ABSTRACT

Brooke Graves, THE INFLUENCE OF BMI AND SELF-EFFICACY LEVELS ON THE ACCURACY IN SELF-REPORTED PHYSICAL ACTIVITY RECALL. (Under the direction of Dr. Katrina DuBose) Department of Exercise and Sport Science, July 2011.

The purpose of this study was to compare self-reported and objectively measured physical activity levels among college students with different body mass index (BMI) classifications (normal weight and overweight/obese), in order to determine if BMI influences physical activity recall accuracy. A secondary purpose was to examine the accuracy in physical activity recall by physical activity self-efficacy. On day one, 52 college students completed the Marlow Crowne Social Desirability Questionnaire, a moderate physical activity self-efficacy questionnaire, a vigorous physical activity self-efficacy questionnaire, and received an ActiGraph GT1M accelerometer to wear for 7 consecutive days. After wearing the accelerometer, participants completed self-report physical activity measures including the Behavior Risk Factor Surveillance Survey (BRFSS) and the International Physical Activity Questionnaire (IPAQ). They also completed a self-efficacy towards physical activity recall questionnaire. No significant difference was found between the average minutes per day spent in moderate and vigorous physical activity by normal and overweight/obese groups for the BRFSS, IPAQ and ActiGraph GT1M. Also, recall accuracy was similar between the normal weight and overweight/obese participants on the BRFSS and IPAQ questionnaires. No significant relationship was found between moderate physical activity self-efficacy and recall accuracy on either the IPAQ or BRFSS. However, vigorous physical activity self-efficacy was positively related to recall accuracy on both the IPAQ and BRFSS. These results suggest that BMI does not affect either the amount of physical activity completed or recall accuracy in college students. In contrast, vigorous physical activity self-efficacy influences recall accuracy of vigorous physical activity.

THE INFLUENCE OF BMI AND SELF-EFFICACY LEVELS ON THE ACCURACY IN SELF-REPORTED PHYSICAL ACTIVITY RECALL

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Chapter I: INTRODUCTION

Obesity continues to be a major problem in the United States (US), and it is an issue that should not be taken apathetically. Nearly one-third of the US adult population is obese, a little over one-third of the US adult population is overweight, and less than one-third of the population is at a healthy weight (Centers for Disease Control and Prevention, 2009). Between 1991 and 1997, a dramatic increase (12.0 to 17.9%) in the prevalence of obesity across all states and age groups occurred (Mokdad et al., 1999). The largest increase in obesity was found in individuals between the ages of 18 to 29 (7.1% to 12.1%) and also in those with some college education (10.6% to 17.8%) (Mokdad et al., 1999). According to the 2010 *F as in Fat Report*, adult obesity rates rose in 28 states from 2007-2009 (Levi, Vinter, St. Laurent & Segal, 2010). The report also revealed that North Carolina tied Michigan for the 10th most obese state, with 29.4% of North Carolina residents classifying as obese (Levi et al., 2010). The data also showed that 35.8% of the population was overweight in North Carolina (Levi et al., 2010) In regards to college students, according to the Spring 2010 National College Health Assessment data, 30.5% (~28,951) described themselves as slightly overweight, while 51.5% (~48,774) of college students reported that they were trying to lose weight (American College Health Association, 2010). Research also shows that a high percentage of college students are engaging in behaviors such as: insufficient physical activity levels, low vegetable and fruit consumption, and low fiber intake that could potentially lead to obesity and other major health concerns (Huang et al., 2003).

Health concerns associated with obesity include: coronary heart disease, type 2 diabetes, cancers, hypertension, dyslipidemia, stroke, liver disease, gallbladder disease, sleep apnea, osteoarthritis and gynecological problems (Must et al., 1999). Obese youth and young adults are at risk for severe health problems similar to obese adults. An increasing number of children and young adults are developing type 2 diabetes, hypertension, sleep apnea, dyslipidemia, and cardiovascular disease risk factors at an early age (Ludwig, 2007). Developing these diseases at an early age, could potentially shorten the lives of many youth (Fontaine, Redden, Wang, Westfall & Allison, 2003). Must et al. (1992) used growth records from the Third Harvard Growth Study of 1922—1935 and found that males who were overweight during adolescents had a relative risk for all-cause mortality of 1.8 (95% CI: 1.2 to 2.7) and a relative risk for coronary heart disease mortality of 2.3 (95% CI: 1.4 to 4.1) when compared to lean males. This means that individuals who were overweight as adolescents had an elevated risk of all-cause and coronary heart disease mortality. The long-term consequences of obesity related diseases are of significant importance (Must & Strauss, 1999).

To help combat these diseases and to improve health, the American Heart Association (AHA) and American College of Sports Medicine (ACSM) recommend that adults engage in moderately intense physical activity 30 minutes a day, five days a week or engage in vigorously intense physical activity 20 minutes a day, 3 days a week; and they also recommend that adults take part in muscle-strengthening activities in major muscle groups, 2 or more days a week (Haskell et al., 2007). According to the Centers for Disease Control and Prevention (CDC), in 2003 45.9% of the US population was meeting these recommendations; while only 37.6% of North Carolina residents were meeting recommendations (Centers for Disease Control and Prevention, 2005). This number was down 4.7% compared to 2001 data for North Carolina (Centers for Disease Control and Prevention, 2005). Over half of North Carolinians are not meeting physical activity guidelines; and the same is true in many other states (Centers for Disease Control and Prevention, 2005).

Epidemiological data reveals that physical activity levels decline from high school through adulthood (Kilpatrick, Hebert, & Bartholomew, 2005). In 1995, 63.7% of children in grades 9-12 reported participating in vigorous physical activity; however, by age 21 only 42% of men and 30% of women reported participating in vigorous physical activity (US Department of Health and Human Services, 1996). Further, participation in all types of physical activity declines from adolescents to young adults (US Department of Health and Human Services, 1996).

With a high percent (40.4%) of young adults (18-24 years) not meeting CDC/ACSM physical activity recommendations, it is important that reliable physical activity measures are used to better serve this population in order to create and implement effective physical activity interventions (Haskell et al., 2007). Much of the research conducted on physical activity levels in college students has been done with self-report questionnaires (Dinger & Behrens, 2006). Questionnaires measure people's perception about their physical activity. Questionnaires have been associated with recall error, such as overestimation of self-reported time in physical activity, lack of accuracy in the activity being recalled, and the inability to distinguish between varying intensities in physical activity (Dinger & Behrens, 2006). However, there are also ways to objectively measure physical activity. An accelerometer is one device that measures physical activity objectively by determining the amount of time spent at various physical activity intensities (Dinger & Behrens, 2006). Accelerometers have not been widely utilized to assess physical activity levels involving large groups; questionnaires are typically used instead (Dinger & Behrens, 2006). With that being said, in 2003-2004 the National Health and Nutritional Examination Survey (NHANES) started incorporating accelerometers to measure physical activity levels in US children and adults (Troiano et al., 2008).

Accelerometers have been used along with questionnaires in validity studies. Previous studies conducted by Yore et al. (2007) and Craig et al. (2003) used accelerometers to determine the accuracy of self-report questionnaires. Yore et al. (2007) found that the validity in the Behavior Risk Factor Surveillance Survey (BRFSS) had fair agreement ($k = .26$ to .31, CI: 0.09—0.53) to the CSA accelerometer. Craig et al. (2003) reported that the criterion-related validity of the self-report IPAQ-short questionnaire had fair to moderate agreement ($\rho = .30$, 95% CI: .23–.36) to the CSA accelerometer. Since the largest increase in obesity was found in individuals aged 18 to 29, it is crucial that researchers accurately evaluate physical activity in young adults (Mokdad et al., 1999).

There is limited research regarding recall biases in college students. A variety of factors may potentially influence a person's response to questionnaires, such as social desirability, weight loss attempts, body mass index (BMI) and physical activity self-efficacy, are examined in order to gather accurate information. Social desirability is the tendency of individuals to respond in a manner that is socially acceptable and consistent with social norms and beliefs (Hebert et al., 1997). Adams et al. (2005) found that social desirability was positively associated with over reporting of physical activity on questionnaires (the Stanford Five-City Project's 7-day recall and the Minnesota Leisure Time Physical Activity Survey). This means that people who scored higher on a social desirability scale were more likely to over report the amount of time they were engaged in physical activity.

In regards to weight loss attempts, Lichtman et al., (1992) found that obese individuals who were trying to lose weight and also had a history of failing to lose weight, underreported their actual food intake by an average 47 ± 16 percent and over reported their physical activity by 51 ± 75 percent. These individuals were less accurate in their physical activity recall. Overweight individuals who are dieting and who over-report their physical activity could have a difficult time losing weight (Lichtman, et al., 1992; Jakicic, Polley & Wing, 1998). Another study found that overweight adults reported significantly more vigorous physical activity than normal weight adults; however, this self-reported vigorous physical activity was not confirmed by the corresponding accelerometer data (Slootmaker, Schuit, Chinapaw, Siedell & Mechelen, 2009). The study determined that overweight were less accurate in recalling completed vigorous physical activity. In contrast, a different study found no relationship between BMI status and physical activity recall accuracy in older adults (mean age 58.4 ± 6.3 years) (Falkner, McCann & Trevisan, 2001). Due to limited research, it is unclear if there is truly a discrepancy between BMI classification and accuracy of recalled physical activity (self-reported activity) when compared to objectively measured physical activity.

Physical activity self-efficacy also plays a role in understanding physical activity related behavior (McAuley 1993; Cust et al, 2009). Self-efficacy focuses on an individual's belief that he/she can successfully perform a certain behavior (Lox et al., 2006). Based on work from Bandura (1986), McAuley (1991) suggested that individuals with higher physical activity self-efficacy were more likely to engage in physical activity than individuals with low physical activity self-efficacy. To evaluate the relationship between self-efficacy and physical activity, McAuley (1993) examined physical activity self-efficacy in the maintenance of exercise participation in previously sedentary middle aged adults. The participants were studied 4 months following a structured exercise program. Results showed that the participants with higher physical activity self-efficacy reported "greater maintenance of exercise participation" during the 4 months post exercise intervention (McAuley, 1993).

Self-efficacy levels towards physical activity recall could also play a role in physical activity measurements. Cust et al. (2009) examined self-efficacy towards physical activity recall and recall accuracy in adults. The results showed that those who reported higher levels of self-efficacy towards recalling physical activity had higher recall accuracy for most of the physical activity measures on each questionnaire (Cust et al., 2009). Cust et al. (2009) concluded that self-efficacy ratings towards recalling physical activity could be useful as indicators of recall accuracy. It is unclear if physical activity self-efficacy influences the level of accuracy in recalling physical activity in college students.

In 2007, the Behavior Risk Factor Surveillance Survey found that 41% of young adults (18-24 years old) living in the US were not meeting physical activity guidelines. According to the Fall 2009 National College Health Assessment, 56.4% of college students were not meeting physical activity recommendations (American College Health Association, 2009). These individuals could soon be facing the health consequences as a result of inactivity. Fortunately, there has been greater national attention to the harmful effects of inactivity and obesity in recent years. Many students have a desire to become more physically active, thus there is a need for physical activity interventions in the college setting (Calfas, Sallis, Lovato, & Campbell 1994). However, in order to develop an effective intervention, researches must understand the numerous devices used to measure physical activity, such as accelerometers and questionnaires, as well as understand the potential factors that could influence physical activity questionnaire responses.

The purpose of this study is to:

1. Determine if self-reported and objectively measured physical activity levels differ among college students with different BMI classifications (normal weight-BMI 18.5-24.9 kg/m^2; overweight/obese BMI $\geq$ 25kg/m^2)
    a. Hypothesis: a significant different difference will be present between BMI classification and the amount of self reported physical activity and objectively measured physical activity, showing that individuals with a higher BMI classification will have less physical activity.
2. Determine if physical activity recall accuracy is related to BMI classification (normal weight-BMI 18.5-24.9 kg/m^2; overweight/obese BMI $\geq$ 25kg/m^2) among college students.
    a. Hypothesis: a significant difference will be present between BMI classification and the recall accuracy of moderate and vigorous physical activity, showing that individuals with higher BMIs will be less accurate in recalling their physical activity.
3. Determine if physical activity self-efficacy is related with the accuracy in recalling physical activity levels.
    a. Hypothesis: a significant difference will be present between physical activity self-efficacy levels and the recall accuracy of moderate and vigorous physical activity recall. Those with lower self-efficacy will be less accurate in recalling their physical activity levels via self-report questionnaires.
4. Determine if self-efficacy towards physical activity recall is related to recall accuracy in college students.

   a. Hypothesis: a significant difference will be present between self-efficacy towards physical activity recall and recall accuracy of moderate and vigorous physical activity recall. Those with lower self-efficacy towards physical activity recall will be less accurate in recalling their physical activity levels via self-report questionnaires

5. Determine if weight loss attempts were related to the recall accuracy of moderate and vigorous physical activity.
   a. Hypothesis: those who are attempting to lose weight will significantly over-report their moderate and vigorous physical activity compared to those not attempting to lose weight.
6. Determine if social desirability was related to the recall accuracy of moderate and vigorous physical activity.
   a. Hypothesis: a significant difference will be present between social desirability and recall accuracy. Those with a higher social desirability will be less accurate.

Significance

Numerous college students are not meeting physical activity guidelines. Therefore, there is a need for accurate physical activity measurements and interventions in this group. This study is significant because it measures physical activity objectively in college students. Many of the previous physical activity data gathered in this age group has been collected via self-report questionnaires. If discrepancies exist between self-report physical activity questionnaires and accelerometers among college students with different BMI classifications and/or physical activity self-efficacy levels, the information could be useful for researchers and fitness professionals. Researchers and fitness professionals could use the knowledge from this study to find more accurate methods to collect physical activity data and also develop more effective physical activity interventions. For example, self-report questionnaires could be less accurate in college students with a greater BMI, which in turn could lead to newer and more effective self-report questionnaires for data collection. In regards to fitness professionals, they could potentially have access to more accurate physical activity data which in turn could lead to more safe and effective interventions that progress at a more realistic pace.

Delimitations

1. BMI will be used to determine obesity status, instead of body fat percentage, in order to classify participants as either normal weight, overweight, or obese.
2. An ActiGraph GT1M accelerometer will be used with the accelerometer data to measure objective physical activity levels.
3. The International Physical Activity Questionnaire and the Behavior Risk Factor Surveillance Survey will be used to assess self-reported physical activity.
4. Physical activity cut points that will be used were developed by Freedson et al. (Freedson et al., 1998).

Limitations

1. Accelerometer cannot assess upper body movement, activities in water, movement on bicycles, or rowing machines.
2. Self-report physical activity measures assume participants understand the differences between intensity levels.
3. The BRFSS was always administered before the IPAQ questionnaire, and the moderate physical activity self-efficacy form was always administered before the vigorous form.

Definitions

Physical activity:

1. Physical activity is any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen, Powell & Christenson, 1985).
2. Moderate-intensity physical activity is defined as working hard enough to raise your heart rate and break a sweat, yet also still be able to carry on a conversation. It can be quantified as being between 3.0 and 6.0 metabolic equivalents (Haskell et al., 2007).
3. Vigorous-intensity physical activity is defined as working hard enough to cause rapid breathing and a substantial increase in heart rate. It can be quantified as greater than 6.0 metabolic equivalents (Haskell et al., 2007).

Physical activity cut points:

4. Cut points developed by Freedson et al. (1998) will be used to determine physical activity intensities from the accelerometer:
    a. Inactivity 0-499 counts/min
    b. Light Activity 500-1952 counts/min
    c. Moderate Activity 1953-5724 counts/min
    d. Vigorous Activity $\geq$ 5725 counts/min

Epoch Level:

5. The epoch level is set sampling interval used in accelerometer data collection.

Obesity status classification:

6. **Body mass index (BMI)** describes weight relative to height. It is calculated as weight (kg)/height squared (m^2). This calculation is significantly correlated with total body fat content (National Institutes of Health, 1998).
    a. **Normal weight**- BMI 18.5-24.9 kg/m^2 (National Institutes of Health, 1998).
    b. **Overweight**- BMI 25-29.9 kg/m^2 (National Institutes of Health, 1998).
    c. **Obese**- BMI ≥ 30 kg/m^2 (National Institutes of Health, 1998).

Accelerometer:

7. An accelerometer is a device that can be used objectively to quantify physical activity and to determine the time spent in various physical activity intensities (Dinger & Behrens, 2006).

Questionnaire:

8. A questionnaire is a set of questions for obtaining either statistically useful or personal information from individuals.

Self-Efficacy:

9. Self-efficacy describes the extent to which an individual feels he or she can successfully perform a desired behavior (Lox et al., 2006). It is generally considered to be a form of self-confidence.
    a. **Physical Activity Self-Efficacy**- the extent to which an individual feels he or she can successfully perform physical activity (McAuley, 1993).
    b. **Self-Efficacy towards Physical Activity Recall-**describes how successful an individual feels they are correctly recalling their physical activity on a physical activity recall questionnaire (Cust et al., 2009).

Social Desirability:

10. Social desirability is the defensive tendency of individuals to respond in a manner that is socially acceptable and consistent with social norms and beliefs (Hebert et al., 1997).

Recall Accuracy

11. The difference between self-reported and objectively measured physical activity
    a. Moderate objectively measured physical activity minus IPAQ moderated minutes
    b. Vigorous objectively measured physical activity minus IPAQ vigorous minutes
    c. Moderate objectively measured physical activity minus BRFSS moderate minutes
    d. Vigorous objectively measured physical activity minus BRFSS vigorous minutes

Chapter 2: REVIEW OF LITERATURE

The purpose of this chapter is to review the literature examine obesity and physical activity trends, physical activity measurement techniques, and self-efficacy. The sections of the review of literature will include: obesity, inactivity and health, college inactivity, physical activity questionnaires, physical activity monitoring devices, self-efficacy and a summary. The purpose of the following review is to demonstrate how self-reported physical activity levels may be affected by BMI classification and self-efficacy levels.

Obesity

According to NHANES data, adult obesity rate increased from 15.0% in the 1976-1980 survey to 32.9% in the 2003-2004 survey (Ogden, Carroll, McDowell, & Flegal, 2007). In 2005-2006 over 72 million people in the United States were classified as obese (Ogden et al., 2007). NHANES data from 2007-2008 showed that 68% of adults were classified as either overweight or obese in the United States (Flegal, Ogden, Carroll, & Curtin, 2010). Unfortunately, many people do not consider the health-related consequences of obesity. Obesity is associated with: coronary heart disease, type 2 diabetes, cancer, hypertension, dyslipidemia, stroke, liver disease, gallbladder disease, sleep apnea, osteoarthritis, and gynecological problems (Must et al., 1999). Calle et al. (1999) found that individuals who had a BMI over 25 kg/m^2 (women) or 26.5 kg/m^2 (men) had a significantly higher risk of dying from cardiovascular disease and all cause mortality. This is not surprising since high blood pressure is one of the most common disorders associated with weight gain (Must et al., 1999).

Weight gain as an adolescent can also effect a person’s blood pressure status as an adult. In the Bogalusa Heart Study, 1,594 adolescents (aged 13-17 years) were examined and 783 of these adolescents participated in a survey as young adults between ages 25-31 years of age (Srinivasan, Bao, Wattigney, & Berenson, 1996). As adolescents, the participants were either categorized as lean (BMI less than 25th percentile) or adolescent-onset adult overweight (BMI in upper 25th percentile) according to age, race, sex-specific BMI percentile of the Bogalusa population (Srinivasan et al., 1996). The results indicate that 58% of the adolescents who were overweight remained overweight as adults, and 41% of lean adolescents remained lean as young adults, while 19% shifted to the overweight category as adults. Overweight adolescents were 8.5-times more likely to have high blood pressure as adults when compared to lean adolescents (Srinivasan et al., 1996).

With these health issues in mind, Figure 1 shows that only 1 state (Colorado) has an obesity rate below 20%; while 6 states (Alabama, Mississippi, Oklahoma, South Carolina, Tennessee, and West Virginia) have an obesity rate over 30 % (Centers for Disease Control and Prevention, 2008). In North Carolina, 65.7% adults were overweight or obese in 2008, which is up 2.8% from 2006 (Behavior Risk Factor Surveillance System: North Carolina, 2008). According to the 2010 *F as in Fat Report*, North Carolina tied Michigan for the 10th most obese state (Levi et al., 2010). Obesity continues to be a significant problem in North Carolina, similar to many other southeastern states. According to the Behavioral Risk Factor Surveillance System, from 1991 to 1998 there was a 69% increase in obesity among adults between the ages of 18-29 years (Mokdad et al., 1999). Unfortunately, the rise in obesity is not limited to adults. Healthy People 2010 reported that during 1988-1994 that 11% of children and adolescents aged 6 to 19 years of age were either overweight or obese (http://www.healthypeople.gov); while the NHANES 2007-2008 survey found that 31.7% of children and adolescents between the ages of 2 to 19 years were obese (Ogden, Carroll, Curtin, Lamb & Flegal, 2010).

Developing an obesity related disease at a young age can only complicate the lives of these individuals. Obese school-aged children are 26 to 41% more likely to be obese as adults (Serdula et al., 1993). With severe levels of obesity, in early adulthood a person could decrease their years of life by 5 to 20 years (Fontaine et al., 2003). Actions that strive to reduce the onset of obesity and increase physical activity should be taken seriously.

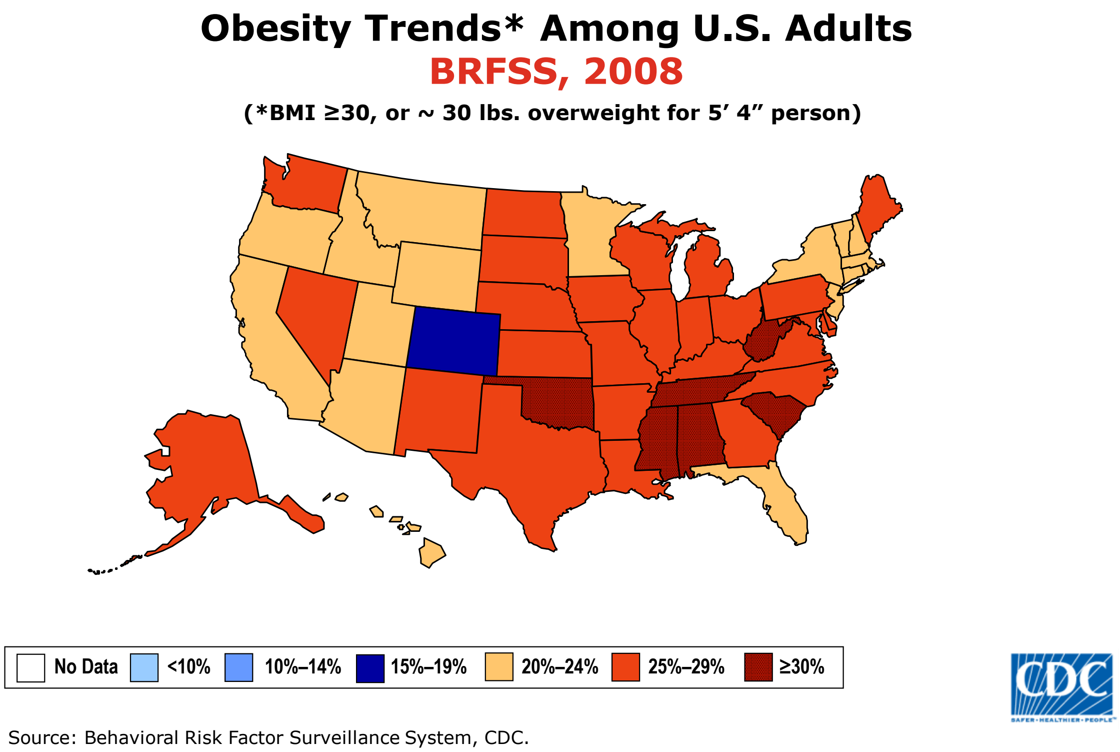

Figure 1. Behavioral Risk Factor Surveillance System- Obesity Trends Among United States Adults in 2008

Inactivity and Health

The prevalence of obesity related health conditions in younger adults is increasing (Must et al., 1999). Physical activity has numerous health benefits to combat these obesity related conditions. Regular physical activity can: reduce the risk of obesity related diseases such as heart disease, diabetes, colon cancer, hypertension, increase muscle and bone strength, increase lean muscle and decrease body fat, enhance psychological well-being, and most importantly lower death rates (Paffenbarger, Wing, Hyde, & Jung, 1983; Blair et al., 1989; Pereira et al. 1999; Kesaniemi et al., 2001).

High blood pressure is one of the most common diseases associated with weight gain (Must et al., 1999). Several studies have found a relationship between greater amounts of physical activity and reduced hypertension rates (Paffenbarger et al.1983; Pereira et al. 1999). Paffenbarger and colleagues gathered information from Harvard University's entrance physical examination records and student athletic data in the years 1916-1950, mailed health and physical activity questionnaires in 1962 and 1966, and a questionnaire regarding physician diagnosed hypertension. There was a 6 to 10 year follow-up as well. The population consisted of 14,998 men aged 35-74 years who were initially free of hypertension in 1962 or 1966. The standard for hypertension at the time was 160+ mmHg systolic and 95+ mmHg diastolic (Paffenbarger et al., 1983).

The results from the study showed that 681 alumni had developed hypertension by 1972 (Paffenbarger et al., 1983). It was found that 59% of the alumni did not engage in vigorous sports (such as running, swimming, handball, tennis, and cross-country skiing), while 41% did (Paffenbarger et al., 1983). Those who did not engage in vigorous sports had a 35% greater risk of developing hypertension compared to those who engaged in vigorous sports (Paffenbarger et al., 1983). However, this was not the case when looking at light sporting activities (Paffenbarger et. al., 1983). Men who did not engage in sports had a similar risk of developing hypertension as those who engaged in light sports (Paffenbarger et al., 1983). Furthermore, varsity sports and intramural athletes were not associated with lower risks of hypertension unless they engaged in vigorous physical activities post-college (Paffenbarger et al., 1983). Regarding kcal expenditure, alumni who expended less than 2,000 kcal per week had a 30% greater risk of hypertension (Paffenbarger et al., 1983). The main finding in the Harvard Alumni study was an inverse relationship between vigorous sport play and hypertension risk (Paffenbarger et al., 1983).

Similar findings were found in a study by Pereira et al. (1999). The study population consisted of 16% African American adults (n=1,188, 60% female) and 84% Caucasians (n=6,251, 53% female) adults between the ages of 45-65 years (Pereira et al., 1999). Pereira et al. (1999) found that Caucasian men (45-65 years of age) with the greatest amounts of physical activity were 34% less likely to develop hypertension over a 6 year period compared to men with low physical activity levels.

Higher physical activity levels are also associated with lower risks of all cause mortality (Gregg, Gerzoff, Caspersen, Williams & Narayan, 2003). Gregg et al. (2003) sampled 2,896 diabetics over the age of 18 (range 18-95 years) from the 1990 and 1991 National Health Interview Survey. The participants' physical activity levels were assessed by asking the following questions: (1) how often did you walk for exercise during the previous 2 weeks; (2) what is the average number of minutes you spent walking each time; (3) how much did your heart and breathing rates increase: no increase, small, medium, or large. Leisure physical activities such as aerobics, basketball, cycling, gardening, jogging, swimming, tennis, and weight lifting were also assessed. The total number of hours per week that the participants spent walking and the total number of hours per week spent in leisure physical activities was calculated. The mortality rate was determined by matching the deceased party's name with the National Death Index (Gregg et al., 2003). They found that 46.0% of the participants walked for exercise and 20.7% reported walking for at least 2 hours per week (Gregg et al., 2003). Participants who walked for at least 2 hours per week had a 39% lower all cause mortality rate than those who did not report walking for exercise (Gregg et al., 2003). Diabetics who reported walking 3 to 4 hours per week, and those who reported a moderate increase in heart rate and breathing while walking had the lowest mortality rates (Gregg et al., 2003).

Physical activity has also been shown to decrease mortality rates in non-diabetic individuals as well. Data from the Nurses' Health Study was used to examine the impact of physical activity on morbidity rates in 116,564 women (30 to 55 years) without cardiovascular disease and cancer (Hu et al., 2004). The women were followed for 24 years and provided follow-up data every 2 years (Hu et al., 2004). Nurses that registered for the study were mailed questionnaires regarding their medical history and lifestyle. Self-reported physical activity levels, height and weight were also obtained in the cohort and BMI was calculated (Hu et al., 2004). To measure physical activity, in 1980 and 1982, the participants reported the number of hours they had spent each week during the past year engaging in moderate and vigorous physical activity (Hu et al., 2004). In 1986, physical activity was measured differently by using an eight item questionnaire. The questionnaire assessed the average amount of time spent per week jogging, walking, running, bicycling, swimming, playing tennis, squash and doing calisthenics (Hu et al., 2004). Mortality was assessed by relatives and the National Death Indexes (Hu et al., 2004). The mortality rates were lowest among women who were physically active and lean (BMI lower than 23.0 kg/m^2) (Hu et al., 2004). Modest amounts of weight gain during adulthood also increased mortality rates (Hu et al.2004). The study concluded that excess weight and low physical activity levels leads to increased mortality rates (Hu et al., 2004).

Similar findings between physical activity patterns and mortality were also found in males (Myers et al., 2004). Myers et al. (2004) evaluated current and past physical activity patterns in 842 (59 ± 11 years) male subjects. The participants were also questioned about their clinical history, medications, and risk factors starting from 1987 to present (Myers et al., 2004). Participants completed a treadmill exercise test to determine exercise capacity. Physical activity patterns were assessed via questionnaire formats similar to the Harvard Alumni studies by Paffenbarger et al. (1983). Mortality rates were measured by the Social Security Death Index. Myers et al. (2004) found a 20% increase in survival for those who expended an extra 1,000-kcal per week (approximately 1 MET) in adulthood (Myers et al., 2004). Men with the lowest levels of exercise capacity had higher rates of mortality compared to those with the highest exercise capacity rates (Myers et al., 2004). Myers et al. (2004) also found that men who had low energy expenditure levels and low physical activity levels had higher mortality rates. Blair et al. (1989) also found that after an 8 year follow-up, lower mortality levels among men and women were associated with higher fitness levels.

Low energy expenditure is also linked with other health problems. Obesity is associated with a positive energy balance, expending less energy than energy consumed. A negative energy balance can reduce the risk of excess body fat. Regular vigorous physical activity has been associated with less abdominal fat in adolescents by creating a negative energy balance (Dionne, Almeras, Bouchard & Tremblay, 2000). Dionne and colleagues (2000) compared inactive individuals to active individuals regarding physical activity patterns and fat deposition. Male participants aged 14.5 ± 3.3 years completed a physical activity diary for 2 weekdays and 1 weekend. They found that the active group had a significantly lower BMI, body weight, and body fat accumulation than the inactive group (Dionne et al., 2000). Similar findings have also been found in adults and young children (Tremblay et al., 1990; Rowlands, Eston & Ingledew, 1999). In young children, it was found that obese children were significantly less physically active than non-obese children (Page et al., 2005). It is important to note that exercise specialist have found vigorous activity is not solely needed for health benefits. Other types of activities under established physical activity guidelines, such as moderate physical activity and weight training, can improve a person's health as well.

The AHA/ACSM recommends that healthy adults under 65 years of age engage in either moderately intense physical activity 30 minutes a day, five days a week; or engage in vigorously intense physical activity 20 minutes a day, 3 days a week (Haskell et al., 2007). AHA/ACSM also recommends doing 8 to 10 strength-training exercises and 8 to 12 repetitions of each exercise twice a week (Haskell et al., 2007). The above AHA/ACSM recommendations were established to update scientific knowledge and to enhance/clarify the 1995 CDC/ACSM physical activity recommendations. The 1995 CDC/ACSM recommendations state that "every US adult should accumulate 30 minutes or more of moderate-intensity on most, preferably all, days of the week" (Pate et al., 1995). The 1995 recommendations were established to help encourage the sedentary US population to become more active. Since the publication of the CDC/ACSM guidelines, many people didn't accept and/or misinterpreted the recommendations (Haskell et al., 2007). Many people believed that only vigorous physical activity could provide health benefits (Haskell et al., 2007). There was also variability in the interpretation of how many days during the week quantified to "most days of the week" (Haskell et al., 2007). Research prior to 1995 revealed that many Americans were not engaging in leisure time physical activity (Haskell et al., 2007). Due to the high numbers of inactivity, newer and clearer recommendations were established in hopes of increasing physical activity.

The AHA/ACSM recommendations served to clarify previous misconceptions about physical activity in order to provide people with a clear activity goal. Even with clear recommendations and the benefits of physical activity widely known, most people do not meet physical activity recommendations. Unfortunately, over half of the nation's population has not been meeting AHA/ACSM physical activity recommendations for several years (Troiano et al., 2008; Haskell et al., 2007; Haung et al., 2003).

College Inactivity

Epidemiological data reveals that across the nation physical activity levels decline from high school to adulthood (Kilpatrick et al., 2005). In 2005, 59.6% of men and women aged 18 -24 years were meeting CDC/ACSM physical activity recommendations; however, only 39% of people 65 years or older were meeting recommendations (Haskell et al., 2007). Nationally, 18.4% of adults age 18-24 reported no leisure time physical activity; while 20.8% of adults aged 25-34 reported inactivity (Behavioral Risk Factor Surveillance System, 2007). Many college students are not meeting physical activity recommendations, especially those ≥ 20 years of age (Huang et al., 2003). According to the Fall 2009 National College Health Assessment, 56.4% of college students were not meeting physical activity recommendations, whereas fall 2008 data indicated that 54.1% were not meeting recommendations (American College Health Association, 2009).

Since numerous research studies have found associations between physical inactivity and various disease conditions, programs such as Exercise is Medicine on Campus, Healthy Campus

2010 and Healthy Campus 2020 have been developed to address health issues in college students. Exercise is Medicine on Campus strives to promote physical activity and its health benefits on university campuses for all its members (http://exerciseismedicine.org/campus.htm). The organization provides tips and tools that can be used to help manage and prevent health problems through exercise.

Healthy Campus 2010 and 2020 were established in junction with Healthy People 2010 and 2020. Healthy Campus 2010 and 2020 have two objectives directly related to the CDC/ACSM and AHA/ACSM physical activity recommendations: objective 1: "increase the attainment of recommended levels of cardiovascular physical activity defined as 30 minutes of moderate physical activity at least 5 times per week or 20 minutes of vigorous physical activity at least 3 times per week"; and objective 2: "increase the proportion of people who perform physical activities that enhance and maintain muscular strength and endurance on 2 or more days of the week" (Mack, Wilson, Lightheart, Oster, & Gunnell, 2009).

Mack et al. (2009) studied these two objectives in college students across the nation via a self-report physical activity questionnaire from 2000 to 2004. The participants were 127,794 students (female = 75,968; male = 42,679) with an average age of 22.07 ± 5.89 years. The majority of the participants were enrolled in a 4 year university (95%, n = 121,412). The 2004 data showed that 42.20% (95% CI: 41.74 to 42.65) of participants reported meeting moderate and vigorous (MVPA) recommendations and 48.60% (95% CI: 48.14 to 49.06) reported meeting muscular strength and endurance guidelines. The number of participants meeting each objective fluctuated each year between 2000 and 2004 (ranging from 40.3-44.2% for objective 1, and 47.2-51.1% for objective 2) (Mack et al., 2009). The results show that small increases and decreases in physical activity occurred over a 4 year period and a large majority of college students are not engaging in adequate amounts of physical activity to obtain health benefits.

McArthur and Raedeke (2009) not only examined physical activity in college students but they also examined race and sex differences. Participants were 636 undergraduate students (mean age 19.6 ± 2.73 years, range 17 to 50 years) enrolled in a lifetime physical activity and fitness class. Participants were administered a survey during the second week of the course (prior to the start of actual physical activity during class) to prevent course content from influencing survey responses (McArthur & Raedeke, 2009). To assess physical activity, students completed the Godin Leisure-Time Physical Exercise Questionnaire. This questionnaire assessed how many times the participants completed strenuous, moderate, and mild bouts of physical activity for at least 15 minutes during a typical 7-day period. Participants were also questioned about their knowledge of physical activity recommendations. To assess knowledge participants were asked "How much moderate-intensity exercise should adults do to promote overall good health?" followed by answer options that varied in duration and frequency.

The results showed a significant interaction in sex X race with BMI as the dependent variable [F (1,588) = 6.9, p = .009)], African American females students had the highest BMI and Caucasian females had the lowest mean BMI (McArthur & Raedeke, 2009). There was also a significant main effect for race [F (1,588) = 20.16, p < .0001], with African American students having a higher average BMI compared to Caucasian students. However, some researchers suggest that race specific BMI categories are more accurate than the general BMI classifications (WHO expert consultation, 2004; Evans, Rowe, Racette, Ross, & McAuley, 2006; Rahman & Berenson, 2010). With regards to physical activity, students were physically active an average of 3.5 ± 1.87 days per week. There was a sex X race interaction in physical activity [F (1,588) =

5.32, p = .02] with a large effect size (d = .81), as well as significant main effects for sex [F(1,588) = 12.76, p < .0001] and race [F = 13.25, p < .0001] with African American female students being the least active, followed by Caucasian females, African American males, and Caucasian male students (McAuthur & Raedeke, 2009).

McArthur and Raedeke (2009) also examined knowledge of CDC/ACSM recommendations among college students. Only 40% of the students were aware of the CDC/ACSM recommendation of 30 minutes of moderate-intensity physical activity on most days of the week. In regards to sex and race comparisons, 43% of African American and 41% of Caucasian males, and 31% of African American females and 39% of Caucasian females were aware of the CDC/ACSM recommendation, but these differences were not statistically different.

Other studies have also found racial differences in regards to physical activity in adults, college students, and children (Crespo et al. 2000; Suminski, Petosa, Utter & Zhang, 2002; Felton et al., 2002). A study conducted by Crespo et al. (2000) examined racial differences in physical activity among adults 20 years and older. Crespo et al. (2000) found that African Americans (35%) and Mexican Americans (40%) reported more physical inactivity than Caucasians (18%). Suminiski et. al (2002) found that minority female students displayed higher rates of physical inactivity when compared to Caucasian female students. The reported physical inactivity rates across race and gender were 28.1% Asian females, 23.5% African American females, 17.4% Hispanic females, 20.3% Caucasian females, 11.7% Asian males, 7.7% African American males, 12.0% Hispanic males, and 13.8% Caucasian males. When examining all ethnic groups combined, the authors found that 22.0% of women and 11.3% of men did not engage in any physical activity during the month prior to the study (Suminski et al., 2002).

Physical activity patterns established as a university student could follow an individual into early adulthood (Sparling & Snow, 2002). Sparling & Snow (2002) surveyed 968 college alumni with graduation dates in the following years: 1988, 1990, 1992, 1994, and 1996. The average time past graduation for the sample was 6.2 ± 2.8 years. The participants were all graduates from a university in the southern part of the US in a major metropolitan area. Participants filled out questionnaires about their current physical activity (moderate, vigorous and strength training); high school sports; exercise patterns in college; comparisons between current physical activity levels and college physical activity levels; and awareness of current physical activity recommendations. Of the participants, 66.1% reported "enjoying exercise," 28.4% reported "neither enjoy nor dislike exercise", and 5.5% reported that they "dislike exercise" (Sparling & Snow, 2002). When the college alumni were asked to recall their typical exercise pattern in their senior year of college, 43.1% reported "regular exercise" (≥ 3 days/week), 39.5% reported "irregular exercise" (1-2 days/ week), and 17.4% described themselves as "non-exercisers" (< 1 day/ week). There were 2 major findings in the study, (a) 84.7% of those who were regular exercisers during their senior year of college, remained active 5 to 10 years later; (b) 81.3% of those who were non-exercisers as college seniors maintained an inactive lifestyle (Sparling & Snow, 2002). These findings suggest that patterns established in college have an impact on physical activity in the early years post graduation.

Numerous college students are still having trouble meeting physical activity recommendations. On many college campuses, the inactivity level is clearly evident and the obesity rate is quiet prevalent. Fortunately, many students want to become more physically active; therefore there is a need for physical activity interventions (Calfas et al., 1994). However, to develop an effective intervention, a researcher should understand the devices used to measure physical activity, such as accelerometers and questionnaires, and also understand the potential factors that could influence physical activity participation and the self-report of physical activity levels.

Physical Activity Questionnaires and Recall Bias

Self-report questionnaires are typically used to measure physical activity in large population studies (Dinger & Behrens, 2006). They provide an inexpensive and noninvasive way to collect physical activity information from individuals. The most common way to assess physical activity is through self-administered questionnaires (Slootmaker et al., 2009). There are numerous widely used physical activity questionnaires to choose from, for various age groups and in multiple languages. However, questionnaires can sometimes be associated with errors, such as overestimation of self-reported physical activity, lack of accuracy in the activity being recalled, and the inability to distinguish between varying intensities in physical activity (Dinger & Behrens, 2006).

Social desirability can also cause errors in reporting physical activity levels on questionnaires. Social desirability is the tendency of individuals to respond in a manner that is socially acceptable and consistent with social norms and beliefs (Hebert et al., 1997). Social approval is defined as the tendency to seek either praise or a positive response (Hebert et al., 1997). Adams et al., (2005) conducted a study examining the effects of social desirability and social approval on self-report physical activity questionnaires in 81 women (age range: 40 to 65 years; mean age = 49.1 years). Objective measures of physical activity were used to test for errors that could be attributed to social desirability and social approval in self-reported physical activity assessments. During the study participants completed both objective and subjective measures. Objective measurements included: doubly labeled water measurement and wearing an ActiGraph GT1M accelerometer for 14 days; while subjective measurements included: 7 interviewer administered 24-hour physical activity recalls (PARs), 2 self-administered 7-day PARs, a 33-item Marlowe-Crowne Social Desirability Scale, and a 20-item Martin-Larson Approval Motivation Scale.

Adams et al. (2005) found that social desirability was positively associated with over reporting of physical activity on questionnaires (the Stanford Five-City Project's 7-day recall and the Minnesota Leisure Time Physical Activity Survey). This means that people who scored higher on a social desirability scale were more likely to over report the amount of time they were engaged in physical activity. Energy expenditure was overestimated by 0.65 kcal/kg/day on the second 7-day PAR (95% CI: 0.06, 1.25) when compared to double labeled water, and moderate and vigorous activity durations were overestimated ranging from 4.15—11.30 minutes/day on both 7-day PARs when compared to the ActiGraph GT1M accelerometer (Adams et al., 2005). Social approval was negatively associated with interviewer administered 24-hour PAR among women with a BMI of 27 kg/m^2 or higher ($\beta = -0.25$, 95% CI: -0.45, -0.04), but not among women with a BMI lower than 27 kg/m^2 (Adams et al., 2005). Overweight women were more likely to want to "please" the study staff by reporting higher levels of physical activity.

In a study conducted by McMurray et al. (2008), BMI status and physical activity recall were examined in young girls. McMurray et al. (2008) compared overweight and normal weight adolescent girls to determine if overweight girls were more likely to over report physical activity levels. McMurray et al. (2008) assessed 1021 girls aged 11-14 years (37% overweight). Each child wore an Actigraph GT1M accelerometer for 6 consecutive days. The ActiGraph was set to record in 3-second intervals; and an 18-hour day was used for each girl (6AM to midnight). A participant was considered compliant if they wore the monitor during 80% of the time available during a given block (blocks: before school, during school, after school, early evening, and evening). After the accelerometer was returned the girls completed a 3 Day Physical Activity Recall (PAR) with the supervision of a trained research assistant. Only data from the previous day PAR (PDPAR) was used due to the accuracy of the recall data declining in the second and third day. Based on weight status, participants were placed into one of 3 categories: (1) normal: BMI < 85th percentile, (2) at risk for overweight: BMI ≥ 85th to < 95th percentile, (3) overweight: BMI ≥ 95th percentile. Self-reported intensities for common activities were assessed by using the 8 most frequently recalled activities in the PDPAR.

The results from the study showed that when using a questionnaire the at risk for overweight and the overweight girls reported similar levels of MVPA. According to accelerometer data the normal weight girls averaged 25.3±1.1 min MVPA/day, while the overweight group averaged 20.8±1.5 min/day. Accelerometer count data was compared to the blocks of self-report data from the PDPAR by using a counts/block ratio (Cts:B ratio). By using the counts/block ratio, McMurray and colleagues (2008) found that girls who were at risk for overweight (cts:B ratio = 11.43) and overweight girls (cts:B ration= 11.19) obtained fewer minutes of MVPA than normal weight girls (cts:B ratio = 13.88). This suggested that girls who were either at risk for being overweight or overweight over-estimated their MVPA levels to a greater extent than normal weight girls. The results from the study also found that there were no significant differences in the intensity ratings for a given activity across the 3 BMI categories (McMurray et al., 2008). Meaning that girls in each BMI category reported similar intensity ratings for the 8 most frequently recalled activities in the PDPAR. One explanation for this finding was that people often exercise within their own comfort zone. Therefore, at risk for overweight girls may have lowered their intensity level to compensate to a certain comfort level (McMurray et al., 2008). In contrast, others found that overweight individuals have a higher rate of perceived exertion than normal weight individuals during exercise (Ekkekakis & Lind, 2005). If Ekkekakis & Lind are correct, this could have major influences on physical activity interventions and programs. Many physical activity interventions do not take into consideration that overweight and obese individuals might have a higher rate of perceived exertion. This in turn may have led to interventions and programs that start out at an advanced and unsafe level for these individuals. In most of the successfully weight loss programs, that slowly progress, the average weight loss is approximately 1 kg per week (Dishman, Washburn & Heath, 2004). However, this slow progress in weight loss is often discouraging to those who see extreme weight loss programs that include dangerous levels of physical activity publicized. Popular television shows such as the Biggest Loser and Celebrity Fit Club have glamorized these intense physical activity levels in an unfit subgroup. Research shows that a 50% drop out rate in the first 6 months of weight loss programs is common (Dishman et al., 2004). This subgroup should be handled with a more gradual progression in physical activity, yet safely challenging, if Ekkekakis and Lind's findings are correct.

Results similar to McMurray et al. (2008) have been found in adults (Slootmaker et al., 2009; Buchowski, Townsend, Chen, Acra, & Sun, 1990). Slootmaker et al. (2009) found that overweight adults reported higher amounts self-reported vigorous physical activity when compared to accelerometer data. McMurray et al. (2008) study's findings could play a significant role in data collection and interventions because some overweight individuals believe they are getting more physical activity than they really are. This could be a problem if a person is trying to either lose weight or make health improvements. In a study conducted by Lichtman et al.,

(1992) it was found that obese individuals (average age 48 ± 12 years) who were trying to lose weight and also had a history of failing to lose weight, underreported their actual food intake by an average 47 ± 16 percent and over reported their physical activity by 51 ± 75 percent. Other studies have found that overweight individuals tend to underreport their caloric intake and/or over report their physical activity (Irwin, Ainsworth & Conway, 2001; Braitman, Adlin & Stanton, 1985; Prentince et al., 1986; Jakicic et al., 1998). Jakicic et al. (1998) found that 40-60% of overweight women in a weight loss program over reported the amount of physical activity they performed, and also loss less weight than those who under-reported or accurately reported their physical activity. Overweight individuals are possibly exercising well below their intended levels of physical activity. Therefore understanding potential errors associated with self-report instruments are important, as well measuring physical activity objectively when possible.

The majority of physical activity studies examining physical activity and self-efficacy have not focused on college students. Furthermore, the few studies in this population have predominately used physical activity questionnaires to assess students' physical activity levels (Keating, Guan, Pinero, & Bridges, 2005; Dinger & Behrens, 2006; McAuthur & Raedeke, 2009; Suminski et al., 2002; Buckworth & Nigg, 2004; Burke, Carron & Eys, 2005; Huang et al., 2003; Kilpatrick et al., 2005). According to Keating et al. (2005) one problem with previous research studies in college students is their "inconsistent and subjective physical activity measures." By only relying on questionnaires to assess physical activity, researchers set themselves up for many potential sources of error such as overestimation and discrepancies in physical activity intensity ratings (Dinger & Behrens, 2006). Many college students are not meeting physical activity guidelines, (Huang et al., 2003). Consequently it is essential that researches gather accurate information regarding physical activity in college students in order to counteract the growing trend of inactivity in this population. The use of objective measuring devices could help reduce the number of limitations associated with questionnaires and previous college physical activity research studies (Dinger & Behrens, 2006).

Physical Activity Monitoring Devices

Due to the limitations associated with questionnaires, some researchers choose to measure physical activity objectively with devices such as pedometers, heart rate monitors, and doubly labeled water. Accelerometers are an easy and commonly used method to assess free living activity. They can determine the amount of time spent at various physical activity intensities by objectively quantifying physical activity (Sirard, Melanson, Li, & Freedson, 2000). Accelerometer reliability studies have been traditionally conducted in a laboratory setting with standardized movements (Metcalf, Curnow, Evans & Voss, 2002). A study in 2004 examined the reliability of accelerometers through standardized bouts of activity (Welk, Schaben, & Morrow, 2004). In the study, Welk et al. (2004) examined the reliability of four different types of accelerometers (CSA/MTI ; Brotrainer Pro; Tritrac; Actical) in four samples of approximately 32 to 38 university students majoring in Exercise Science. Participants completed 3 trials of walking on a treadmill at 3 mph for 5 minutes while wearing 1 of the 4 brands of accelerometers. A G coefficient, which functioned as an extension of intraclass reliability, determined the reliability of each monitor. The CSA/MTI monitor had the highest G coefficient (G = 0.64; SEM = 348) for a single trial compared to the Tritrac (G = 0.573; SEM = 184), Biotrainer Pro (G =0.557, SEM = 0.664), and Actical (G = 0.432, SEM = 557) (Welk et al., 2004). The intraclass correlation coefficient was also determined across multiple trails. The intraclass correlations were 0.80 for the CSA/MTI, 0.73 for the Tritrac, 0.68 for the Biotrainer, and 0.62 for the Actical (Welk et al., 2004). The variability across monitoring units was also calculated and labeled as the monitor (M) term. The CSA/MTI had the smallest variability across monitors (M = 0.9%) while the Tritrac had the largest variability (11.6%) (Welk et al., 2004). The M term for Biotrainer Pro was 9.4%, and Actical had a M term of 9.6% (Welk et al., 2004). Overall, the CSA/MTI monitor was determined to have the least amount of error in this study; it was also determined to have acceptable reliability (Welk et al., 2004).

However, there are limitations associated with accelerometers as well. In a validity study by Hendelman et al. (2000), accelerometers had limitations in detecting certain types of activities. Hendelman et al. (2000) had 25 participants (10 male, 15 female) between the ages of 30 and 50 years (average age was 40.8 ± 7.2 years) engage in various physical activities while wearing a portable metabolic system to measure respiratory gas exchanges, CSA accelerometer, triaxial Tritrac monitor, and a Yamax pedometer. Each participant walked at four self selected speeds (leisurely, comfortable, moderate and brisk pace) on an indoor track, played two holes of golf while pulling their clubs in a cart. The participants also completed the following indoor and household task: 5 minutes of washing windows, dusting, vacuuming, using a push lawn mower, and planting shrubs (Hendelman et al., 2000). Accelerometers were unable to detect upper body movement or changes in terrain, therefore they have the potential to underestimate free-living physical activity (Hendelman et al., 2000). Basset et al. (2000) reported similar findings in adults. They found that accelerometers underestimated physical activity during upper body movements, arm movements, pushing, and changes in terrain (Bassett et al., 2000)

The results from the Hendelman et al. (2000) study revealed a moderate correlation (r = .77) between the metabolic cost (METs) and the CSA counts and a strong correlation (r = .89) between the Tritrac and METs calculated for the walking trials. The correlations were reduced when all the activities were combined in the comparison, r = .59 for the CSA and r = .62 for the Tritrac (Hendelman et al., 2000). The authors found that these two accelerometers underestimated the intensities of all the activities when compared to the MET value. This suggests that using accelerometers to estimate energy cost in field evaluations is not highly accurate because the type of activity performed may be inappropriate when compared to a laboratory developed equation (Hendelman et al., 2000).

It is believed that accelerometers can estimate light to moderate physical activities more accurately than a questionnaire (Welk, Thompson, Galpher, & Dunn, 1997). One study found accelerometers to be reliable in field based research (Sirard et al., 2000). Sirard et al. (2000) compared a CSA accelerometer, a 7-day recall, and an activity diary (criterion measure) during a field evaluation. The participants (9 male and 10 female) wore an accelerometer (model 7164) for 7 days, completed a 7-day physical activity recall, and an activity diary on 3 days (Sirard et al., 2000). Initially, there were 10 men and 10 women (aged 25.0 ± 3.6 years) in the study (Sirard et al., 2000).

When comparing the accelerometer and the 3-day activity diary, no significant differences were found between time spent in moderate intensity (Sirard et al., 2000). However, the accelerometer recorded 5.9% more time spent in light activity ($P < .01$) when compared to the 3-day activity diary (Sirard et al., 2000). The accelerometer also recorded 81% less hard activity ($P < .01$) and 84% less very had activity ($P < .01$) compared to the 3 day activity diary (Sirard et al., 2000). The coefficient of determination between the accelerometer total counts and the diary total kcal was 68% (Kappa = 0.53, $P < .01$) (Sirard et al., 2000).

When the accelerometer and the 7-day recall were compared, no significant difference was found between the number of minutes spent in light activity (*P* = .26) (Sirard et al., 2000). However, when moderate activity was compared, the accelerometer recorded 43.8% less activity (*P* = .06) than the 7-day recall, 94.3% less hard activity (*P* < .01), and 93.8% less very hard activity (*P* < .01) (Sirard et al., 2000).

Sirard et al. (2000) concluded that the accelerometer correlated more strongly with the 3-day activity diary and the 7-day physical activity recall when total kcal and total counts were compared as opposed to specific activity intensities (Sirard et al., 2000). This could be due to individuals having different perceptions of physical activity intensities based on their fitness level (Sirard et al., 2000). Another researcher suggested that psychological factors such as social desirability could also play a part in how individuals respond to physical activity recalls (Adams et al., 2005). Sirard et al. (2000) determined that CSA accelerometers could be useful in the field for measuring total physical activity and patterns of physical activity in young adults. Accelerometers are a popular choice for researchers when studying physical activity in the field because accelerometers are often more practical than other objective measuring techniques such as doubly labeled water, heart rate monitors, and pedometers.

The previously mentioned studies show that accelerometers can be used to objectively measure physical activity. However, there are limitations associated with accelerometers as well. Most accelerometers are designed to detect ambulatory movements at the waist, and are dependent on the type of physical activity performed (Slootmaker et al., 2009). It appears that accelerometers are more reliable in laboratory settings versus free-living physical activity settings. This could be due to the fact that accelerometers are unable to detect upper body movement such as pulling or lifting objects, or changes in terrain, which could ultimately lead to an underestimation in free-living physical activities (Hendelman et al., 2000). However, Sirard et al. (2000) found that accelerometers could sufficiently be used to measure total physical activity counts in free-living situations. Specific physical activity intensities were compared and the accelerometer was less accurate in free-living physical activity when compared to an activity diary, and 7-day physical activity recall (Sirard et al., 2000). Nevertheless, there are numerous outside factors, such as upper body movement, accelerometer placement, and type of physical activity, that influence the accuracy of physical activity monitoring devices, thus there is no gold standard method used to measure physical activity at this point. It is unclear if discrepancies between the accelerometer and non-objective measures could also be due to the participant's individual perceptions of physical activity intensities based on fitness level and/or psychological factors such as social desirability or self-efficacy as well. Furthermore, no objectively measured studies regarding this issue in college students were found.

Self-Efficacy

Many factors can influence individuals' physical activity levels (Furia, Lee, Strother, & Huang, 2009). Self-efficacy focuses on an individual's belief that he/she will be successful in performing a certain behavior (Lox, Ginis & Petruzzello, 2006). Bandura (2004) believed that self-efficacy was a large determining factor in human action. Girls who have a higher physical activity self-efficacy are less influenced by their believed barriers, and more likely to be physically active (Dishman et al., 2005). Ball et al. (2000) found that overweight individuals, particularly women, have a lower exercise self-efficacy. The perception of being too fat to exercise can become a barrier to physical activity among overweight and obese individuals (Ball, Crawford & Owen, 2000). This means that overweight/obese individuals are less likely to engage in physical activities, therefore increasing the risk for health problems.

Individuals with low versus high self-efficacy have differences in examining the rate of perceived exertion during exercise. Pender et al. (2002) studied pre and post-exercise self-efficacy levels in 103 females, aged 8 to 17 years (89% Caucasian and 11% other racial/ethnic groups). The participants attended two sessions in a laboratory. During the first session, data was collected for demographics, physical activity history, anthropometric measures, and peak VO_2 (Pender et al., 2002). Five to 7 days later the girls attended their second session. During this session each participant cycled for 20 minutes on a cycle ergometer at 60% of their own peak VO_2. Participants cycled in a climatic chamber in order to simulate a warm summer day (90 degrees F, 50% relative humidity).

Participants' self-efficacy towards multiple cycling tasks on a stationary ergometer was assessed via an 8-item questionnaire with progressively more difficult cycling tasks (Pender et al., 2002). Rate of perceived exertion (RPE) was measured every 4 minutes during the cycling tasks. The tasks varied from five 1-minute increments of cycling for 5 total minutes of cycling continuously at a fast paced for 40 minutes (Pender et al., 2002). Each participant ranked their confidence on each task on a scale from 0 (not at all confident) to 100 (completely confident). Self-efficacy scores were determined by summing the confidence rating from all items and dividing by the total number of items (Pender et al., 2002). The self-efficacy levels were measured before and 20 minutes after the cycling tasks.

Results revealed that pre-exercise self-efficacy scores were inversely related to RPE during the exercise test ($r = -.41$, $\rho \leq .001$) (Pender et al., 2002). The participants with a higher pre-exercise self-efficacy had a lower RPE during the exercise task (Pender et al., 2002). RPE was inversely related to post-exercise self-efficacy as well ($r= -.38$, $\rho \leq .001$); meaning lower RPE levels during exercise were associated with a greater sense of physical activity self-efficacy following exercise (Pender et al., 2002). RPE was also inversely associated with peak VO_2 (r = -.21) (Pender et al., 2002). Similar findings regarding RPE and self-efficacy were also found in adults (Rudolph & McAuley, 1996). Rudolph & McAuley (1996) found that adults with lower self-efficacy reported a higher RPE during exercise. These results suggests that having low self-efficacy in physical activity may hinder an enjoyable exercise experience due to discomfort and lead to lower physical activity levels (Pender et al., 2002). These individuals could also decide that they are not capable of being successful at completing physical activity tasks and consequently, they never change from being sedentary to a healthier lifestyle.

What does this mean for previously sedentary individuals who successfully make it through a physical activity intervention program? McAuley (1993) examined self-efficacy in the maintenance of exercise participation in previously sedentary middle aged adults, who completed a structured exercise program. Sixty-six (38 females and 28 males) of the 99 original exercise program participants took part in a 4 month post intervention study (McAuley, 1993). A series of analysis showed that the responders that participated in the follow-up were similar on either self-efficacy or other psychological parameters when compared to the people who only participated in the original study and not the follow-up (McAuley, 1993). However, the responders attended significantly more exercise sessions during the exercise intervention (McAuley, 1993). During the follow-up study, participants were measured on their (a) exercise behavior via telephone interview questions and mailed a Seven Day Physical Activity Questionnaire, (b) self-efficacy towards exercising three times a week in face of barriers, and (c) self-efficacy towards future exercise participation (McAuley, 1993). Results showed that the participants with higher self-efficacy reported a "greater maintenance of exercise participation" during the 4 months post exercise intervention (McAuley, 1993). The results suggest that individuals with a higher self-efficacy are more likely to overcome physical activity barriers and maintain exercise post intervention. Therefore, adult physical activity interventions should also address self-efficacy in order to gain long term maintenance in exercise change.

Self-efficacy may play a major part in the physical activity participation among college students (Sullum, Clark, & King, 2000; Wallace, Buckworth, Kirby, & Sherman, 2000). In a study conducted by Sullum and colleges (2000), 52 Brown University undergraduates (age range 18 to 23 years) were measured on process of change, decisional balance, self-efficacy and exercise relapse at baseline and approximately 8 weeks later at follow-up. At baseline, participants were described as physically active students who participated in physical activity at least 3 times per week for at least 20 minutes per session. At follow-up, 13% (n=7) of the participants were described as relapsers (those individuals who did not exercise at least 3 times per week for at least 20 minutes per session at follow-up), and 87% (n = 45) were exercise maintainers (those who were still physically active at least 3 times per week for at least 20 minutes per session). When comparing those who relapsed to those who maintained, the researchers found that the participants who relapsed reported more cons in the decisional balance questionnaire at baseline than the maintainers reported (Sullum et al., 2000). Also, relapsers reported fewer pros to exercise over time, whereas the number of pros reported did not change significantly for the maintainers (Sullum et al., 2000). Furthermore, the relapse group scored lower on self-efficacy at baseline compared to the maintainer group (Sullum et al., 2000). The study's findings suggest that those with higher self-efficacy are less likely to relapse.

A study conducted by Wallace et al. (2000) examined 937 undergraduate students to study the role of self-efficacy has in stage of change in exercise behavior. A cross sectional survey was mailed to participants to examine "personal, behavioral, and environmental characteristics" linked with exercise behaviors (Wallace et al., 2000). The study determined that self-efficacy, physical activity history, and a non-exercise VO_2 max estimation significantly predicted the current stage of change for exercise behavior in an individual (Wallace et al., 2000). In females, exercise self-efficacy ($p < .001$) was one of the best predictors of stage of exercise behavior change. In males, physical activity history ($p < .001$), and exercise self-efficacy ($p < .001$) were strong predictors of stage of exercise behavior change (Wallace et al., 2000). So the higher these factors are, the better the stage of change in college students.

Self-efficacy influences children's physical activity patterns as well. Trost et al. (2001) studied 187 sixth grade students (133 non obese and 54 obese) with a mean age of 11.4 ± 0.6. BMI classification was used to define obesity status as a BMI $\geq 95^{th}$ percentile. Participants wore an accelerometer (CSA, model 7164) for 7 days and completed questionnaires, on physical activity self-efficacy, social influence regarding physical activity, beliefs about physical activity outcomes, perceived physical activity levels of parents and peers, access to sporting and fitness equipment at home, involvement in community physical activity organizations and sports teams, and hours spent watching television or playing video games (Trost, Kerr, Ward, & Pate, 2001). Results revealed that obese children had significantly lower daily accumulation of total physical activity counts, lower moderate physical activity counts, vigorous physical activity counts and fewer 5, 10 and 20 minute bouts of MVPA when compared to the non-obese children. (Trost et al., 2001). Obese children were also involved in significantly fewer community-based physical activity organizations and had a significantly lower level of physical activity self-efficacy. Trost et al. (2001) suggests that these results indicate a need address self-efficacy when monitoring physical activity patterns. The role that obesity status and physical activity levels have on self-efficacy in college students is currently unknown.

When studying physical activity it is important to gather accurate measures of physical activity in order to obtain valid estimates of physical activity levels. Sometimes personality traits can affect the accuracy of a measurement (Adams et. al 2005). Adams et al. (2005) found that personality traits, such as social desirability, affect how an individual responds in self-report physical questionnaires. People who scored higher on social desirability scale are more likely to over report the amount of time they engage in physical activities (Adams et al., 2005). Physical activity self-efficacy has been found to affect physical activity levels (Dishman et al., 2005). It has been found that people who have a higher physical activity self-efficacy are more likely to be physically active, yet it is unclear if physical activity self-efficacy influences the level of accuracy in recalling physical activity on self-report questionnaires in college students (Dishman et al., 2005). However, it was found that self-efficacy towards physical activity recall can affect the recall accuracy in adults completing a physical activity questionnaire (Cust et al., 2009).

Cust et al. (2009) examined self-efficacy towards physical activity recall and recall accuracy in 97 males and 80 females between the ages of 50 and 65 years. At baseline, participants completed the European Prospective Investigation into Cancer and Nutrition (EPIC) past year physical activity questionnaire and the IPAQ 7-day questionnaire. During follow-up, the participants wore an ActiGraph accelerometer for a 7-day period on 3 separate occasions that were 14 weeks apart. Ten months after baseline, the EPIC and IPAQ were administered again. Participants also rated their self-efficacy towards each answer on both questionnaires at baseline and follow-up (Cust et al., 2009).

The results showed that those who reported higher levels of self-efficacy towards recall had higher recall accuracy for 8 out of 12 physical activity measures on each questionnaire (Cust, et al., 2009). The eight physical activity measures included 5 items on the EPIC (total physical activity index, occupational activity index, total non-occupational activity, vigorous activity, and light-moderate activity) and 3 items on the IPAQ (total moderate + vigorous activity, moderate activity, and moderate activity + walking). The authors concluded that self-efficacy ratings towards physical activity recalls could be useful as indicators of recall accuracy. Due to limited research it is unclear if moderate and vigorous physical activity self-efficacy influences the level of accuracy in recalling physical activity in college students.

Summary

The rate of obesity has increased tremendously over the past two decades. Obesity is associated with: coronary heart disease, type 2 diabetes, cancer, hypertension, dyslipidemia, stroke, liver disease, gallbladder disease, sleep apnea, osteoarthritis, and gynecological problems (Must et al., 1999). With so many diseases linked to obesity, it is imperative that this issue is taken seriously. With unhealthy behaviors, such as: unhealthy eating habits and physical inactivity, starting at a young age and progressively becoming worse over time, it is important to combat these issues early in a person's life. A high percentage of college students are overweight and do not meet physical activity guidelines, thus it is important that reliable physical activity measures exists to better serve this population (Huang et al., 2003).

Physical activity questionnaires are associated with sources of error, such as overestimation of self-reported physical activity, lack of accuracy in the activity being recalled, and the inability to distinguish between varying intensities in physical activity (Dinger & Behrens, 2006). McMurray et al. (2008) found that girls who are overweight tend to over report their physical activity, and they perceive themselves as doing more physical activity than they're actually doing. It is unclear if obesity status affects self-report physical activity measures in college aged students too. Since questionnaires can be associated with error, objective measures, such as accelerometers are often used to measure physical activity. Unfortunately, there are numerous outside factors that influence the accuracy of physical activity monitoring devices as well, such as mode of physical activity and accelerometer placement (Hendelman et al., 2000). Currently, there is no gold standard device used to measure physical activity. Thus, a researcher must determine factors that affect physical activity measuring devices in order to better understand their output.

The cognitive factor self-efficacy has been known to play a part in the actual participation of physical activity (Dishman et al., 2005; Ball et al., 2000; Bandura, 2004; Lox et al., 2006). Self-efficacy focuses on an individual's belief that he/she will be successful in performing a certain behavior (Lox et al., 2006). Dishman et al. (2005) found that girls who have higher self-efficacy about physical activity were less influenced by their believed barrier, and more likely to be physically active. In a study conducted by Ball et al. (2000), it was found that overweight individuals, particularly women, have a lower exercise self-efficacy. These individuals were less likely to engage in physical activities, therefore increasing their risk for health problems. Self-efficacy has also been shown to play a part in the way a person reports physical activity level intensities. In a study conducted by Pender et al. (2002) it was found that when participants exercised at 60% of their VO_2 max, higher pre-exercise self-efficacy levels were associated with a lower RPE during the exercise task; and it was found that RPE was inversely related to post-exercise self-efficacy as well. Rudolph & McAuley (1996) found similar results; in that adults with lower physical activity self-efficacy reported higher RPE during exercise. These results suggest that having low self-efficacy in physical activity may be related to more discomfort during exercise and lead to lower physical activity levels. Results also suggest that people with lower self-efficacy levels could perceive themselves as doing more physical activity (higher RPE levels) than they actually are. It is unclear if low self-efficacy levels could lead to discrepancies on physical activity questionnaires by over reporting.

A study conducted by Cust et al. (2009) showed that self-efficacy towards physical activity recall could play a role in the accuracy of recalling physical activity on self-report questionnaires. The results showed that those who reported higher levels of self-efficacy towards recalling physical activity had higher recall accuracy for most of the physical activity measures on each questionnaire (Cust et al., 2009). However it is unclear if physical activity self-efficacy influences recall accuracy similar to the way self-efficacy towards physical activity recall affects recall accuracy.

The purpose of this study is to determine if self-reported and objectively measured physical activity levels differ among college students with different BMI classifications. A secondary purpose is to determine if physical activity self-efficacy is correlated with accuracy in self-reported physical activity levels. The results from this study, could aid in gathering accurate physical activity measures among college students.

Significance

Numerous college students are not meeting physical activity guidelines. Therefore, there is a need for accurate physical activity measurements and interventions in this group. This study is significant because it measures physical activity objectively in college students. Many of the previous physical activity data gathered in this age group has been collected via self-report questionnaires. If discrepancies exist between self-report physical activity questionnaires and accelerometers among college students with different BMI classifications and/or physical activity self-efficacy levels, the information could be useful for researchers and fitness professionals. Researchers and fitness professionals could use the knowledge from this study to find more accurate ways to collect physical activity data and also develop more effective physical activity interventions. For example, self-report questionnaires could be less accurate in college students with a greater BMI, which in turn could lead to newer and more effective self-report questionnaires for data collection. In regards to fitness professionals, they could potentially have access to more accurate physical activity data which in turn could lead to more safe and effective interventions that progress at a more realistic pace.

CHAPTER 3: METHODS

Participants

Participants were undergraduate students recruited through various Psychology 1000 classes at East Carolina University. Participants between the ages of 18-24 years were included. Participants over the age of 24 were excluded in order to sample "traditional" students in a similar developmental period. All participants were full-time degree seeking students at the university. Students were required to complete an informed consent before participating in the study (see Appendix B). All procedures were approved by the University Medical Center Institutional Review Board (see Appendix A).

The goal was to examine students across a variety of BMI categories (healthy, overweight, and obese). A total of 62 participants were recruited for the study. Participants were ambulatory without any pre-existing conditions that excluded them from physical activity, such as: cardiovascular disease and severe cancer.

Recruitment

Participants were recruited through Psychology 1000 courses via the Psychology Department's Experiment Track at East Carolina University. Psychology 1000 is an entry level required course for a variety of majors at East Carolina University. Students in Psychology 1000 courses were given the opportunity to partake in research studies. Students were allowed to sign up to participate in research studies after reading the research description available on the Experiment Track website. Once a potential participant expressed interest in this particular study, the participant was questioned to see if he/she met inclusion criteria. Interested students were questioned about their height and weight to ensure a variety of BMI categories were represented in the study, and also on their activity level to ensure a diverse group of active and inactive individuals was represented. Activity level was assessed by asking the participants: Considering a 7-Day period (a week), during your leisure-time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)? (1) Often (2) Sometimes (3) Never/rarely. Participants were classified as active if they answered with "often" or "sometimes". As an incentive for participating in the study, participants received up to 5 credit points in towards their Psychology 1000 course, a debriefing about physical activity levels, and individual physical activity recommendations based on the data collected.

Design

The study design was correlational in nature. The accuracy in self-reported physical activity levels were compared across different BMI classifications. Moderate and vigorous physical activity self-efficacy levels were also compared to physical activity levels. Social desirability, self-reported physical activity, and physical activity recall self-efficacy were also assessed. Data collection took place over an 8-10 day period. During the process the participants were given an accelerometer and were also asked to complete 6 different questionnaires.

Procedures

Informed consent and demographic information regarding age, race, sex, and class standing (freshman, sophomore, junior and senior) were collected. Students were questioned on whether or not they were currently trying to lose weight. Anthropometric measures were taken on each participant including height and weight. BMI status was determined from these measures and participants were classified as normal, overweight, or obese. Participants completed a physical activity self-efficacy questionnaire and Marlowe Crowne social desirability scale, on day 1; they were also issued an ActiGraph GT1M accelerometer. They were instructed to wear the accelerometer at hip level, in line with their knee. Each participant was instructed to begin wearing the accelerometer the day after receiving the device for a total of 7 consecutive days for at least 8 hours a day. After completing 7 days of accelerometer wear, the participant returned the device and completed the BRFSS, IPAQ-short questionnaire, as well as a 7 item questionnaire regarding their self-efficacy towards recalling physical activity on the IPAQ-short questionnaire.

Following data collection, the participants received feedback regarding their current physical activity levels. They also received individualized physical activity recommendations based on their collected data measurements.

Anthropometric Measures

Participants' height and weight were measured in the laboratory with the participant's shoes off. Participants removed any extraneous items (keys, cell phone, etc.) from their clothing before stepping on the scale. Height was recorded to the nearest centimeter and weight was recorded in kilograms to the tenth decimal place. BMI was calculated as body mass in kilograms divided by height in meters squared (kg/m^2). Normal weight was classified as BMI 18.5-24.9 kg/m^2, overweight as a BMI 25-29.9 kg/m^2, and obese as a BMI $\geq$ 30 kg/m^2 (National Institutes of Health, 1998).

Measurement of Physical Activity

Activity Monitor

Numerous techniques could have been used to measure physical activity in a field-based setting such as pedometers, heart rate monitors and doubly labeled water. However, an accelerometer was chosen because it is a device commonly used to objectively measure physical activity. Even though doubly labeled water is more accurate than accelerometer based assessments, the accelerometer is less expensive than doubly labeled water and more practical in this research study.

An ActiGraph accelerometer was used in the study to measure physical activity. ActiGraph GT1M accelerometers are dual-axis accelerometers that measure and record activity counts and steps taken (ActiGraph, Pensacola, FL). The data output from the accelerometer is reported as activity counts using the manufacturer's software (Rothney, Apker, Song & Chen, 2008). The validity of the ActiGraph GT1M accelerometer has been reviewed in several studies. In a validity study conducted by Hendelman et al. (2000), a moderate relationship ($r = .77$) was found between CSA (a.k.a. ActiGraph) accelerometer counts and metabolic costs (METs from portable metabolic measuring system) in field based walking activities. A reduced correlation ($r = .59$) was found in activities such as golf, washing windows, dusting, vacuuming, pushing a lawn mower, and planting shrubs (Hendelman et al., 2000). In a study conducted by Sirard et al. (2000), the CSA accelerometer was compared to a 3-day recall and a 7-day recall. When comparing the accelerometer and the 3-day activity diary, no significant differences were found between time spent in moderate intensity (Sirard et al., 2000). When the accelerometer and the 7-day recall were compared, no significant difference was found between the number of minutes spent in light activity ($P = 0.26$) (Sirard et al., 2000). Sirard et al. (2000) determined that CSA accelerometers could be sufficient in observing field based physical activity in young adults.

The epoch level for each accelerometer was set at 1 minute. The majority of studies in adults using accelerometers estimate physical activity intensity have used cut points based on 1-min epochs (Trost, McIver, & Pate, 2005; Freedson, Melanson, & Sirard, 1998). Participants were instructed to wear the accelerometer for 7 total days. Previous research has shown that 3 to 5 days of monitoring is required to reliably estimate habitual physical activity (Trost et al., 2005; Matthews, Ainsworth, Thompson & Basset, 2002). Therefore, for this study, 4 days of accelerometer wear for at least 8 hours per day counted as valid day of wear.

To determine the number of minutes spent at different intensities of physical activity, the Freedson et al. (1998) cut points were used: light, $\leq$ 1952 $ct{\cdot}m^{-1}$; moderate, 1953-5274 $ct{\cdot}m^{-1}$; vigorous, 5725-9498 $ct{\cdot}m^{-1}$; and very vigorous activity, more than 9498 $ct{\cdot}m^{-1}$. The vigorous and very vigorous categories of Freedson et al. were combined to create a total vigorous physical activity category ($\geq$ 5725 $ct{\cdot}m^{-1}$). These cut points were the most common cut points used in previous studies that were researched for this investigation (Ainsworth et al., 2000).

Physical Activity Questionnaire.

The BRFSS was self administered to determine the physical activity that occurred in a typical week. The BRFSS has 13 questions regarding occupational, leisure-time, household, transportation, walking, muscle strengthening, moderate, and vigorous physical activities. A previous study conducted by Yore et al. (2007) found that the validity BRFSS had fair agreement (k = .26 to .31, CI: 0.09—0.53) to the ActiGraph GT1M accelerometer. This questionnaire was chosen because it is commonly used on a national level to measure progress towards meeting physical activity guidelines (Yore et al., 2007).

The IPAQ-short was self administered to determine the physical activity that occurred in the previous 7 days. The IPAQ-short is a 4 item questionnaire that assesses vigorous physical activity, moderate physical activity, and walking activity. The IPAQ-short was chosen because it was found to be reliable and valid in numerous countries (Craig et al., 2003). The IPAQ-short corresponded to the same 7 days the participants wear the ActiGraph GT1M accelerometers. Craig et al. (2003) demonstrated that the criterion validity of the self-report IPAQ-short had fair to moderate agreement ($\rho = .30$, 95% CI 0.23–0.36) to CSA accelerometers, which was comparable to other self-reported validation studies (Sallis & Saelens, 2000). Craig et al. (2003) also found the test-retest reliability of the IPAQ short to be “generally good” ($\rho = .76$, 95% CI 0.73–0.77). Hagstromer et al. (2006) found a strong positive relationship between ActiGraph GT1M accelerometers and the IPAQ-long for total physical activity ($\rho = .55$, $P < .001$) and vigorous physical activity ($\rho = .71$, $P < .001$); however, a weaker relationship was found in moderate physical activity ($\rho = .21$, $P = .051$). It was determined that a self-administered IPAQ-long has acceptable validity when assessing physical activity levels in patterns in healthy adults (Hagstromer, Oja & Sjostrom, 2006). Dinger et al. (2006) found the reliability and validity in the IPAQ-short with college students. Moderate to high reliability ($r = .71$ to $.89$) was found between two administrations of the IPAQ-short. Criterion validity correlation coefficients ranged from 0.15 to 0.26 for total weekly time spent in physical activity from the IPAQ-short and values from the ActiGraph GT1M accelerometer (Dinger, Behrens & Han, 2006). For time spent in moderate activity, the IPAQ-short was significantly associated with the majority of accelerometer variables ($\rho = .19$ to $.23$, $p < .05$). The results suggest that the validity and stability reliability of the IPAQ-short are acceptable for use in college students.

Measurement of Self-Efficacy

Physical Activity Self-Efficacy

A self-efficacy scale was developed for the study to assess exercise self-efficacy in meeting the AHA/ACSM moderate and vigorous intensity recommendations. The scale was developed based on the recommended approach by Bandura (1997) and McAuley and Mihalko (1998). The questionnaire consisted of two parts, one to gauge moderate physical activity self-efficacy and another for vigorous physical activity. The moderate intensity physical activity self-efficacy scale was similar to the scale used by Raedeke et al. (2010). The moderate scale consisted of 13-items, which asked the participant to rate their degree of confidence in their ability to perform moderate intensity physical activity, with progressive conditions: 5, 10, 15, 20, and 30 minutes consecutively on a confidence scale from 0-100%. They also rated their degree of confidence in completing 30 minutes of moderate intensity physical activity for the following: 1, 2, 3, 4, 5, 6, and 7 days a week. The vigorous intensity scale, modeled after the Raedeke et al. (2010) scale consisted of 11 items, which asked the participant to rate their degree of confidence in their ability to perform vigorous intensity physical activity, with progressive conditions: 5, 10, 15, and 20 minutes consecutively on a scale from 0-100%. They also rated their degree of confidence in completing 20 minutes of vigorous intensity physical activity for the following: 1, 2, 3, 4, 5, 6, and 7 days a week. A physical activity self-efficacy score was obtained for each moderate and vigorous intensities by averaging the sum of items to result in 0% - 100% confidence rating.

Physical Activity Recall Self-Efficacy.

Self-efficacy in physical activity recall was measured by asking the participants to rate their confidence in recalling past physical activity on the IPAQ-short. The self-efficacy in physical activity recall questionnaire was the exact replica of the questionnaire used in a previous study by Cust et al. (2009). The questionnaire consisted of 7 items corresponding to the 7 possible questions on the IPAQ-short. Participants picked a number ranging from 1 to 5, corresponding to their confidence level for each question, where 1 represents "very unsure", 2 represents "quite unsure", 3 represents "about 50/50", 4 represents "quite sure" and 5 represents "very sure". The questionnaire was completed directly after the IPAQ-short in order for the participants to report their confidence levels immediately following administration of the IPAQ. A physical activity recall self-efficacy score was obtained for both moderate and vigorous intensities by averaging the sum of the corresponding items to result in a 1 to 5 confidence rating. A score < 4 was considered low self-efficacy while a score ≥ 4 was considered high self-efficacy (Cust et al. 2009). These cut points were used in order to compare the results in the present study to the results in the Cust et al. 2009 study.

Social Desirability

The Marlowe-Crowne Social Desirability Scale was used to assess social desirability. The Marlowe-Crowne Social Desirability Scale is a 33-item true/false questionnaire consisting of statements that describe 18 acceptable infrequent behaviors (keyed true) and 15 unacceptable frequent behaviors (keyed false). Example questions include 'I have never intensely disliked anyone' and 'When I don't know something, I don't at all mind admitting it'. The questionnaire can be self-administered easily and quickly. To calculate a social desirability score each participant was awarded either a value of 1 or -1 for each of the 33 items. A participant received a 1 if the item was keyed true and the participant answered true, or if the item was keyed false and the participant answered false. A participant received a value of -1 for an item if the item was keyed true and the participant answered false, or if the item was keyed false and the participant answered true. To develop the final social desirability score on the Marlowe-Crowne Social Desirability scale, a sum the each of the 33 items for each participants was calculated. Crowne and Marlowe (1960) found an internal consistency reliability of .88 when the test was administered to undergraduate students. Crowne (1960) also found a test-retest correlation of .89 when the test was administered to undergraduate students on two separate occasions by a month interval. The validity of the Marlowe Crowne Social Desirability scale had a correlation of .35 to the Edwards Social Desirability Scale (Crowne 1960).

Data Analysis

Data from each ActiGraph GT1M monitor was downloaded via the ActiGraph manufacturer software and imported into Microsoft Excel. Data was then imported into the Meter Plus Version 4.2.1 software. Minutes per day of light, moderate, and vigorous physical activity from the ActiGraph GT1M, and valid days of accelerometer wear was determined with the Meter Plus Version 4.21 software. Descriptive statistics (means and standard deviations) were computed for data from the ActiGraph GT1M monitor, IPAQ-short and BRFSS questionnaires, physical activity self-efficacy questionnaire, physical activity recall self-efficacy questionnaire, age, height, weight, and body mass index (BMI). Frequencies were computed for gender, race, class standing, weight loss attempts, obesity status, and self-reported physical activity status (active vs. inactive). Gender and race differences were not examined due to a small sample size.

To examine the relationship between physical activity assessment methods, correlations were used. Independent t-tests were used to compare normal weight and obese/overweight groups across age, height, weight, and BMI. An independent t-test was also used to compare the normal weight and overweight/obese groups across the amount of moderate and vigorous physical activity minutes on the BRFSS, IPAQ, and ActiGraph GT1M. An independent t-test was used to compare self-reported activity levels across the amount of moderate and vigorous physical activity minutes on the BRFSS, IPAQ, and ActiGraph GT1M. The independent t-test was also used to assess differences between self-reported activity status and moderate and vigorous physical activity self-efficacy. The differences in weight loss attempts and moderate and vigorous physical activity self-efficacy were also assessed by independent t-test. Chi-Square analysis was used to compare normal weight and overweight/obese groups across self-reported physical activity status. The independent t-test was used to compare the differences between the normal weight and overweight/obese group and the level of recall accuracy on the BRFSS and IPAQ questionnaires for moderate and vigorous physical activity. Effect size (Cohen's *d*) was calculated to evaluate the size of the change between the normal weight and overweight/obese groups, as well as the change between those trying to lose weight and not trying to lose weight within a BMI group. Cohen (1988) suggested that a large effect size was > 0.80, a medium effect size was approximately 0.50, and effect sizes < 0.20 are small.

A 2 X 2 ANOVA was used to examine the effect of weight loss attempts and BMI group on recall accuracy. Regression analysis was used to examine the relationship between moderate and vigorous physical activity self-efficacy, and recall accuracy on the BRFSS and IPAQ questionnaires. An independent t-test was used to assess self-efficacy towards physical activity recall (high and low self-efficacy) and recall accuracy for moderate and vigorous physical activity on the IPAQ. Pearson's correlation was used to assess the relationship between the Marlowe-Crowne Social Desirability Scale and recall accuracy as well as the Marlowe-Crowne

Social Desirability Scale and minutes of moderate and vigorous physical activity from the BRFSS, IPAQ, and ActiGraph GT1M.

The alpha level was set at .05 for comparisons unless stated otherwise. Microsoft Excel and PASW (SPSS) 18.0 statistical software was used to complete the analyses.

CHAPTER 4: RESULTS

A total of 62 undergraduate students participated in the study. Ten participants were removed for the following reasons: (1) three participants were swimmers and thus their physical activity could not be fully measured objectively by the accelerometer, (2) three participants had unusable objective physical activity data due to an error in accelerometer programming, (3) two participants had a BMI below <18.5 kg/m^2, and (4) two participants did not wear the accelerometer for at least 4 days. Thus, in the final analysis data from 52 participants was used.

Participant characteristics are shown in Table 1. When compared to the normal weight group, the overweight/obese group had a larger BMI, weighed more, and considered themselves to be more active. The majority participants were made up of females (67%) and 33% males. Approximately 60% of the participants were Caucasian, 21% were African American, 4% were Hispanic, 6% were Asian, 2% were Native American, and 8% classified themselves as “Other”. Over half of the participants were college freshman (~85%), ~14% were sophomores and ~2% were juniors. Approximately 58% of the participants had a normal BMI (BMI 18.5 kg/m^2-24.9 kg/m^2) and 42% were either overweight or obese (BMI $\geq$ 25 kg/m^2). When the participants were asked if they were currently trying to lose weight, ~39% responded with “Yes” and ~62% responded with “No”. More overweight/obese participants reported weight loss attempts compared to the normal weight participants ($p < .05$).

Table 1
Characteristics of Participants by BMI Group

	All Participants (N=52) Mean ± SD	Normal Weight (n=30) Mean ± SD	Overweight/Obese (n=22) Mean ± SD
Age (years)	18.71 ± 0.85	18.60 ± 0.62	18.86 ± 1.08
Height (meters)	1.68 ± 0.97	1.67 ± 0.90	1.70 ± 0.10
Weight (kg)	71.83 ± 18.04	61.19 ± 8.88	86.34 ± 17.30*
BMI (kg/m^2)	25.09 ± 5.16	21.80 ± 2.01	29.57 ± 4.76*
Females (%)	35 (67.3%)	24 (46.2%)	11 (21.2%)
Males (%)	17 (32.7%)	6 (11.5%)	11 (21.2%)
Caucasian Race (%)	31 (59.6%)	17 (32.7%)	14 (26.9%)
All Other Races (%)	21 (40.4%)	13 (25.0%)	8 (15.4%)

BMI= Body mass index

* $p < .05$ normal weight vs. overweight/obese

Correlations were calculated to examine the relationships between physical activity assessment methods. The correlation between moderate physical activity on the BRFSS and moderate physical activity on the IPAQ was $r = 0.74$. The correlation between moderate physical activity on the BRFSS and moderate physical activity on the ActiGraph GT1M was $r = 0.05$. The correlation between moderate physical activity on the IPAQ and the ActiGraph GT1Mwas $r = 0.07$. When correlations were examined for vigorous physical activity, a correlation of $r = 0.76$ ($p < .01$) was found between vigorous physical activity on the BRFSS and IPAQ. The correlation between vigorous physical activity on the BRFSS and vigorous physical activity on the ActiGraph GT1M was $r = 0.28$. A correlation of $r = 0.29$ ($p < .05$) was found between the vigorous physical activity on the IPAQ and vigorous physical activity on the ActiGraph GT1M.

On average the participants wore the accelerometer for 6.60 ± 0.69 days and 13.25 ± 1.61 hours per day.The average number of minutes per day spent in moderate and vigorous intensity physical activity by BMI group are shown in Figure 2. Both the normal weight and overweight/obese groups self-reported similar amounts of time spent in of moderate and vigorous physical activity on the BRFSS questionnaire. A similar result was found for the IPAQ. There was not a significant difference between the normal weight and overweight/obese group when the minutes of either moderate or vigorous physical activity were measured objectively by the ActiGraph GT1M. When the minutes per day of physical activity from each of the questionnaires were compared to the ActiGraph GT1M a significantly higher difference was found for moderate and vigorous physical activity on the BRFSS and IPAQ. The participants reported more physical activity on the BRFSS and IPAQ than the activity recorded on the ActiGraph GT1M. However, the minutes per day in moderate and vigorous physical activity were similar between the BRFSS and IPAQ. There was also no significant difference found between those trying to lose weight and the amount of physical activity recorded on the BRFSS, IPAQ, or ActiGraph GT1M ($p > .05$; data not shown).

Table 2 shows the physical activity self-efficacy by BMI group and weight loss attempts. Physical activity self-efficacy levels were similar by BMI group. Participants who were trying to lose weight had a significantly higher self-efficacy level for completing vigorous physical activity when compared to participants who were not actively trying to lose weight ($p < .05$). However, no significant difference was found between weight loss attempts and self-efficacy for moderate physical activity.

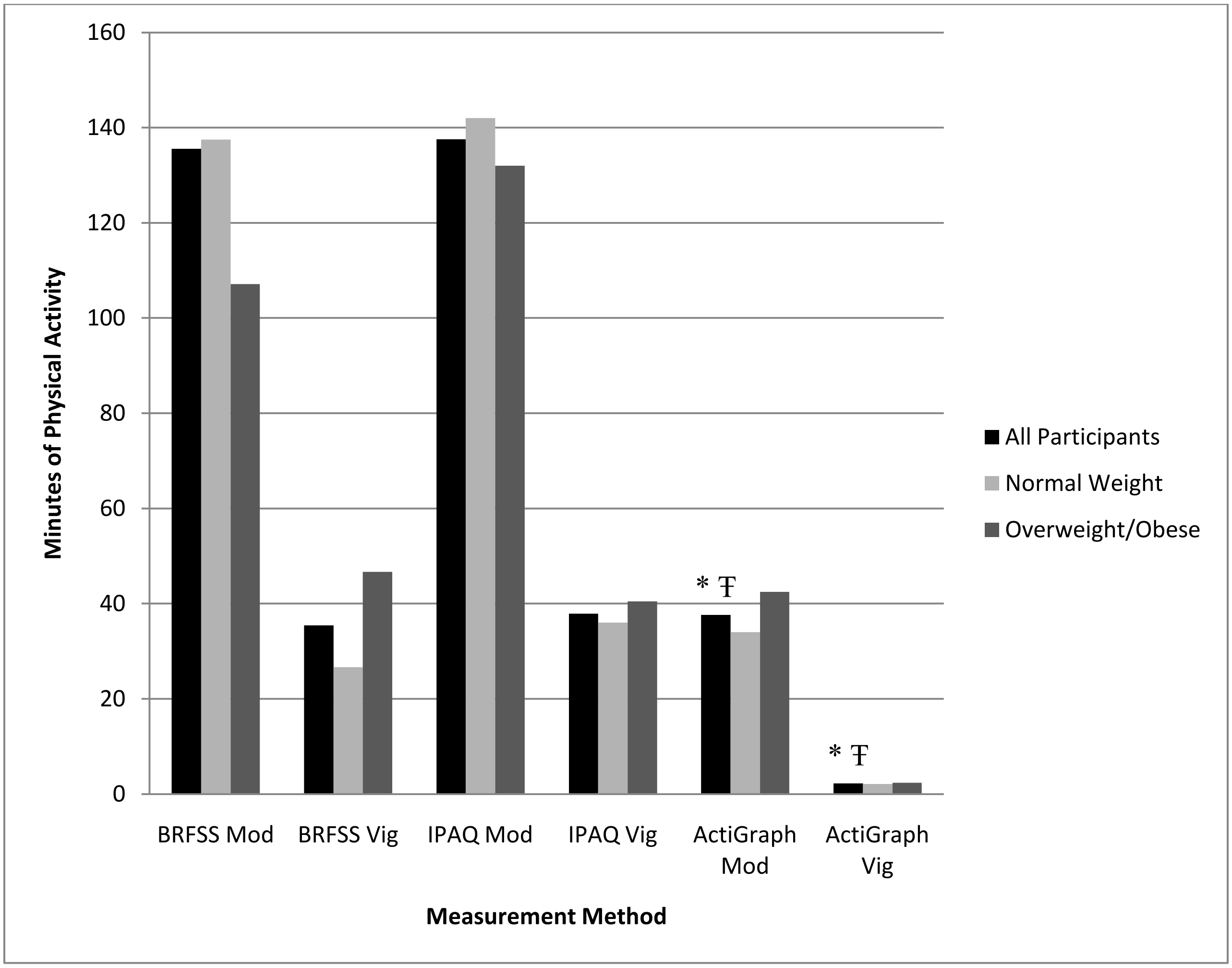

Figure 2. BMI Group and Average Minutes of Physical Activity per Day
* ActiGraph GT1M vs. BRFSS $p < .001$
Ŧ ActiGraph GT1M vs. IPAQ $p < .001$

Table 2

Physical Activity Self-Efficacy, by BMI Group and Weight Loss

	Normal Weight (N=30) Mean ± SD	**Overweight/ Obese (N=22) Mean ± SD**	**Trying to Lose Weight (N=20) Mean ± SD**	**Not Trying to Lose Weight (N=32) Mean ± SD**
SE Mod	0.82 ± 0.17	0.88 ± 0.11	0.89 ± 0.10	0.82 ± 0.17
SE Vig	0.77 ± 0.18	0.85 ± 0.13	0.87 ± 0.11	0.77 ± 0.18*

* $p < .05$ trying vs. not trying to lose weight

SE = self-efficacy

Mod = Moderate

Vig = Vigorous

Recall accuracy was similar for moderate and vigorous physical activity reported on the BRFSS and IPAQ questionnaires by BMI group (Table 3). Both the normal weight and overweight/obese groups tended to over report duration of moderate and vigorous physical activity on each questionnaire. Both groups also over reported their moderate physical activity more than vigorous physical activity. The effect size was moderate between normal weight and overweight/obese groups on the BRFSS vigorous. The remaining effect sizes between normal weight and overweight/obese groups were low. Also, a significant difference was not found between those who reported weight loss attempts and recall accuracy for either moderate or vigorous physical activity on the BRFSS questionnaire (Table 4). A similar result was found on the IPAQ questionnaire. Both groups over reported time spent in moderate and vigorous physical activity on both physical activity questionnaires. Effect sizes were low between weight loss attempts for each physical activity questionnaire. A significant interaction was not found between weight loss, BMI group and recall accuracy for moderate and vigorous physical activity on either questionnaire (BRFSS and IPAQ) (Table 5). The effect size was moderate for vigorous physical activity on the BRFSS between normal weight and overweight/obese groups trying to lose weight. Similar results were found between normal weight and overweight/obese groups not trying to lose weight. The remaining effect sizes were low between normal and overweight/obese groups that were not trying to lose weight and also those tying to lose weight.

When recall accuracy was examined by moderate physical activity self-efficacy there was no relationship between the two for either the BRFSS ($R = .07$) or IPAQ ($R = .03$) questionnaires. Recall accuracy for vigorous physical activity on the BRFSS ($R = .49$) and IPAQ ($R = .45$) were significantly different by physical activity self-efficacy towards vigorous physical activity ($p <$

.05). Those with higher physical activity self-efficacy for completing vigorous physical activity tended to be more accurate in recalling their vigorous physical activity.

Table 6 shows the relationship between self-efficacy towards physical activity recall for the IPAQ. Recall accuracy was similar for moderate and vigorous physical activity reported on the IPAQ by self-efficacy towards physical activity recall on the IPAQ. A similar test was conducted to examine the relationship between self-efficacy towards physical activity recall and BMI group. When self-efficacy towards physical activity recall on the IPAQ was examined by BMI group results were similar between the two groups (normal weight: 3.82 ± 0.66. overweight/obese: 3.74 ± 0.48, $p > .05$).

Analysis was completed examining social desirability and self-reported physical activity. The social desirability score was not related to the amount of self-reported physical activity on either the BRFSS (moderate: $r = -.04$; vigorous: $r = .09$, $p > .05$) or IPAQ (moderate: $r = .05$; vigorous: $r = .09$, $p > .05$) questionnaires. Similar results were found for the ActiGraph GT1M moderate ($r = .20$) and vigorous ($r = .18$) physical activity and social desirability. The social desirability score was not related to recall accuracy for either moderate physical activity ($r = .08$) or vigorous physical activity ($r = -.07$) reported on the BRFSS questionnaires. Similar results were also found between social desirability and recall accuracy for moderate physical activity ($r = -.02$) and vigorous physical activity ($r = -.07$) on the IPAQ. There was no significant relationship between social desirability and either weight loss attempts or social desirability and the number of minutes of moderate and vigorous physical activity ($p > 0.05$).

Table 3

BMI Group and Recall Accuracy for BRFSS and IPAQ

Recall Accuracy	Normal Weight (N=30) Mean ± SD	Overweight/Obese (N=22) Mean ± SD	Effect Size
BRFSS Mod	-104.29 ± 116.97	-88.56 ± 106.98	0.14
BRFSS Vig	-24.43 ± 25.28	-44.28 ± 47.33	0.57
IPAQ Mod	-108.14 ± 139.26	-89.42 ± 116.81	0.14
IPAQ Vig	-34.15 ± 40.08	-38.09 ± 46.03	0.09

Mod = moderate intensity physical activity

Vig = vigorous intensity physical activity

Table 4

Weight Loss Attempts and Recall Accuracy for BRFSS and IPAQ

Recall Accuracy	Trying to Lose Weight (N=18) Mean ± SD	Not Trying to Lose Weight (N=32) Mean ± SD	Effect Size
BRFSS Mod	-118.42 ± 145.46	-85.32 ± 86.64	0.31
BRFSS Vig	-37.41 ± 35.65	-30.53 ± 38.92	0.18
IPAQ Mod	-94.38 ± 121.45	-103.80 ± 135.96	0.07
IPAQ Vig	-33.17 ± 32.21	-37.42 ± 47.84	0.10

Mod = moderate intensity physical activity

Vig = vigorous intensity physical activity

Table 5

Effect of Weight Loss Attempts and BMI Group on Recall Accuracy

	Weight Loss Attempts					
	Not Attempting to Lose Weight			Attempting to Lose Weight		
Recall Accuracy	Normal Weight (N=22) Mean ± SD	Overweight/Obese (N=10) Mean ± SD	Effect Size	Normal Weight (N=8) Mean ± SD	Overweight/Obese (N=12) Mean ± SD	Effect Size
BRFSS Mod	-88.35 ± 78.01	-78.25 ± 109.17	0.12	-152.09 ± 194.23	-97.00 ± 109.71	0.38
BRFSS Vig	-23.84 ± 27.36	-43.92 ± 54.78	0.56	-26.11 ± 19.82	-44.61 ± 42.17	0.56
IPAQ Mod	-114.25 ± 133.97	-84.05 ± 145.59	0.22	-95.15 ± 158.69	-93.81 ± 94.46	0.01
IPAQ Vig	-32.19 ± 42.58	-48.42 ± 58.32	0.34	-39.31 ± 34.68	-28.70 ± 31.20	0.32

Mod = moderate intensity physical activity

Vig = vigorous intensity physical activity

Table 6

Recall Accuracy on the IPAQ by Self-Efficacy Towards Physical Activity Recall

Recall Accuracy	High Self Efficacy (N=21) Mean ± SD	Low Self-Efficacy (N=31) Mean ± SD
IPAQ Mod	-101.91 ± 133.69	-98.15 ± 127.29
IPAQ Vig	-24.51 ± 32.08	-43.99 ± 47.19

Mod = moderate intensity physical activity

Vig = vigorous intensity physical activity

CHAPTER 5: DISUCSSION

The purpose of this study was to determine if self-reported and objectively measured physical activity levels differed among college students with different BMI classifications. Another primary purpose was to determine if recall accuracy was related to BMI classifications. A secondary purpose was to determine if physical activity self-efficacy was correlated with accuracy in self-reported physical activity levels. The difference between self-efficacy towards physical activity recall and recall accuracy of moderate and vigorous physical activity was also examined. Finally, the relationship between social desirability and recall accuracy of moderate and vigorous physical activity was examined.

When the average minutes per day spent in moderate and vigorous physical activity was assessed subjectively and objectively, there was no significant difference between the amount of physical activity completed and BMI group. These results are similar to Meijer et al. (1992) who found no significant difference in objectively measured physical activity levels between obese and lean adults during a 7 day period. Similar results were also found in college students over a 14 day period (Tryon, 1987). In contrast, several studies have found that obese individuals accumulate fewer activity counts than normal weight adults (Cooper, Page, Fox & Mission, 2000; Rutter, 1994; Davis, Hodges & Gillham, 2006). The conflicting results between the studies could be attributed to the age of the participants and the different type of accelerometers used.

Recall accuracy was also similar for moderate and vigorous physical activity reported on the BRFSS and IPAQ by BMI group. Both the normal weight and overweight/obese group tended to over report their durations in moderate and vigorous physical activity on each questionnaire. Similar results have been found in another study. Falkner et al. (2001) found that BMI status did not affect recall accuracy in older adults (mean age 58.4 ± 6.3 years). However, the findings in the current study go against the findings of Slootmaker et al. (2009) who found that overweight adults significantly over reported their vigorous physical activity when compared to normal weight adults. In addition, McMurray et al. (2008) found that children who were at risk for being overweight and those who were overweight overestimated the amount of moderate-to-vigorous physical activity completed when compared to normal weight children. In the prior mentioned studies it could be assumed that a wide variety of BMI ranges were represented based on the population size (Slootmaker: 301 adults; McMurray: 1,021 female children). In the present study, only 52 participants were represented. The different findings could be due to the fact that enough BMI ranges were not represented. Another difference could be due to the fact that all of the participants in the current study were members of the same university. They all had the same access to recreational opportunities (gym/recreation facilities, intramurals, walking paths, and recreational equipment rental and fitness classes) at little to no cost. The Slootmaker et al. (2009) study was made up of workers from 8 different Amsterdam worksite facilities and McMurray et al.'s (2008) participants were made up of middle school girls from the following states: Arizona, California, Louisiana, Maryland, Minnesota, and South Carolina. It is not very probable that the participants in the Slootmaker et al. (2009) or McMurray et al. (2008) studies had equal access to recreational facilities and programs. Another possible explanation for the differences found is that the studies used different questionnaires. The Slootmaker et al. (2009) study used the Activity Questionnaire for Adolescents and Adults which had more categories for various types of physical activity than the questionnaires in the present study (IPAQ and BRFSS). McMurray et al. (2008) had participants complete a Previous Day Physical Activity Recall Questionnaire. In the current study, participants were asked more global physical activity questions and had to recall activity that they completed 7-10 days prior.

Physical activity recall could have been less accurate in the questionnaires used in this study due to these methodological differences.

A significant difference was not found between those who reported weight loss attempts and recall accuracy for either moderate or vigorous physical activity on either the BRFSS or IPAQ questionnaire. Both of the groups, those who reported weight loss attempts and those who were not trying to lose weight, over reported their time spent in moderate and vigorous physical activity on both the BRFSS and IPAQ questionnaires. This result is similar to what Lichtman et al. (1992) found where obese individuals who were trying to lose weight and also had a history of failing to lose weight, over reported their physical activity by approximately 50%. The participants in the Lichtman et al. (1992) study had a BMI greater than 27 kg/m^2 and were trying to lose weight. Whereas, in the current study had very few individuals were classified as obese (n = 9) and some of the overweight/obese participants were not trying to lose weight. Unfortunately, the current study did not ask about prior weight loss attempt success. Therefore, it is unknown if weight loss attempts along with weight loss success/failure affects self-reported physical activity by BMI status in the current study. In spite of this limitation, the current study expands on the results of Lichtman et al (1992), by showing if one is either attempting to lose weight or not, they are going to over report the minutes spent in moderate and vigorous physical activity. To our knowledge this is the first study that examined the difference in physical activity reporting by those who are attempting to lose weight or not. The majority of studies have shown adults in general (Slootmaker et al., 2009; Duncan et al., 2001) and those participating in weight loss studies (Lichtman et al., 1992; Jakicic et al., 1998) over report their physical activity levels.

When recall accuracy was examined by moderate physical activity self-efficacy there was no relationship between either the BRFSS or IPAQ questionnaires. However, recall accuracy for vigorous physical activity on the BRFSS and IPAQ were positively related to physical activity self-efficacy towards vigorous physical activity ($p < .05$). This finding suggests that the higher the physical activity self-efficacy towards vigorous physical activity, the more accurate the participants were in recalling their vigorous physical activity. One explanation for this finding is that the individuals who were more confident in completing vigorous physical activity are more likely to actually take part in vigorous physical activities. Studies have shown that people who have a higher self-efficacy in a certain task, are more likely to complete the task (Bandura, 2004; Dishman et al., 2005). However, in the current study, a regression analysis revealed a positive relationship between vigorous physical activity self-efficacy and vigorous physical activity on the ActiGraph GT1M ($p = 0.032$). Questionnaires have been associated with recall error, one possible reason is the inability to distinguish between varying intensities of physical activity (Dinger & Behrens, 2006). Therefore, people who engage in more vigorous physical activity would logically be able to differentiate between moderate and vigorous activities better than someone who has limited experience/knowledge of types of vigorous physical activities, and hence possible recall vigorous activities more accurately. To our knowledge this is the first study that examined the affects of physical activity self-efficacy on recall accuracy in college students.

Self-efficacy towards recalling physical activity on the IPAQ was examined to see if it was related to recall accuracy. In the current study, there was no significant difference between high or low self-efficacy towards physical activity recall and recall accuracy on the IPAQ. Those who reported higher levels of recall self-efficacy were not more accurate in recalling either moderate or vigorous physical activity on the IPAQ when compared to those with low self-efficacy towards physical activity recall. The findings in this study are different than those found by Cust et al. (2009). Adults (between the ages of 50 and 65 years) who reported higher levels of self-efficacy towards recalling physical activity had higher recall accuracy (Cust et al. 2009). The current study found that this was not the case in college students. In the current study there was a lack of variability in the BMI ranges represented. In the Cust et al. (2009) study, the participants completed the physical activity and self-efficacy questionnaires on several different occasions and the average was used for analysis. In the current study, participants only completed the questionnaires once. In the Cust study, participants may have been able to become better accustomed to the layout and procedures of the assessment. Hence, more accurate scores could have been obtained. On the other hand, often physical activity questionnaires are only completed on one occasion so their results may not be reflective of real world situations. It is not known if completing the questionnaires on more than one occasion could have produced different results in the current study.

Social desirability was not related to the amount of self-reported physical activity on the BRFSS or IPAQ questionnaires or the ActiGraph GT1M accelerometer. Social desirability was also not related to recall accuracy either the BRFSS or IPAQ questionnaires. However, these findings were different than those found by Adams et al. (2005). That study found that social desirability was positively associated with over reporting of physical activity on questionnaires, specifically the Stanford Five-City Project's 7-day recall and the Minnesota Leisure Time Physical Activity Survey (Adams et al., 2005). This means that people who scored higher on a social desirability scale were more likely to over report the amount of time they were engaged in physical activity. The lack of relation in the current study could be due to the fact that all of the participants were currently enrolled in a psychology course and many were familiar with the concept of social desirability and the scale used. However, an actual relation between the items above could truly be non-existent.

There are several limitations to this study. An accelerometer was used to be the objective measure of physical activity; however, these devices are unable to assess upper body movements, movements on bicycles, or rowing machines, so physical activity may be underestimated. When using self-report physical activity questionnaires it is assumed that the participants will understand the differences between intensity levels. However, participants may have misinterpreted the true intensities of their physical activities (Sirard et al., 2000; Dinger & Behrens, 2006). Also when administering the questionnaires, the BRFSS was always completed before the IPAQ. Participants may have simply referenced the BRFSS and copied answers versus trying to recall their answers specifically. A small number of participants in the current study were actually classified as obese (9 participants), thus the overweight and obese groups were combined. Therefore, this study was unable to truly compare normal weight, overweight and obese groups. Future studies should try to recruit more participants in each BMI category.

In conclusion, the findings in the present study show that (1) College students over-reported their duration in moderate and vigorous physical activity, (2) BMI group does not affect recall accuracy of either moderate or vigorous physical activity in college students, (3) Moderate physical activity self-efficacy was not associated with recall accuracy on the BRFSS or IPAQ; however, vigorous physical activity self-efficacy was associated with the recall accuracy of vigorous physical activity, (4) Self-efficacy towards physical activity recall was not associated with recall accuracy of the IPAQ, and (5) Social desirability was not related to the amount of self-reported physical activity.

Since all of the college students in the current study over reported their physical activity, college physical education courses could take an opportunity to better educate students on accurate physical activity self-assessment. Having a better understanding of physical activity assessment could potentially help more individuals meet physical activity requirements and fitness goals. Physical education courses could also teach college students about different types of physical activity and the various intensity levels. If students are exposed to a wider variety of physical activities, logically they would have a better chance of finding an activity they feel confident and comfortable in completing. This in turn could improve physical activity self-efficacy. If their physical activity self-efficacy is higher, they may be more likely to take part in physical activity (Bandura, 2004; Dishman et al., 2005). Thus, their accuracy in reporting physical activity and the odds of meeting fitness goals could also improve.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL LETTER

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
1L-09 Brody Medical Sciences Building• 600 Moye Boulevard • Greenville, NC 27834
Office **252-744-2914** • Fax **252-744-2284** • **www.ecu.edu/irb**

TO: Brooke Graves, Student, Dept of EXSS, ECU—Mailstop: 559

FROM: UMCIRB KK

DATE: December 30, 2010

RE: Expedited Category Research Study

TITLE: "Self-report and objective physical activity measurements in college students"

UMCIRB #10-0786

This research study has undergone review and approval using expedited review on 12.22.10. This research study is eligible for review under an expedited category number 4 & 7. The Chairperson (or designee) deemed this **unfunded** study **no more than minimal risk** requiring a continuing review in **12 months**. Changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. The investigator must submit a continuing review/closure application to the UMCIRB prior to the date of study expiration. The investigator must adhere to all reporting requirements for this study.

The above referenced research study has been given approval for the period of **12.22.10** to **12.21.11**. The approval includes the following items:

- Internal Processing Form (dated 12.15.10)
- Informed Consent (dated 12.21.10)
- Cover Letter
- Demographics, version 2 (12/2010)
- Marlowe-Crowne Questionnaire
- Physical Activity in the Past Seven Days, Version 05 (12/2010)
- BRFSS Physical Activity Questions, Version 2 (01/2001)
- SE Mod Forms, Version 1 (12/2010)
- SE Vig Form, Version 1 (12/2010)
- COI Disclosure Form (dated 12.15.10)

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

The UMCIRB applies 45 CFR 46, Subparts A-D, to all research reviewed by the UMCIRB regardless of the funding source. 21 CFR 50 and 21 CFR 56 are applied to all research studies under the Food and Drug Administration regulation. The UMCIRB follows applicable International Conference on Harmonisation Good Clinical Practice guidelines.

APPENDIX B

INFORMED CONSENT

1907-2007 CENTENNIAL
East Carolina University

UNIVERSITY HEALTH SYSTEMS
of Eastern Carolina

Informed Consent to Participate in Research

Information to consider before taking part in research that has no more than minimal risk.

Title of Research Study: Self-report and objective physical activity measurements in college students

Principal Investigator: Brooke Graves
Institution/Department or Division: Department of Exercise and Sport Science
Address: 101 Minges Coliseum, East Carolina University, Greenville, NC 27858
Telephone #: 252-328-1996

Researchers at East Carolina University (ECU) study problems in society, health problems, environmental problems, behavior problems and the human condition. Our goal is to try to find ways to improve the lives of you and others. To do this, we need the help of volunteers who are willing to take part in research.

Why is this research being done?

The purpose of this research is to study the differences in self-report and objective physical activity measurements in college students. The decision to take part in this research study is yours to make. By doing this research study, we hope to learn better ways to measure physical activity in college students and how to design more effective physical activity interventions in this age group.

Why am I being invited to take part in this research?

You are being invited to participate because you are an undergarduate college student at East Carolina University enrolled in PSYC 1000. If you volunteer to take part in this research, you will be one of about 45 people to do so.

Are there reasons I should not take part in this research?

I understand that I should not volunteer for this research study if I am under 18 years old, have known cardiovascular disease, severe cancer, or any condition that limits my ability to perform physical activity.

What other choices do I have if I do not take part in this research?

You can choose not to participate.

Where is the research going to take place and how long will it last?

All research procedures will take place in the Activity Promotion Lab, located in Minges Arena. The first visit will last for approximately one hour. The second visit will last approximately 30 minutes.

Title of Study: Self-report and objective physical activity measurements in college students

What will I be asked to do?
You will be asked to do the following:
Participate in 2 laboratory visits and wear a small activity monitoring device for 7 consecutive days.

On the first visit, we will go over the Informed consent. You will also complete questionnaires regarding general demographics and your physical activity. Your height and weight will also be measured. You will be given an activity monitoring device that you will wear for 7 consecutive days.

On the second visit, you will return your activity monitoring device. You will also complete questionnaires regarding your physical activity.

You will then be given feedback regarding your physical activity levels via email. You will also receive individual physical activity recommendations based on your collected data measurements.

What possible harms or discomforts might I experience if I take part in the research?
It has been determined that the risks associated with this research are no more than what you would experience in everyday life.

What are the possible benefits I may experience from taking part in this research?
You can earn up to 5 extra credit points: 2 points for completing both study visits (1 point for each visit), 1 point for wearing the accelerometer 2-3 days, 2 points for 4-6 days, and 3 points for 7 days of wear.

You will have the opportunity to know your current physical activity levels; as well as receive individualized physical activity recommendations.

Will I be paid for taking part in this research?
We will not pay you for the time you volunteer while being in this study.

What will it cost me to take part in this research?
It will not cost you any money to be part of the research.

Who will know that I took part in this research and learn personal information about me?
To do this research, ECU and the people and organizations listed below may know that you took part in this research and may see information about you that is normally kept private. With your permission, these people may use your private information to do this research:

- The University & Medical Center Institutional Review Board (UMCIRB) and its staff, who have responsibility for overseeing your welfare during this research, and other ECU staff who oversee this research.

How will you keep the information you collect about me secure? How long will you keep it?
Only the investigators and personnel associated with this study will have access to the data obtained. No identifying information will be released. An unique id will be assigned to you and only the primary investigator and key research personnel will have access to the code your name. Data will be secured in a locked filing cabinet in the primary investigator's laboratory. These measures will protect your identity. The data will be kept for 7 years. Any data that is presented in papers or at conferences will be done so as group data with no identification of the individual.

What if I decide I do not want to continue in this research?
If you decide you no longer want to be in this research after it has already started, you may stop at any time. You will not be penalized or criticized for stopping.

Title of Study: Self-report and objective physical activity measurements in college students

Who should I contact if I have questions?

The people conducting this study will be available to answer any questions concerning this research, now or in the future. You may contact the Principal Investigator, Brooke Graves at 252-328-1996 (days, between 9 AM till 5 PM) or Dr. Katrina D. DuBose at 252-328-1599 (days, between 9 AM till 4:30 PM).

If you have questions about your rights as someone taking part in research, you may call the UMCIRB Office at phone number 252-744-2914 (days, 8:00 am-5:00 pm). If you would like to report a complaint or concern about this research study, you may call the Director of UMCIRB Office, at 252-744-1971

I have decided I want to take part in this research. What should I do now?

The person obtaining informed consent will ask you to read the following and if you agree, you should sign this form:

- I have read (or had read to me) all of the above information.
- I have had an opportunity to ask questions about things in this research I did not understand and have received satisfactory answers.
- I know that I can stop taking part in this study at any time.
- By signing this informed consent form, I am not giving up any of my rights.
- I have been given a copy of this consent document, and it is mine to keep.

Participant's Name (PRINT) **Signature** **Date**

Person Obtaining Informed Consent: I have conducted the initial informed consent process. I have orally reviewed the contents of the consent document with the person who has signed above, and answered all of the person's questions about the research.

Person Obtaining Consent (PRINT) **Signature** **Date**

Principal Investigator (PRINT) ***Signature*** ***Date***
(If other than person obtaining informed consent)

UMCIRB Number: 10-0786

Consent Version # or Date: 12-21-10
UMCIRB Version 2010.05.01

UMCIRB
APPROVED
FROM 12-22-10
TO 12-21-11

Participant's Initials

APPENDIX C

DEMOGRAPHIC FORM

Demographics

Age:__________________

Circle One Number for Each Item:

Gender: 1. Female 2. Male

Race: 1. Caucasian 2. African American 3. Hispanic

4. Asian 5. Native American 6. Other

7. Refused to Answer

Class Year: 1. Freshman 2. Sophomore 3. Junior 4. Senior

Are you actively trying to lose weight?

1. Yes 2. No

Measured By Research Staff:

Height:_______________ cm ____________________meters _______________ft

Weight: ______________kg ______________________lbs

APPENDIX D

MODERATE PHYSICAL ACTIVITY SELF-EFFICACY FORM

The items listed below are designed to assess your **beliefs in your ability to engage in 30 minutes of moderate intensity physical activity on most if not all days of the week**. Moderate activities are activities that take moderate physical effort and make you breathe somewhat harder than normal. Using the scales listed below, please indicate how confident you are in your ability to do the amount of physical activity listed in each question.

For example, if you **have complete confidence** that you could complete that amount of physical activity, you would **circle <u>100%</u>**. However, if you had **no confidence at all** that you could complete that amount of physical activity you would **circle <u>0%</u>**.

Please remember to answer honestly and accurately. There are no right or wrong answers.

Mark your answer by circling a %:

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

NOT AT ALL CONFIDENT	MODERATELY CONFIDENT	HIGHLY CONFIDENT

1. I am able to be perform **5 consecutive minutes** of moderate intensity physical activity (a moderately hard to hard level of physical exertion) without stopping.

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

2. I am able to be perform **10 consecutive minutes** of moderate intensity physical activity (a moderately hard to hard level of physical exertion) without stopping.

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

3. I am able to be perform **15 consecutive minutes** of moderate intensity physical activity (a moderately hard to hard level of physical exertion) without stopping.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4. I am able to be perform **20 consecutive minutes** of moderate intensity physical activity (a moderately hard to hard level of physical exertion) without stopping.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

5. I am able to be perform **25 consecutive minutes** of moderate intensity physical activity (a moderately hard to hard level of physical exertion) without stopping.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

6. I am able to be perform **30 consecutive minutes** of moderate intensity physical activity (a moderately hard to hard level of physical exertion) without stopping.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Please remember to answer honestly and accurately. There are no right or wrong answers.

Mark your answer by circling a %:

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

NOT AT ALL	MODERATELY	HIGHLY
CONFIDENT	CONFIDENT	CONFIDENT

7. I am able to accumulate **a total of 30 minutes** of moderate intensity physical activity **one day** per week on a regular basis.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

8. I am able to accumulate **a total of 30 minutes** of moderate intensity physical activity **two days** per week on a regular basis.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

9. I am able to accumulate **a total of 30 minutes** of moderate intensity physical activity **three days** per week on a regular basis.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

10. I am able to accumulate **a total of 30 minutes** of moderate intensity physical activity **four days** per week on a regular basis.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

11. I am able to accumulate **a total of 30 minutes** of moderate intensity physical activity **five days** per week on a regular basis.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

12. I am able to accumulate **a total of 30 minutes** of moderate intensity physical activity **six days** per week on a regular basis.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

13. I am able to accumulate **a total of 30 minutes** of moderate intensity physical activity **seven days** per week on a regular basis.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

APPENDIX E

VIGOROUS PHYSICAL ACTIVITY SELF-EFFICACY FORM

The items listed below are designed to assess your **beliefs in your ability to engage in 30 minutes of vigorous intensity physical activity on most if not all days of the week**. Vigorous activities are physical activities that take hard physical effort and make you breathe much harder than normal. Using the scales listed below, please indicate how confident you are in your ability to do the amount of physical activity listed in each question.

For example, if you **have complete confidence** that you could complete that amount of physical activity, you would **circle 100%**. However, if you had **no confidence at all** that you could complete that amount of physical activity you would **circle 0%**.

Please remember to answer honestly and accurately. There are no right or wrong answers.

Mark your answer by circling a %:

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

NOT AT ALL CONFIDENT	MODERATELY CONFIDENT	HIGHLY CONFIDENT

1. I am able to be perform **5 consecutive minutes** of vigorous intensity physical activity (a moderately hard to hard level of physical exertion) without stopping.

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

2. I am able to be perform **10 consecutive minutes** of vigorous intensity physical activity (a moderately hard to hard level of physical exertion) without stopping.

   0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

3. I am able to be perform **15 consecutive minutes** of vigorous intensity physical activity (a moderately hard to hard level of physical exertion) without stopping.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

4. I am able to be perform **20 consecutive minutes** of vigorous intensity physical activity (a moderately hard to hard level of physical exertion) without stopping.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Please remember to answer honestly and accurately. There are no right or wrong answers.

Mark your answer by circling a %:

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

NOT AT ALL	MODERATELY	HIGHLY
CONFIDENT	CONFIDENT	CONFIDENT

5. I am able to accumulate **a total of 20 minutes** of vigorous intensity physical activity **one day** per week on a regular basis.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

6. I am able to accumulate **a total of 20 minutes** of vigorous intensity physical activity **two days** per week on a regular basis.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

7. I am able to accumulate **a total of 20 minutes** of vigorous intensity physical activity **three days** per week on a regular basis.

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

8. I am able to accumulate **a total of 20 minutes** of vigorous intensity physical activity **four days** per week on a regular basis.

0%   10%   20%   30%   40%   50%   60%   70%   80%   90%   100%

9. I am able to accumulate **a total of 20 minutes** of vigorous intensity physical activity **five days** per week on a regular basis.

0%   10%   20%   30%   40%   50%   60%   70%   80%   90%   100%

10. I am able to accumulate **a total of 20 minutes** of vigorous intensity physical activity **six days** per week on a regular basis.

0%   10%   20%   30%   40%   50%   60%   70%   80%   90%   100%

11. I am able to accumulate **a total of 20 minutes** of vigorous intensity physical activity **seven days** per week on a regular basis.

0%   10%   20%   30%   40%   50%   60%   70%   80%   90%   100%

APPENDIX F

MARLOW CROWNE SOCIAL DESIRABILITY FORM

Personal Reaction Inventory

DIRECTIONS: Listed below are a number of statements concerning personal attitudes and traits. Read each item and decide whether the statement is true or false as it pertains to you personally. Please darken the circle for true or for false. Please respond to each item. Do not leave any blank.

Statement	True	False
1. Before voting, I thoroughly investigate the qualifications of all of the candidates.	T	F
2. I never hesitate to go out of my way to help someone in trouble.	T	F
3. It is sometimes hard for me to go on with my work if I am not encouraged.	T	F
4. I have never intensely disliked anyone.	T	F
5. On occasion I have had doubts about my ability to succeed in life.	T	F
6. I sometimes feel resentful when I don't get my way.	T	F
7. I am always careful about my manner of dress.	T	F
8. My table manners at home are as good as when I eat out in a restaurant.	T	F
9. If I could get into a movie without paying and be sure I was not seen, I would probably do it.	T	F
10. On a few occasions, I have given up doing something because I thought too little of my ability.	T	F
11. I like to gossip at times.	T	F
12. There have been times when I felt like rebelling against people in authority even though I knew they were right.	T	F
13. No matter who I am talking to, I am always a good listener.	T	F
14. I can remember "playing sick" to get out of something.	T	F
15. There have been occasions when I took advantage of someone.	T	F
16. I am always willing to admit it when I make a mistake.	T	F
17. I always try to practice what I preach.	T	F
18. I don't find it particularly difficult to get along with loud-mouthed, obnoxious people.	T	F
19. I sometimes try to get even rather than forgive and forget.	T	F
20. When I don't know something, I don't at all mind admitting it.	T	F
21. I am always courteous, even to people who are disagreeable.	T	F
22. At times I have really insisted on having things my own way.	T	F
23. There have been occasions when I have felt like smashing things.	T	F

24. I would never think of letting someone else be punished for my wrong doings.	T	F
25. I never resent being able to return a favor.	T	F
Statement	**True**	**False**
26. I have never been irked when people expressed ideas very different from my own.	T	F
27. I never make a long trip without checking the safety of my car.	T	F
28. There have been times when I was quite jealous of the good fortune of others.	T	F
29. I have almost never felt the urge to tell someone off.	T	F
30. I am sometimes irritated by people who ask favors of me.	T	F
31. I have never felt that I was punished without cause.	T	F
32. I sometimes think when people have misfortune they only get what they deserve.	T	F
33. I have never deliberately said something that hurt someone's feelings.	T	F

APPENDIX G

BRFSS FORM

BRFSS Physical Activity Questions

1. Do you work for a living?

___ 1. No **(go to Q. 3)**

___ 2. Yes

___ 7. Don't know/ Refused **(go to Q. 3)**

2. When you are at work, which of the following best describes what you do? Would you say:

	a.	Mostly sitting or standing	1
	b.	Mostly walking	2
	c.	Mostly heavy labor or physically	
Do not read		demanding work	3
these responses		Don't know/Not sure	7
		Refused	9

If respondent has multiple jobs, include all jobs

3. In a usual week, do you walk for at least 10 minutes at a time [*include working time if employed*,] for recreation, exercise, to get to and from places, or for any other reason?

a.	Yes	1
b.	No **Go to Q. 6**	2
	Don't know/Not sure **Go to Q. 6**	7
	Refused **Go to Q. 6**	9

4. How many days per week do you walk for at least 10 minutes at a time?

Days per week	____
Don't know/Not sure	77
Refused	99

5. On days when you walk for at least 10 minutes at a time, how much total time per day do you spend walking?

Hours and minutes per day	____: ____ ____
Don't know/Not sure	777
Refused	999

6. In a usual week, do you do any activities designed to increase muscle strength or tone, such
as lifting weights, pull-ups, push-ups, or sit-ups?

a. Yes	1
b. No **Go to Q. 8**	2
Don't know/Not sure **Go to Q. 8**	7
Refused **Go to Q. 8**	9

7. How many days per week do you do these activities?

Days per week	____
Don't know/Not sure	77
Refused	99

We are interested in two types of physical activity - vigorous and moderate. Please answer even if you have included these activities in previous questions. Vigorous activities cause large increases in breathing or heart rate whi1le moderate activities cause small increases in breathing or heart rate.

Now, thinking about the moderate activities you do *[if employed, think about time when you are not working,]...*

8. In a usual week, do you do moderate activities for at least 10 minutes at a time, such as brisk walking, bicycling, vacuuming, gardening, or anything else that causes small increases in breathing or heart rate?

a.	Yes	1
b.	No **Go to Q. 11**	2
	Don't know/Not sure **Go to Q. 11**	7
	Refused **Go to Q. 11**	9

9. How many days per week do you do these moderate activities for at least 10 minutes at a time?

Days per week	____
Don't know/Not sure	77
Refused	99

10. On days when you do moderate activities for at least 10 minutes at a time, how much total time per day do you spend doing these activities?

Hours and minutes per day	____: ____ ____
Don't know/Not sure	777
Refused	999

Now, thinking about the vigorous activities you do *[if employed, think about time when you are not working,]*...

11. In a usual week, do you do vigorous activities for at least 10 minutes at a time, such as running, aerobics, heavy yard work, or anything else that causes large increases in breathing or heart rate?

a.	Yes	1
b.	No **End**	2
	Don't know/Not sure **End**	7
	Refused **End**	9

12. How many days per week do you do these vigorous activities for at least 10 minutes at a time?

Days per week	____
Don't know/Not sure	77
Refused	99

13. On days when you do vigorous activities for at least 10 minutes at a time, how much total time per day do you spend doing these activities?

Hours and minutes per day	____: ____ ____
Don't know/Not sure	777
Refused	999

APPENDIX H

IPAQ FORM

SECTION 3 –Physical activity in the past 7 days

The questions in this section are also about physical activity but are different to those you answered in the first section. Please complete these questions without referring back to your answers in section 1.

The next questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ **days per week**

☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ **days per week**

☐ No moderate physical activities → ***Skip to question 5***

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on **weekdays** during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

☐ Don't know/Not sure

APPENDIX I

SELF-EFFICACY TOWARDS PHYSICAL ACTIVITY RECALL ON IPAQ FORM

8. Thinking about the questions that you have just answered (Section 3, questions 1-7 listed above), how sure are you that your answers were accurate? Please rate them on a scale of 1 to 5 for each question answered, where 1 is very unsure and 5 is very sure (circle number):

	very unsure	quite unsure	about 50/5	quite sure	very sure
	1	**2**	**3**	**4**	**5**
Q1. vigorous activity- days	1	2	3	4	5
Q2. vigorous activity- time	1	2	3	4	5
Q3. moderate activity- days	1	2	3	4	5
Q4. moderate activity- time	1	2	3	4	5
Q5. walking- days	1	2	3	4	5
Q6. walking- time	1	2	3	4	5
Q7. sitting- time	1	2	3	4	5