
<td>14.3%</td>
</tr>
<tr>
<td>3 – 5 Months</td>
<td>1</td>
</tr>
<tr>
<td>% within how long using a WFT</td>
<td>20%</td>
</tr>
<tr>
<td>5 – 7 Months</td>
<td>0</td>
</tr>
<tr>
<td>% within how long using a WFT</td>
<td>10%</td>
</tr>
<tr>
<td>7 – 9 Months</td>
<td>0</td>
</tr>
<tr>
<td>% within how long using a WFT</td>
<td>87.5%</td>
</tr>
<tr>
<td>9 – 11 Months</td>
<td>1</td>
</tr>
<tr>
<td>% within how long using a WFT</td>
<td>14.3%</td>
</tr>
<tr>
<td>1 Year or longer</td>
<td>0</td>
</tr>
<tr>
<td>% within how long using a WFT</td>
<td>16.1%</td>
</tr>
</tbody>
</table>

Note. WFT: Wearable Fitness Tracker
Table 6. WFT Users’ Motivation Level to Increase Physical Activity

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>2</td>
<td>2.5</td>
</tr>
<tr>
<td>A little bit</td>
<td>7</td>
<td>8.8</td>
</tr>
<tr>
<td>Somewhat</td>
<td>16</td>
<td>20.0</td>
</tr>
<tr>
<td>Quite a bit</td>
<td>25</td>
<td>31.3</td>
</tr>
<tr>
<td>Very much</td>
<td>30</td>
<td>37.5</td>
</tr>
</tbody>
</table>
Table 7. Relations among Demographic Factors and Use of Wearable Fitness Trackers

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>$SE$</th>
<th>Wald Statistic</th>
<th>$df$</th>
<th>$p$</th>
<th>$Exp(B)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>.815</td>
<td>.271</td>
<td>9.068</td>
<td>1</td>
<td>.003</td>
<td>2.259</td>
</tr>
<tr>
<td>Race/Ethnicity (White/Not White)</td>
<td>.355</td>
<td>.321</td>
<td>1.220</td>
<td>1</td>
<td>.269</td>
<td>1.425</td>
</tr>
<tr>
<td>Body Mass Index</td>
<td>.105</td>
<td>.244</td>
<td>.184</td>
<td>1</td>
<td>.668</td>
<td>1.111</td>
</tr>
</tbody>
</table>

(Overweight/Obese or Not)
Table 8. Reasons* for Non-Use of Wearable Fitness Tracker (N=249)

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Too expensive</td>
<td>105</td>
<td>42.2</td>
</tr>
<tr>
<td>Don’t like how they look</td>
<td>24</td>
<td>9.6</td>
</tr>
<tr>
<td>Don’t like how others having my information</td>
<td>9</td>
<td>3.6</td>
</tr>
<tr>
<td>Don’t need to, I know how active I am</td>
<td>84</td>
<td>33.7</td>
</tr>
<tr>
<td>Not interested</td>
<td>129</td>
<td>51.8</td>
</tr>
<tr>
<td>Don’t like how they fit</td>
<td>11</td>
<td>4.4</td>
</tr>
<tr>
<td>Don’t trust their accuracy</td>
<td>30</td>
<td>12</td>
</tr>
<tr>
<td>Other</td>
<td>48</td>
<td>19</td>
</tr>
</tbody>
</table>

Note. Participants were able to choose more than one
Table 9. Length of use of WFT prior to Discontinuation

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Length of Time Using Wearable Fitness Tracker (N=80)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 Month</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>1 – 3 Months</td>
<td>13</td>
<td>32.5</td>
</tr>
<tr>
<td>3 – 5 Months</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>5 – 7 Months</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>7 – 9 Months</td>
<td>5</td>
<td>12.5</td>
</tr>
<tr>
<td>9 – 11 Months</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>1 Year +</td>
<td>10</td>
<td>25</td>
</tr>
</tbody>
</table>
Table 10. Reasons* for Discontinuation of use of Wearable Fitness Tracker

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost interest</td>
<td>20</td>
<td>50</td>
</tr>
<tr>
<td>Could never remember to charge it</td>
<td>18</td>
<td>45</td>
</tr>
<tr>
<td>It took too much time</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>The tracker was not accurate</td>
<td>7</td>
<td>17.5</td>
</tr>
<tr>
<td>Too many technical problems</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Didn’t like how they fit</td>
<td>1</td>
<td>2.5</td>
</tr>
<tr>
<td>Didn’t like how they looked</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>It broke</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>I lost it</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>15</td>
</tr>
</tbody>
</table>

Note. Participants were able to choose more than one item
Study Two: College Students’ Use and Perceptions of Mobile Health Apps to Enhance the Health Benefits of Wearable Fitness Trackers
Introduction

Mobile health apps (mHealth apps) have the potential to address areas of concern related to the health of college students. Specifically, according to the National College Health Association (2016), nearly 40% of college students are either overweight or obese. Importantly, just over half of male college students and 43.1% of female college students are not meeting the Centers for Disease Control (2015) physical activity recommendations. Given how tech savvy college students are (Gowin, Cheney, Gwin, & Franklin-Wann, 2015; Melton, Bland, Harris, Kelly, & Chandler, 2015) their use of mHealth apps in helping them to manage their health is an important area for researchers and health educators to investigate.

MHealth apps are health-related software applications (apps), designed specifically for smart phones and tablets, which are capable of connecting to the Internet and providing feedback to individuals regarding their tracked health and wellness behaviors in order to help them manage their personal health (Handel, 2011). Between the Google Play Store© and the Apple App Store© there are approximately 30,000 mHealth apps currently available (Bhuyan et al., 2016). The use of mHealth apps continues to rise rapidly (Bhuyan et al., 2016; Handel, 2011; Krebs & Duncan, 2015). The most commonly downloaded mHealth apps address nutrition, diet, and physical activity (Krebs & Duncan, 2015). Additionally, there are many mHealth apps that help individuals to manage chronic diseases such as diabetes and heart disease (Bhuyan et al., 2016). For instance, there are apps that help with medication adherence and with managing blood glucose. There are also apps that are preventive in nature such as stress management and smoking cessation (Bhuyan et al., 2016). The use of mHealth apps is on the rise (Bhuyan et al., 2016; Chang, Kaasinen, & Kaipainen, 2012; Gowin, Cheney, Gwin, & Franklin Wann, 2015;
Handel, 2011). In fact, it has been estimated that by 2018 nearly 1.7 billion smartphone and tablet users will download one or more mHealth apps (Bhuyan et al., 2016).

**Theories related to mHealth Apps and Behavior Change**

The constructs of Social Cognitive Theory (SCT) (Voth et al., 2016) are well suited to the potential function of mHealth apps in helping users to change their behaviors. One of those constructs, that is especially key in predicting exercise adherence, is self-efficacy or confidence in one’s ability to adopt said behavior. Additionally, mHealth apps allow for users to establish personalized goals and in doing so they set behavioral intentions. According to Bandura (1977) setting goals is one way of realizing behavioral intentions by establishing self-incentives and guidelines for behaviors, thereby establishing motivation for behavior change.

**Review of the Literature**

In a review of the literature there were two recent studies that directly investigated the adoption of mHealth apps amongst adults in the United States (Bhuyan et al., 2016; Krebs & Duncan, 2015). Krebs and Duncan (2015) conducted online survey research with adult (18 and older) mobile cellular telephone users (N=1,604) throughout the US to investigate reasons for using, perceptions of, and reasons for discontinuing the use of mHealth apps. The authors utilized a survey management company to recruit using quota sampling methods to ensure the demographic makeup of participants was similar to that of the US population from which they were drawn. Therefore, of the 1,604 participants nearly 50% were female, 50% had graduated high school or had less education, and 60% earned less than $50,000 per year. Average age of participants was approximately 40 years, with ages ranging between 18 and 81 years. Additionally, body mass index (BMI) for participants indicated that 62% were overweight or obese. Results showed that nearly 60% of participants had downloaded mHealth apps and 42%
of those participants downloaded more than five mHealth apps. The three most common reasons for downloading the apps were to track physical activity (52.8%), track dietary consumption (47.6%), to lose weight (46.8%), and to learn new exercises (34%).

In addition to types of apps, Krebs and Duncan (2015) also investigated participants’ use and perceptions of mHealth apps. They found that 81% of participants reported the belief that their mHealth apps were “moderately” or “highly” accurate in recording data. Interestingly, 41% of participants would “never pay anything” for a mHealth app, 20.2% would pay up to $1.99 and 22.7% would pay up to $5.99. Krebs and Duncan (2015) also reported on reasons that were given by participants for not using mHealth apps which included a lack of interest (27%), no perceived need (11%), lack of trust in the apps collecting their data (15%), and worry about using too much of their data plan (13%). Finally, the most common reasons for discontinuation of use included: data entry “took too much time” (44%), “loss of interest” (40%), “hidden costs” (33%), and apps were considered “confusing” (33%). Results indicated an increased likelihood of downloading mHealth apps by younger participants, those being Latino/Hispanic, those with higher education and or income levels, and those who were obese. There was no significant correlation between mHealth app use and gender of the participants or the presence of other chronic conditions (besides obesity).

Bhuyan et al. (2016) used data from the fourth edition of the National Cancer Institute’s Health Information National Trends Survey (HINTS4) (N= 3,677) to investigate ownership and use of mHealth apps among US adults. HINTS4 is a cross-sectional survey (mailed questionnaire) that is administered in alternating years which includes participants that are US adults (18 years and older), civilian and non-institutionalized. For their analysis of the characteristics of mHealth app users, Bhuyan and colleagues (2016) only included eight hundred
and nineteen HINTS4 respondents who had a mHealth app on their smartphone or tablet. About 60% of their participants had used their mHealth app for helping them to achieve their health behavior goals. The authors assessed the relationship between various demographics and likelihood of using mHealth apps. Their findings indicated that persons using mHealth apps tended to be in good physical health, had health insurance coverage, believed they could take good care of themselves, and had higher levels of education. Those who used mHealth apps were also more likely to be younger participants (35 years of age or younger). Finally, with regards to the use of mHealth apps to achieve health behavior goals, older respondents were less likely to use mHealth apps for health behavior goals and that those who were obese or severely obese were more likely to use mHealth apps to achieve their health behavior goals compared to those that were underweight (Bhuyan et al., 2016).

**Research with College Students.** A review of the literature identified just three relevant studies that investigated college students’ use of mHealth apps (Cho, Quinlan, Park, & Noh, 2014; Gowin et al., 2015a; Haithcox-Dennis, Brinkley, Richman, DeWeese, & Byrd, 2012). Haithcox-Dennis et al. (2012) conducted a web-based survey to investigate attitudes and usage of mHealth apps in undergraduate students enrolled in a mandatory personal health course at a large southeastern university (N=1,487). Demographically, a majority of survey respondents were White, Non-Hispanics (75%), female (62%) and freshmen (64%). If participants reported not owning a smartphone or tablet they were excluded from the study. Haithcox-Dennis et al. (2012) recruited a panel of health education and technology experts to review the survey for their study. The survey consisted of questions related to students’ purchasing behaviors of mHealth apps (e.g. amount willing to pay); frequency and duration of daily use; how they determine credibility
of the apps and types of apps that they were currently using. The two open ended questions asked what types of mHealth apps they (and other college students) would be interested in and why.

Results indicated that 54% of respondents used only a smartphone or a smart device (tablet, iPad, iPod) and 34% reported using both a smartphone and a smart device (Haithcox-Dennis et al., 2012). Just over a quarter (26%) of respondents reported downloading a mobile app in the last 30 days, of which 36% reported that the most recent mobile app downloaded was a game. This is much lower than mHealth app usage in US adults (36%) as assessed by Bhuyan and colleagues (2016). Participants who downloaded mHealth apps \( n=255 \) was largely female (67%), freshman (63%), and white non-Hispanic (63%). Most (78%) participants downloaded free mHealth apps. Nearly 90% of respondents used mHealth apps related to diet, fitness and weight loss with the main health goal being to increase physical activity or to lose weight. In consideration of what respondents reported as being the “most important factor” in deciding to purchase a mHealth app, 44% reported “price” as the most important factor, while others valued a positive review (26%), and achieving a specific health goal (18%). Interestingly, when asked about how they determined the credibility of a mHealth app, respondents looked to reviews, ratings, price and recommendations from friends/family. The two qualitative (open-ended) questions of the survey asked respondents if they could design their own mobile application for college students what topic they would choose. The number one topic of choice was “diet and physical activity” (50%).

There were several shortcomings for the aforementioned study. For instance, Haithcox-Dennis et al. (2012) did not investigate the reasons for not using a mHealth app and given that only 17% of respondents reported using a mHealth app and yet 50% of respondents stated that they would design a mHealth app related to fitness and weight loss, it is an important area for
research to investigate the reasons for non-use of mHealth apps and to assess the combined use of mHealth apps with wearable fitness trackers. This current study will investigate both of these areas.

Cho et al. (2014) utilized SurveyMonkey to administer an online survey to investigate college students’ (N=422) reasons for adopting mHealth apps on smartphone devices. Cho et al. assessed use of mHealth apps, beliefs about apps, health consciousness, eHealth literacy, and perceptions of how easy mHealth apps were to use. A majority of participants were female (59.6%) with an average age of 22 years. Distribution of participants was even across freshmen (24.2%), sophomore (22%), junior (27.5%) and senior (26.3%) level classes. Findings indicated that the more health conscious a respondent was, the less likely it was that they perceived mHealth apps as being useful and so their intention to use mHealth apps was lower. Similarly, this study found that those with high levels of e-Health literacy were less likely to perceive mHealth apps as useful. Cho et al. did not consider reasons for not using mHealth apps and they did not assess the use of mHealth apps in conjunction with wearable fitness trackers. The current study contributes to the literature by investigating these factors amongst college students.

Gowin et al. (2015) conducted qualitative research through semi-structured, one-on-one interviews (N = 27) of college students at a large southwestern US university. A majority of participants (n = 25, 92%) were white, just over three quarters of participants (78%) were female and most reported using more than one health and fitness app. Participants were asked to focus their responses on the app that they used the most. The most commonly reported mHealth apps in this study were MyFitnessPal (Focuses on both physical activity and nutrition), LoseIt! (Focuses on weight loss), and Runkeeper (Focuses on physical activity). Thirty-seven percent of
participants used their mHealth apps for over a year. Nearly half of participants found the app through the recommendation of a family member and used it along with the family member.

Over half of participants indicated having a goal to increase physical activity/exercise and nearly half of participants indicated that they had a goal related to nutrition/healthy eating (Gowin et al., 2015). Additionally, these participants reported that having an app was helping them to achieve the goal by increasing their awareness of the target behavior and/or by providing encouragement via visual or auditory cues. Nearly half of participants referred to the mHealth app as if it were a person using terms like “little motivator” and “coach” (p.227). Gowin et al.’s study provided good preliminary data, and the current study will provide additional information for the literature by conducting a detailed investigation of why and how college students use mHealth apps using a larger sample, while also providing novel information about how college students use mHealth apps in conjunction with wearable fitness trackers.

**Theoretical Orientation.** The component of Social Cognitive Theory (Bandura 1977, 2001) that is focused on in research questions for this study will be how motivation impacts use of WFTs and MHealth apps. Using a WFT alone provides the user with limited feedback such as number of steps or flights of stairs in a simple LCD display. Whereas, if the user was also using the related mHealth app, that knowledge feedback would include bright, graphic displays of progress for the day, week and month thereby giving them more information covering a greater span of time which may help them to better understand their behaviors thereby potentially getting them better results that may increase their *motivation*. Thus, for this study our aim will be to examine whether those who use mHealth apps will be more motivated to engage in PA.
**Study Aims**

The aims of this study were:

1. To assess college students’ use of mHealth apps to enhance the effectiveness of WFTs.
2. To assess college students’ perceptions of mHealth apps to enhance the effectiveness of WFTs.
3. To determine relationships among college students’ use of mHealth apps and their motivation for engaging in physical activity.
4. To examine the relations among demographic factors and use of mHealth apps.

**Research Questions and Hypotheses**

The following research questions and hypotheses were examined (Table 2):

1. To document key information about use of mobile health apps (mHealth apps) by college students (e.g., types of mHealth apps, features used, sharing data).
2. To understand the types of information used by college students from their mHealth apps.
3. To understand how use of mHealth apps impact motivation for physical activity.
   - **H1:** Students who reported using more features of their mHealth apps would report higher levels of motivation.
   - **H2:** Students who reported sharing their wearable fitness tracker data with more people through use of mHealth apps would report higher levels of motivation for engaging in physical activity.
   - **H3:** Students who reported using a higher number of mHealth apps would report higher levels of motivation for engaging in physical activity.
4. Examine the relationship among demographic factors and use of mHealth apps with WFT.
• **H1:** Females would be more likely to use mHealth apps with WFTs than males.

• **H2:** White, Non-Hispanic students would use mHealth apps with WFTs more frequently than other ethnic groups.

• **H3:** Students with higher BMI would be more likely to use mHealth apps with WFT than those with lower BMI.

5. To document reasons for Non-Use of mHealth apps with WFTs (e.g., not interested; takes up too much memory, etc.)

**Methods**

**Participants**

Participants in this study (the same participants described in Study 1) were college students attending a large urban public research university including its’ two regional campuses. To obtain a representative sample size with the lowest potential sampling error (margin of error 5%) a sample size calculator was used and indicated a minimum sample size of 381 participants (Raosoft, 2014). This study was approved by a university-based institutional review board (approval letter in Appendix A).

**Instrument**

A four-page survey (Appendix B) was developed by the researcher after informal discussions with adults using wearable fitness trackers and an extensive review of literature. Consultation with three experts in health education was also used in the review of survey items. The survey consisted of four sections assessing use and perceptions of: (1) Wearable Fitness Trackers, (2) Mobile Health Apps, (3) Demographic & Health Information, and (4) Non-Use Questions. The focus of this paper is to address the use of mHealth apps. The use of WFTs is
described in Study One of this document and therefore this section of the survey is not discussed in detail in this paper.

The Mobile Health Apps section contained a total of nine questions. This section started with an explanation about mobile health apps; “All wearable Fitness Trackers have related mobile health applications (apps) that can be downloaded onto a smartphone and can be used together with the wearable fitness tracker.” The first question assessed participants’ use of their tracker’s related mobile health app with provided answer options of “yes” and “no.” If participants answered “no” they were asked why not and provided with a series of options (choose all that apply) including an “other” write in option in case their reason was not listed. The second question assessed what features of the related mobile health app participants utilized (choose all that apply) with 9 common features provided as answer options and an “other” write in option. Question three assessed with whom participants shared their tracked fitness successes. Students selected answers from among 11 answer options including an option for “nobody” and an “other” write in option in case their person was not listed.

Prior to presenting the next set of six questions participants were provided with the following information: “All wearable fitness trackers have the ability to sync (connect) to mobile Health apps that are not related to the tracker.” Question four assessed what other mobile health apps participants synced their fitness trackers to with answer options including 5 common mobile health apps unrelated to fitness trackers, a “none” option was provided in case participants did not use unrelated mHealth apps and an “other” write in option was provided in case their mHealth app was not listed. Question five assessed how often participants used “any” mobile health app with their wearable fitness tracker, with eight answer options ranging from “less than once a day” to “several times a week”. Question six assessed participants’ perceptions
on whether using a mobile health app enhanced their WFT’s ability to increase their level of motivation to be more physically active with five answer options ranging from “not at all” to “very much” and one option for “not sure”. Questions seven through nine assessed participants’ perceptions as to whether or not their use of mHealth apps in conjunction with their WFT increased their level of physical activity (Question 7), their number of steps taken daily (Question 8) and improved their overall health (Question 9). Answer options for these questions were the same as for question six.

A section assessing demographic and health information included standard demographic questions to allow participants to record: gender, age and ethnicity (Questions 1 – 3). Items also addressed which campus the participants’ attended and the participants’ major. Another item assessed participants’ self-reported weight and height for determination of their Body Mass Index. Participants’ chronic health conditions also were recorded.

A section for discussion of non-use started with instructions to only answer questions if participants did not use a WFT. Question 1 assessed participants’ reason/s for not using a WFT with seven answer options based on the literature review (instructed to choose all that apply) and an “other” write in option. Prior to questions 2 and 3 instructions were “If you “used to” use a wearable fitness tracker but have stopped using it please answer the following questions…” Question 2 assessed how long participants used a wearable fitness tracker with space for them to write a number of years, months, weeks, days. Question 3 assessed participants’ reasons for discontinuing the use of a wearable fitness tracker with ten answer options (choose all that apply) and one “other” write in option.
Procedures

The procedures were the same as those for the first study in this document. To identify classrooms for recruiting participants an email was sent to faculty via the faculty listserv (Appendix C). The researcher attended the class at the specified time and location and briefly introduced the purpose of the survey (Appendix D). An Information Sheet to explain the study and provide contact information for the author and representatives of the Institutional Review Board was also administered with the survey (Appendix E). As described in study one, a test-retest reliability study was performed with 37 participants (same as those used in Study One) from the three campuses.

Data Analyses

Data from surveys was entered into the Statistical Package for Social Sciences (SPSS, version 23). Research questions 1, 2, and 5 were exploratory in nature and were analyzed using descriptive statistics. Research question 3 was examined using a linear regression analysis. Research question 4 was analyzed using a logistic regression analysis.

Test-retest reliability for answers to the survey questions was assessed using percent agreement (Araujo & Born, 1985; Berchtold, 2016). The initial survey was administered to 37 participants and the retest was administered two weeks later. Of the 37 participants, seven completed the mHealth app questions pertaining to this study. Twenty-one of the thirty mHealth app survey items showed satisfactory percent agreement (71% - 100%). The remaining nine survey items fell below the satisfactory percent agreement (17% - 57%). Four of the items falling below satisfactory percent agreement pertained to features of the mHealth app (43% - 57% agreement.) The remaining five items indicating a lower percent agreement were related to participants’ perceptions of their level of motivation (50% agreement), increase in physical
activity (33% agreement), increase in daily steps taken (17% agreement), and improved overall health (33% agreement.) This level of agreement may be attributable to a response shift where an individual’s self-evaluation has changed (Polit, 2014) over the testing period.

Results

Demographic Characteristics

A total of 356 undergraduate students (245 females, 110 males, 1 did not indicate gender) completed surveys. Demographic information is presented in Table 1.

A majority of participants \((n = 294, 83\%)\) were white with the next largest ethnicities being Black/African American \((n = 41, 11.6\%)\), Asian \((n = 17, 4.8\%)\), and Hispanic/Latino/Spanish \((n = 9, 2.5\%)\). Participant age ranged from 18 – 48 years with the average age being 21 years \((SD = 4.75)\). Body Mass Index (BMI) was calculated from participants’ self-reported height and weight and indicated that most \((n = 195, 55\%)\) were normal weight (see Table 1).

Research Question 1: Document Key Information about use of mHealth apps

A total of 80 participants had previously reported using a wearable fitness tracker and responded to the survey question regarding whether they used the tracker’s related mHealth app. A majority of participants \((n = 67, 84\%)\) reported using their WFTs mHealth app.

As can be seen in Table 2, approximately two-thirds \((n = 45)\) of participants reported sharing their tracked information through the use of a mHealth app with their family and friends. Just
over one-third \((n = 25)\) reported not sharing their data with anybody. Aside from the use of the WFT’s related mHealth app, participants were asked which, if any, additional mHealth apps they used in conjunction with their trackers and a majority \((n = 48, 68.8\%)\) reported none. Frequency of use of their mHealth app was widely dispersed with the most frequently cited use being “once a day” \((n = 18, 26.1 \%)\).

**Research Question 2: Understand the Types of Information Used from their mHealth Apps**

When asked which features participants used from their mHealth app a majority of participants reported using “data updates throughout the day to assess daily goals” \((n = 47, 66.2\%)\) and “weekly data summaries” \((n = 42, 59.2 \%)\). Table 3 summarizes the various types of information used by participants from their mHealth apps.

*Insert Table 3 about here*

**Research Question 3: Understand How Use of mHealth apps Impacts College Students’ Motivation for Physical Activity**

A linear regression analysis was conducted to examine research question 3. The independent variables were number of features used from their mHealth app, number of people with whom participants reported sharing their WFTs data via their mHealth app, and the number of mHealth apps with which participants reported syncing their WFTs. The dependent variable was motivation for engaging in physical activity. Results of the regression analysis were significant \((p = .026)\). The model predicted 13.4\% of the variance in motivation for engaging in physical activity. The number of mHealth apps was the only significant predictor \((p = .021)\). The other two predictors were not significant (see Table 4).
Specifically, those who used more apps were likely to report higher levels of motivation to engage in physical activity.

**Research Question 4: Examine the Relationship among demographic factors and use of mHealth apps**

Demographic factors were sex, BMI, and race. One logistic regression model was conducted in order to examine the impact of these factors in the most parsimonious model. Sex (male, female), BMI (recoded to overweight [BMI of obese and overweight categories] and not overweight [BMI of normal weight and underweight categories]) and race (recoded to white and not white) were examined as independent variables. Use of related (to WFT) mHealth app was the dependent variable. Results indicated that demographic variables were not significantly related to using mHealth apps.

**Research Question 5: Document Reasons for Non-Use of mHealth apps**

A total of 13 participants answered “no” to whether they used their WFT’s related mHealth app. Twelve answered the subsequent non-use question to provide reasons (choose all that apply) for not using the mHealth app. These reasons included not owning a smart phone ($n = 2$) which is necessary to use any mHealth app, a few ($n = 3$) did not know there was a related mHealth app, one participant felt it took up too much memory on their phone, a couple ($n = 2$) reported it drained their phone battery, and one participant cited that using a mHealth app used up too much of their phone’s data plan. Three participants wrote in “other” as not using a mHealth app because they get “all the information I need from my GPS watch.”
Discussion

This study adds to the knowledge base related to the use of mobile health apps (mHealth apps) among college students. This is pertinent given that the National College Health Association (2016) reports that college students are not getting enough physical activity (Reiner et al., 2013). A total of 80 students citing use of a wearable fitness tracker answered questions about the use of the tracker’s related mHealth app. Those participants that did not use a mHealth app answered a question pertaining to reasons for non-use. The next sections of this discussion provide information for the research questions guiding this study.

Research Question 1: Document Key Information about use of mHealth apps by College Students

A majority (83.8%) of participants reported using their wearable fitness tracker’s (WFT’s) related mHealth app. This percentage is higher than that cited by Krebs and Duncan (2015). They reported that 60% of survey participants used a mHealth app. Krebs and Duncan (2015) inquired only about use of any mHealth app and this study required that participants discuss the use of mHealth apps if participants had and were using WFTs. This author’s review of literature did not identify any studies that investigated data sharing behaviors of WFT and mHealth app users. This study found that if participants shared their WFT data through the use of any mHealth app, they were most likely to share this information with family or friends. Interestingly, participants in this study most commonly reported using their mHealth apps just “once a day” \((n = 18)\) or just “once a week” \((n = 13)\). Haithcox-Dennis et al. (2012) reported on college students frequency related to downloading mHealth apps but not regarding their frequency of use once the mHealth app was downloaded, and thus results of the study provided new information on the use of mHealth apps.
Research Question 2: Understand the Types of Information Used by College Students from their mHealth Apps

This study revealed several types of information used from participants’ mHealth apps. The two most common reasons for use of a mHealth app were for “data updates throughout the day to assess daily goals” \((n = 47)\) and “weekly data summaries” \((n = 42)\). Specifically, participants reported being most interested in tracking sleep \((n = 37)\) and tracking their weight \((n = 29)\). Krebs and Duncan (2015) reported that surveyed US adults used mHealth apps to track physical activity, diet and weight. Both Gowin et al. (2015) and Haithcox-Dennis et al. (2012) reported college students’ use of mHealth apps was primarily to increase physical activity. Findings of this study indicated more varied use of apps in tracking sleep as well as weight.

Research Question 3: Understand How Use of mHealth apps Impacts College Students’ Motivation for Physical Activity

It was hypothesized that the more participants shared their mHealth data, the more information they would use from their mHealth apps. Secondly, those using more mHealth apps that were synced with their trackers, would report higher levels of motivation for engaging in physical activity. The only relationship that was confirmed was that college students using higher numbers of mHealth apps synced with their WFTS also reported higher levels of motivation to engage in physical activity. It may be that syncing one’s WFT to multiple mHealth apps provides additional information and feedback that may increase one’s level of motivation. Future research should investigate the potential benefits of using multiple technologies to support behavior change.
Research Question 4: Examine the Relationship among demographic factors and use of mHealth apps

None of the demographic factors (gender, race and BMI) were related to use of mHealth apps. In their study, Krebs and Duncan (2015) reported no significant correlation between mHealth app use and gender which corroborates the findings of this study. Krebs and Duncan also found that participants who were obese were more likely to use a mHealth app, and this finding was not confirmed in the current study. With regard to race, Krebs and Duncan reported that Latino/Hispanic participants were more likely to download mHealth apps.

Research Question 5: Document Reasons for Non-Use of mHealth apps

This study found a variety of reasons for non-use of mHealth apps, which included: not owning a smart phone (thus, not able to download a mHealth app), lack of awareness that their tracker had a related mHealth app, and problems with the app draining the phone battery. Krebs and Duncan (2015) were the only study found in this author’s review of literature to have investigated reasons for non-use (and discontinued use) of mHealth apps. None of the reasons cited in their study of US adults were found to be reasons in this study. They identified the following reasons; took too much time to use the app, participants lost interest, costs of using the mHealth app, and they found the app to be too confusing. Hence, more research on reasons for non-use, with larger samples, may be beneficial in uncovering information about reasons for and factors influencing non-use.

Limitations

This study has a several limitations. For example, the fact that the sample was drawn from one college may limit generalization of findings to other settings. This research relied on participants to accurately recall and report their current tracking behaviors, and self-report might
not be accurate or may be inflated due to a social desirability bias. Self-report for discontinuation of use was retrospective and thus might be in accurate. A survey with pre-selected response options may have limited opportunities for discussion, and a mixed methods approach with quantitative and qualitative questions may yield additional information in the future.

**Conclusions**

Physical inactivity on college campuses remains a problem as does overweight and obesity (National College Health Association, 2016). The use of mHealth apps is on the rise (Bhuyan et al., 2016; Handel, 2011; Krebs & Duncan, 2015) with the most commonly downloaded mHealth apps are related to nutrition, diet and physical activity (Krebs & Duncan, 2015). A main function of mHealth apps is to help individuals to manage their personal health (Handel, 2011). To date, little is known regarding the use of mHealth apps and less is known about the use of WFTs in conjunction with their related mHealth apps. The exploratory nature of this study contributes key elements of information regarding college students’ use and perceptions of the effectiveness of mHealth apps. Unfortunately, fewer students used apps than expected, and the small sample size may have limited power to detect significant findings. However, key information about the relationship between app use and motivation was discovered. Those students using more apps reported higher levels of motivation. It may be that students using more apps were more educated about apps and more comfortable using them. This type of information will need to be examined in future studies. As well, this study contributes information regarding reasons for non-use of mHealth apps. Further research is necessary with larger populations over a longer period of time since health behaviors must be maintained.
References


### Tables

Table 1. Demographic Characteristics of Participants (*N* = 356)

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>110</td>
<td>31</td>
</tr>
<tr>
<td>Female</td>
<td>245</td>
<td>69</td>
</tr>
<tr>
<td><strong>Race/Ethnicity</strong>&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>294</td>
<td>83.1</td>
</tr>
<tr>
<td>Hispanic/Latino/Spanish Origin</td>
<td>9</td>
<td>2.5</td>
</tr>
<tr>
<td>Black/African American</td>
<td>41</td>
<td>11.3</td>
</tr>
<tr>
<td>Asian</td>
<td>17</td>
<td>4.8</td>
</tr>
<tr>
<td>American Indian/Alaska Native</td>
<td>1</td>
<td>.3</td>
</tr>
<tr>
<td>Middle Easter/North African</td>
<td>4</td>
<td>1.1</td>
</tr>
<tr>
<td>Native Hawaiian or Pacific Islander</td>
<td>2</td>
<td>.6</td>
</tr>
<tr>
<td><strong>Campus</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main</td>
<td>167</td>
<td>46.9</td>
</tr>
<tr>
<td>Regional 1</td>
<td>90</td>
<td>25.3</td>
</tr>
<tr>
<td>Regional 2</td>
<td>99</td>
<td>27.8</td>
</tr>
<tr>
<td><strong>Major</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthcare Related</td>
<td>206</td>
<td>58.2</td>
</tr>
<tr>
<td>Business Related</td>
<td>16</td>
<td>4.5</td>
</tr>
<tr>
<td>Science Technology Engineering Math (STEM)</td>
<td>37</td>
<td>10.5</td>
</tr>
<tr>
<td>Education</td>
<td>27</td>
<td>7.6</td>
</tr>
<tr>
<td>Criminal Justice</td>
<td>18</td>
<td>5.1</td>
</tr>
<tr>
<td>Other</td>
<td>50</td>
<td>14.1</td>
</tr>
<tr>
<td><strong>Calculated Body Mass Index</strong>&lt;sup&gt;c&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Underweight (BMI &lt; 18.5)</td>
<td>17</td>
<td>4.8</td>
</tr>
<tr>
<td>Normal Weight (BMI 18.5 – 24.9)</td>
<td>195</td>
<td>54.9</td>
</tr>
<tr>
<td>Overweight (BMI 25.0 – 29.9)</td>
<td>77</td>
<td>21.7</td>
</tr>
<tr>
<td>Obese (BMI 30.0 and above)</td>
<td>47</td>
<td>13.3</td>
</tr>
</tbody>
</table>

Notes. This table was also presented for Study One.<br />
<sup>a</sup> One participant did not provide a response for gender.<br />
<sup>b</sup> Two participants did not provide a response for race and 14 chose two race/ethnicity categories.<br />
<sup>c</sup> 1 participant did not provide response and 19 provided incomplete information about weight.
Table 2. College Students’ Use of Mobile Health Apps

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Use of a Wearable Fitness Tracker Related Mobile Health App (n = 80)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>13</td>
<td>16.3</td>
</tr>
<tr>
<td>Yes</td>
<td>67</td>
<td>83.8</td>
</tr>
<tr>
<td><strong>Sharing of tracked fitness success through Mobile Health App</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facebook</td>
<td>2</td>
<td>2.7</td>
</tr>
<tr>
<td>Twitter</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>Snapchat</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>Tumblr</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Pinterest</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td>My Doctor</td>
<td>3</td>
<td>4.1</td>
</tr>
<tr>
<td>Fitness Professional</td>
<td>4</td>
<td>5.5</td>
</tr>
<tr>
<td>Nutrition Professional</td>
<td>4</td>
<td>5.5</td>
</tr>
<tr>
<td>My Family and Friends</td>
<td>45</td>
<td>61.6</td>
</tr>
<tr>
<td>Nobody</td>
<td>25</td>
<td>34.2</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>4.1</td>
</tr>
<tr>
<td><strong>Unrelated Mobile Health Apps synced with Wearable Fitness Tracker</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight Watchers</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Myfitness Pal</td>
<td>15</td>
<td>21.4</td>
</tr>
<tr>
<td>Spark People</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>My Gym/Health Club</td>
<td>2</td>
<td>2.9</td>
</tr>
<tr>
<td>Loseit!</td>
<td>3</td>
<td>4.3</td>
</tr>
<tr>
<td>None</td>
<td>48</td>
<td>68.6</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>4.3</td>
</tr>
<tr>
<td><strong>How Often Do You Use Any Mobile Health App with your Wearable Fitness Tracker</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than once a day</td>
<td>8</td>
<td>11.6</td>
</tr>
<tr>
<td>Once a day</td>
<td>18</td>
<td>26.1</td>
</tr>
<tr>
<td>A few times a day</td>
<td>7</td>
<td>10.1</td>
</tr>
<tr>
<td>Several times a day</td>
<td>5</td>
<td>7.2</td>
</tr>
<tr>
<td>Less than once a week</td>
<td>6</td>
<td>8.7</td>
</tr>
<tr>
<td>Once a week</td>
<td>13</td>
<td>18.8</td>
</tr>
<tr>
<td>A few times a week</td>
<td>8</td>
<td>11.6</td>
</tr>
<tr>
<td>Several times a week</td>
<td>4</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Notes. Participants were able to choose more than one response.
Table 3. Types of Information Used from Mobile Health Apps

<table>
<thead>
<tr>
<th>Item</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data updates throughout day to assess daily goals</td>
<td>47</td>
<td>66.2</td>
</tr>
<tr>
<td>Weekly data summaries</td>
<td>42</td>
<td>59.2</td>
</tr>
<tr>
<td>Connect to other friends using the same tracker</td>
<td>26</td>
<td>36.6</td>
</tr>
<tr>
<td>Alarms/Reminders to help achieve goals</td>
<td>34</td>
<td>47.9</td>
</tr>
<tr>
<td>Individual challenges</td>
<td>31</td>
<td>43.7</td>
</tr>
<tr>
<td>Group / Friend challenges</td>
<td>24</td>
<td>33.8</td>
</tr>
<tr>
<td>Track Food</td>
<td>21</td>
<td>29.6</td>
</tr>
<tr>
<td>Track Sleep</td>
<td>37</td>
<td>52.1</td>
</tr>
<tr>
<td>Track Weight</td>
<td>29</td>
<td>40.8</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Notes. Participants were able to choose more than type of information.
Table 4. Regression Model with Numbers of Features, Sharing, and Mobile Health Apps
Synced to WFT as predictors of Motivation

<table>
<thead>
<tr>
<th>Variable</th>
<th>$B$</th>
<th>Standard Error</th>
<th>Beta</th>
<th>$t$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Features used from Mobile Health Apps</td>
<td>.020</td>
<td>.066</td>
<td>.037</td>
<td>.297</td>
<td>.768</td>
</tr>
<tr>
<td># of People Data Shared</td>
<td>.237</td>
<td>.176</td>
<td>.192</td>
<td>1.516</td>
<td>.134</td>
</tr>
<tr>
<td># of Mobile Health Apps Synced to WFT</td>
<td>.644</td>
<td>.273</td>
<td>.277</td>
<td>2.360</td>
<td>.021</td>
</tr>
</tbody>
</table>
Appendix A – Approval Letter

Institutional Review Board - Federalwide Assurance #00003152

University of Cincinnati

Date: 12/1/2016
From: UC IRB
To: Principal Investigator: Darlene Kinney
     Clermont Medical Assisting

Study ID: 2016-8259
Re: Study Title: College Students' Use and Perceptions of Wearable Fitness Trackers and Mobile Health Apps

The above referenced protocol and all applicable additional documentation provided to the IRB were reviewed and APPROVED using an EXPEDITED review procedure in accordance with 45 CFR 46.110(b)(1)(see below) on 11/22/2016.

This study will be due for continuing review at least 30 days before: 11/21/2019.

The following was reviewed:

Study Documents

Kinney_D.CV_2016-8259.pdf
Nabors.CV_2016-8259.pdf
Recruit_ProfEmail_2016-8259_v1.docx
ScriptSurveyAdmin_2016-8259_v1.docx
Survey_Info_Form_2016-8259_v1.doc
TestRetest_Info_Form_2016-8259_v1.doc
TrackerRsrch_Protocol_2016-8259_v1
TrackerSurvey_2016-8259_v1.docx
The IRB reviewer has determined that this research presents no greater than minimal risk.

Please note the following requirements:

Consent Requirements
Per 45 CFR 46.117 (21 CFR 56.109) the IRB has waived the requirement to obtain DOCUMENTATION of informed consent for all adult participants.

Your research study is approved by the UC IRB and has received an extended approval period. Your study is subject to the following requirements during the period.

• You must submit a continuing review report 30 days prior to end of the extended approval period.

• Changes and modifications to the research must continue to be submitted as amendments via ePAS as needed, during the extended approval period.

• Research receiving an extended approval period continues to be subject to all applicable UC policies including Non-compliance reporting, HIPAA, COI, etc.

• It is the responsibility of the PI to report to the IRB changes in contractual obligations that preclude extended approval times as well as funding or sponsoring status that involve federal agencies.

AMENDMENTS: The principal investigator is responsible for notifying the IRB of any changes in the protocol, participating investigators, procedures, recruitment, consent forms, FDA status, or conflicts of interest. Approval is based on the information as submitted. New procedures cannot be initiated until IRB approval has been given. If you wish to change any aspect of this study, please submit an Amendment via ePAS to the IRB, providing a justification for each requested change.

CONTINUING REVIEW: The investigator is responsible for submitting a Continuing Review via ePAS to the IRB at least 30 days prior to the expiration date listed above. Please note that study procedures may only continue into the next cycle if the IRB has reviewed and granted re-approval prior to the expiration date.

UNANTICIPATED PROBLEMS: The investigator is responsible for reporting unanticipated problems promptly to the IRB via ePAS according to current reporting policies.
**STUDY COMPLETION:** The investigator is responsible for notifying the IRB by submitting a Request to Close via ePAS when the research, including data analysis, has completed.

**Please note:** This approval is through the IRB only. You may be responsible for reporting to other regulatory officials (e.g. VA Research and Development Office, UC Health – University Hospital). Please check with your institution and department to ensure you have met all reporting requirements.

**Statement regarding The International Conference on Harmonization and Good clinical Practices:** The Institutional Review Board is duly constituted (fulfilling FDA requirements for diversity), has written procedures for initial and continuing review of clinical trials: prepares written minutes of convened meetings and retains records pertaining to the review and approval process; all in compliance with requirements defined in 21 CFR Parts 50, 56 and 312 Code of Federal Regulations. This institution is in compliance with the ICH GCP as adopted by FDA/DHHS.

*Thank you for your cooperation during the review process.*
Appendix B – Classroom Recruitment E-mail

Dear <Instructor>:

My name is Dee Kinney and I am Doctoral Candidate in the Health Promotion and Education Program here at the University of Cincinnati. I am currently conducting survey research for my dissertation, approved by UC’s Institutional Review Board (Study ID#), regarding ‘College students’ use and perceptions of wearable fitness trackers and mobile health apps’. The minimum number of surveys that I need to collect is 350 and I plan on beginning data collection starting in __________ (when?).

I would like your permission to administer this survey, in person, to your classes at a time that is most convenient for you. I appreciate the value of your limited class time and will keep my visit brief. It is a paper survey that will take approximately 10 minutes for students to complete.

If you are able and willing to help me in this way, please complete the following information for any classes that I can attend to administer this survey.

Name of Class:
Approximate # of students:
Day of Class:
Time of Class:
Time that I should arrive:
Location of Class: (Please include building name and room number)

Thank you for your consideration,

Dee Kinney

Dee Kinney, MA, MSW, RD
Doctoral Candidate, Health Education
Dee.Kinney@uc.edu
513 – 558 – 1207
Health Promotion & Education
College of Education, Criminal Justice and Human Services
Appendix C – Survey Administration Script

Script for survey administration

Hello, my name is ______________. Our team is currently conducting research for a dissertation about “College students’ use and perceptions of wearable fitness trackers and mobile health apps”

You do not have to participate in this research. It is completely voluntary and anonymous so please do not put your name on the survey. After you read the top information sheet, if you agree to participate simply complete the survey which will take you approximately 10 minutes and return it by placing it in the large manila envelope at the front of the room. You are free to stop the survey at any time. If you do not wish to participate, please do not complete the survey and simply return the survey to the large manila envelope at the front of the room.
Appendix D – Survey Information Form

Information Form for a Research Study
University of Cincinnati
Health Promotion and Education Program
Dee Kinney, Doctoral Candidate – Health Education
Telephone 513-558-1207
Email: Dee.Kinney@uc.edu

Title of Study: Students’ Use and Perceptions of Wearable Fitness Trackers & Mobile Health Apps

Introduction:
You are being asked to take part in a research study. If you wish to participate, then you will complete a survey. Please read this paper carefully and you may ask questions about anything that you do not understand.

Who is doing this research study?
The person in charge of this research study is Dee Kinney, a Doctoral Candidate in Health Education within the Health Promotion and Education Department at the University of Cincinnati. The Dissertation committee includes Dr. Laura Nabors (Chair), Dr. Rebecca Vidourek (Member), and Dr. Ashley Merianos (Member) who will also have access to collected data.

What is the purpose of this research study?
This study looks at college students’ use of and perceptions about wearable fitness trackers and mobile health applications (apps).

Who will be in this research study?
Approximately 350-470 college students at the University of Cincinnati will be participants. Students will need to be able to read and complete the survey.

What will you be asked to do in this research study, and how long will it take?
You will be asked to complete a survey. Questions on the survey will address your use of and thoughts on wearable fitness trackers and mobile health applications as related to increasing physical activity. It will take about ten minutes to complete the survey.

Are there any risks to being in this research study?
This study has been designated as involving minimal risk. If a question makes you uncomfortable, you do NOT need to answer it. If you became uncomfortable while completing the survey at any time, you may stop and then tear up your survey. Please contact Dee Kinney if any issues may arise.

**Are there any benefits from being in this research study?**

You will probably not get any direct benefit from participating. The answers you provide may help others or positively influence scientific knowledge.

**You will not have to pay anything to be in this research study.**

**Do you have choices about taking part in this research study?**

You can say no. If you do not want to take part in this research study, you do not have to complete the survey. You may stop answering questions on the survey at any time. You can skip or decide not to answer questions and this is fine. You can also decide not to turn in the survey. Not taking this survey or deciding not to complete this survey will not hurt your class grade in any way.

**How will your research information be kept confidential?**

No identifying information about yourself will be collected as this survey is anonymous. It is important to know that there will be no information such as your name, address, or birth date on the survey. Your data will be identified by a number. All information will be managed by the Principal Investigator. Data will be stored in a locked file cabinet in a locked office. Data from this research study may be published; but you will not be identified by name. Agents of the University of Cincinnati may inspect study records for audit or quality assurance purposes.

**What are your legal rights in this research study?**

Completing this research survey does not waive any legal rights you may have. This form does not release the investigator, the institution or its agents from liability or negligence.

**What if you have questions about this research study?**

If you have any questions or concerns about this research study, you should contact Dee Kinney at (513) 558-1207 or by email at dee.kinney@uc.edu or you can contact Dr. Laura Nabors at 513-556-5537 or by email at naborsla@ucmail.uc.edu

The UC Institutional Review Board reviews all research projects that involve human participants to be sure the rights and welfare of participants are protected. If you have questions about your rights as a participant, complaints and/or suggestions about the study, you may contact the UC IRB at (513) 558-5259. Or, you may call the UC Research Compliance Hotline at (800) 889-1547, or write to the IRB, 300 University Hall, ML 0567, 51 Goodman Drive, Cincinnati, OH 45221-0567, or email the IRB office at irb@ucmail.uc.edu.

**Do you HAVE to take part in this research study?**
No one has to be in this research study. Refusing to take part will NOT cause any penalty or loss of benefits that you would otherwise have.

BY TURNING IN YOUR COMPLETED SURVEY YOU INDICATE YOUR CONSENT FOR YOUR ANSWERS TO BE USED IN THIS RESEARCH STUDY.

PLEASE KEEP A COPY OF THIS INFORMATION FORM FOR YOUR REFERENCE.
Appendix E – Survey

Student Survey

*All survey responses are completely anonymous. Please DO NOT put your name on this form*

By completing this survey you are consenting to your voluntary participation in this study.

**Section 1 – Wearable Fitness Trackers**

Please Note: Wearable Fitness Trackers include any fitness tracker that you can either clip to your clothing or wear on some part of your body. This may be a Fitbit or a Fuelband or a similar tracker. This does not include trackers that are built into your smartphone.

1. Do you use a wearable fitness tracker as described above?
   - Yes
   - No
   - Used to

   ![Diagram]

   If you answered ‘No’ or ‘Used to’
   Please SKIP TO Section 3 – Demographics & Section 4 – Non-Use questions

2. If you do use a wearable fitness tracker, how long have you been using the tracker?
   - < 1 month
   - 1 – 3 months
   - 3 – 5 months
   - 5 – 7 months
   - 7 – 9 months
   - 9 – 11 months
   - 1 year or longer

3. Which wearable fitness tracker do you currently use? (Please do not include trackers built into your smartphone)
   - Fitbit
   - Nike Fuelband
   - Jawbone Up
   - Garmin
   - Other (Please specify)

4. How often do you wear your fitness tracker?
   - Every day, without fail
   - Most days
   - A few days a week
   - When I remember

5. When do you wear your fitness tracker?
   - Only during the day
   - All day and while sleeping
   - Only when working out

6. Why do you use a wearable fitness tracker?
   - To lose weight
   - To increase my physical activity
   - To improve my workouts
   - To monitor my sleep
   - To monitor my heart rate
   - To monitor a health condition
7. **What information do you use from your wearable fitness tracker?** (Please check all that apply)
   - [# of steps](#)
   - Distance / Miles
   - Active Minutes
   - Calories burned
   - [# of Stairs](#)
   - Other (Please Specify) →

8. **Which information is the MOST important to you?** (Please choose only ONE)
   - [# of Steps](#)
   - Distance / Miles
   - Active Minutes
   - Calories burned

9. **How would you rate your confidence to be physically active since you began using a wearable fitness tracker?**
   - Not Confident
   - Slightly Confident
   - Moderately Confident
   - Extremely Confident

*While answering the following questions, please keep this in mind:*
*PHYSICAL ACTIVITY* may include purposeful activity such as taking a fitness class, running, bicycling, walking or it may simply be adding steps wherever you can into your day (i.e. – taking the stairs, parking further or even walking circles around your kitchen table just to meet a step goal you’ve set).

10. **Does using a wearable fitness tracker increase your physical activity?**
    - Not at all
    - A little
    - Somewhat
    - Quite a bit
    - Very much
    - Not sure

11. **Do you feel more motivated to be physically active because of your wearable fitness tracker?**
    - Not at all
    - A little
    - Somewhat
    - Quite a bit
    - Very much
    - Not sure

12. **Does using a wearable fitness tracker increase the number of steps you take every day?**
    - Not at all
    - A little
    - Somewhat
    - Quite a bit
    - Very much
    - Not sure

13. **Based on your tracker data, about how many steps do you get in on a regular basis?**
    - Less than 5,000 Steps per day
    - 5,000 – 7,499 Steps per day
    - 7,500 – 9,999 Steps per day
    - 10,000 – 12,499 Steps per day
    - 12,500 or more Steps per day
    - I don’t know

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**Section 2 – Mobile Health Apps**
Please note: All wearable Fitness Trackers have related mobile health applications (apps) that can be downloaded onto a smartphone and can be used together with the wearable fitness tracker.

14. Do you use your fitness tracker’s related mobile Health app?

- Yes
- No

If ‘No’, why not? (Choose all that apply)
- I don’t have a smart-phone
- I didn’t know there was a related app
- It takes up too much memory on my phone
- Other (Please specify)

15. What features of your fitness tracker’s mobile Health app do you utilize? (Choose all that apply)

- Data updates throughout day to see how you are doing with your daily goals
- Weekly data summaries / Trend data
- Connect to other friends using the same tracker
- Alarms / Reminders to help achieve goals
- Other (Please specify)

- Individual Challenges (To reach established goal and receive icon trophy/badge)
- Group / Friend Challenges (Compete with others)
- Track Food
- Track Sleep
- Track Weight

16. With whom do you share your tracked fitness successes (i.e. – goals met, badges, competitions won) as tracked by your fitness tracker’s mobile Health app? (Choose all that apply)

- Facebook
- Twitter
- Snap Chat
- My Doctor
- My family & friends

- Tumblr
- Pinterest

- Fitness Professional
- Nutrition Professional
- Other

- Nobody

Please note: All wearable fitness trackers have the ability to sync (connect) to mobile Health apps that are not related to the tracker.

17. What other mobile health apps do you sync (connect) your fitness tracker to?

- Weight Watchers
- Myfitness Pal
- My gym/health club
- Loseit!
- Other (Please specify)

- Myfitness Pal

- Loseit!
18. How often do you use any mobile health app with your wearable fitness trackers?
- Less than once a day
- Once a day
- A few times a day
- Several times a day
- Less than once a week
- Once a week
- A few times a week
- Several times a week

19. Does using mobile health app/s enhance your fitness tracker’s ability to increase your motivation level to be more physically active? (Circle One)
- Not at all
- A little bit
- Somewhat
- Quite a bit
- Very much
- Not sure

20. To what extent do you believe that your use of a mobile health app/s enhances your fitness tracker’s ability to increase your physical activity? (Circle One)
- Not at all
- A little bit
- Somewhat
- Quite a bit
- Very much
- Not sure

21. To what extent do you believe that your use of mobile health app/s enhances your fitness tracker’s ability to increase daily steps taken? (Circle One)
- Not at all
- A little bit
- Somewhat
- Quite a bit
- Very much
- Not sure

22. To what extent do you believe that your use of mobile health app/s enhances your fitness tracker’s ability to improve your overall health? (Circle One)
- Not at all
- A little bit
- Somewhat
- Quite a bit
- Very much
- Not sure

Section 3 – Demographic & Health Information
(Please complete these questions whether you use a wearable fitness or not)

1. Gender
   - Female
   - Male

2. Age (Please write in) ___________ years

3. Race / Ethnicity (Please select all of the categories that describe you)
   - White
   - Hispanic/Latino/Spanish Origin
   - Black / African American
   - Asian
   - American Indian / Alaska Native
   - Middle Eastern / North African
   - Native Hawaiian or Other Pacific Islander

4. Campus
   - Clifton
   - Clermont College
   - Blue Ash

5. What is your major? ________________________________
6. What is your height? _____ Feet _____ Inches  What is your weight? _______ Pounds

7. Have you ever been diagnosed with any of the following health conditions?
(Please check all that apply)
- Arthritis    - Depression    - Heart Disease
- Anxiety     - Diabetes      - Overweight or Obesity
- Cancer      - Fibromyalgia  - Other (Please Specify)

8. Are you a student Athlete?  ❌ YES  ❌ NO

Section 4 – Non-Use Questions
(Only answer these questions if you DO NOT USE a wearable fitness Tracker)

1. If you do not use a wearable fitness tracker, why not? (Select all that apply)
- Too expensive
- Don’t like how they look
- Don’t like others having my information
- Don’t need to, I know how active I am
- Other (please write in)

If you ‘used to’ use a wearable fitness tracker but have stopped using it please answer the following questions...

2. How long did you use the tracker for? (Please write in number)
   _______ Years _______ Months _______ Weeks or _______ Days

3. Why did you stop using your wearable fitness tracker?
- Lost interest
- Could never remember to charge it
- It took too much time
- The tracker was not accurate
- Too many technical problems with the tracker
- Didn’t like how they fit
- Didn’t like how they looked
- It broke
- I lost it
- It used too much of my data plan
- Other (please write in)

Thank you for your time!

Please return this survey to the large manila envelope at the front of the room.
Appendix F – Survey Test-Retest Information Form

Information Form for a Research Study
Students Completing the Survey Two Times
University of Cincinnati
Health Promotion and Education Program
Dee Kinney, Doctoral Candidate – Health Education
Telephone 513-558-1207
Email: Dee.Kinney@uc.edu

Title of Study: Students’ Use and Perceptions of Wearable Fitness Trackers & Mobile Health Apps

Introduction:
You are being asked to take part in a research study. If you wish to participate, then you will complete a survey TWO TIMES (Today and again 10 – 14 days from now). Please read this paper carefully and you may ask questions about anything that you do not understand.

Who is doing this research study?
The person in charge of this research study is Dee Kinney, a Doctoral Candidate in Health Education within the Health Promotion and Education Department at the University of Cincinnati. The Dissertation committee includes Dr. Laura Nabors (Chair), Dr. Rebecca Vidourek (Member), and Dr. Ashley Merianos (Member) who will also have access to collected data.

What is the purpose of this research study?
This study looks at college students’ use of and perceptions about wearable fitness trackers and mobile health applications (apps).

Who will be in this research study?
Approximately 20-30 college students at the University of Cincinnati will be participants. Students will need to be able to read and complete the survey and be 18 years or older.

What will you be asked to do in this research study, and how long will it take?
You will be asked to complete a survey TWO TIMES. You will complete the survey TODAY and again a second time about ten days to 2 weeks from today. Questions on the survey will address your use of and thoughts on wearable fitness trackers and mobile health applications as related to increasing physical activity. It will take about ten minutes to complete the survey each time you take it.

Are there any risks to being in this research study?
This study has been designated as involving minimal risk. If a question makes you uncomfortable, you do NOT need to answer it. If you became uncomfortable while completing the survey at any time, you may stop and then tear up your survey. Please contact Dee Kinney if any issues may arise.

**Are there any benefits from being in this research study?**

You will probably not get any direct benefit from participating. The answers you provide may help others or positively influence scientific knowledge.

**You will not have to pay anything to be in this research study.**

**Do you have choices about taking part in this research study?**

You can say no. If you do not want to take part in this research study, you do not have to complete the survey. You may stop answering questions on the survey at any time. You can skip or decide not to answer questions and this is fine. You can also decide not to turn in the survey. Not taking this survey or deciding not to complete this survey will not hurt your class grade in any way.

**How will your research information be kept confidential?**

No identifying information about yourself will be collected as this survey is anonymous. It is important to know that there will be no information such as your name, address, or birth date on the survey. Your data will be identified by a number. All information will be managed by the Principal Investigator. Data will be stored in a locked file cabinet in a locked office. Data from this research study may be published; but you will not be identified by name. Agents of the University of Cincinnati may inspect study records for audit or quality assurance purposes.

**What are your legal rights in this research study?**

Completing this research survey does not waive any legal rights you may have. This form does not release the investigator, the institution or its agents from liability or negligence.

**What if you have questions about this research study?**

If you have any questions or concerns about this research study, you should contact Dee Kinney at (513) 558-1207 or by email at dee.kinney@uc.edu or you can contact Dr. Laura Nabors at 513-556-5537 or by email at naborsla@ucmail.uc.edu

The UC Institutional Review Board reviews all research projects that involve human participants to be sure the rights and welfare of participants are protected. If you have questions about your rights as a participant, complaints and/or suggestions about the study, you may contact the UC IRB at (513) 558-5259. Or, you may call the UC Research Compliance Hotline at (800) 889-1547, or write to the IRB, 300 University Hall, ML 0567, 51 Goodman Drive, Cincinnati, OH 45221-0567, or email the IRB office at irb@ucmail.uc.edu.

**Do you HAVE to take part in this research study?**
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