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Due to limitations in instruction hours and resources, it has become increasingly difficult for physical education to simultaneously provide knowledge, skills and sufficient physical activity needed for healthful living. Consequently, leisure-time physical activity participation becomes a significant opportunity to supplement physical education for students to be physically active. Ennis (2010) pointed out that health-related fitness knowledge, motor skills and physical activity demonstrated in physical education have become critical in developing students' healthful living behavior. Guided by the transfer theory, the purpose of this study was to describe the extent to which college students' knowledge and skills demonstrated in physical education are associated with leisure-time physical activity behavior. A total of 186 student participants (99 males, 87 females) in basketball, volleyball, and soccer classes at one of the University of North Carolina completed fitness knowledge tests, in-class physical activity measures, sports skills tests, and a leisure-time physical activity recall survey. Pearson correlation, multiple regression analysis, and canonical correlation analyses were used to examine association at variable-to-variable (bivariate) and variable set-to-set levels. The major findings include (a) There was no relationship between health-related fitness knowledge and leisure-time physical activity behavior at the variable to variable level. (b) In-class physical activity and sport skills demonstrated in physical education had a weak correlation with leisure-time physical activity behavior. (c) There was a variable set-to-set correlation between skill and leisure time sport-specific physical activity participation in soccer. These findings

support the assumption of transfer theory that behavior transfer is unlikely to rely on the variable to variable associations. It is more likely to take place in a holistic way, where individual factors in one environment (e.g., physical education) work together as a set to interact with a set of factors in a different environment (e.g., leisure-time physical activity settings). The findings imply a holistic approach to be used in further research to examine the relationship between physical education and leisure-time physical activity.

THE RELATIONSHIP BETWEEN PHYSICAL EDUCATION AND LEISURE-TIME PHYSICAL ACTIVITY BEHAVIOR

by

Yangyang Deng

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APPROVAL PAGE

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CHAPTER I

INTRODUCTION

Research evidence suggests that many adverse health conditions are correlated with physical inactivity (Warburton, Nicol, & Bredin, 2006). Physical education programs have been found effective in promoting physical activity and reducing sedentary behavior (Sollerhed & Ejlertsson, 2008). Ennis (2010) suggested that health-related fitness knowledge, skills and physical activity demonstrated in physical education are critical in assisting students to develop their healthful living behavior. Although physical education provides a good amount of physical activity, additional participation in physical activity is still needed for children and youth to meet the 60 minutes daily requirement of moderate to vigorous physical activity. Consequently, leisure-time physical activity participation becomes a significant opportunity to supplement physical activity received in physical education, especially on days when students do not have physical education classes. Thus, the connection between knowledge and skills demonstrated in physical education and leisure time behavior needs to be understood.

In this chapter, I discuss the theoretical framework of transfer of knowledge and skills (transfer theory) to illustrate the possibility of transferring knowledge and skills demonstrated in physical education to leisure-time physical activity. Then, I review and discuss the literature related to leisure-time physical activity behaviors in connection with behaviors in physical education. Lastly, I present the research questions, hypotheses, a

significance of the study. Definitions of the key concepts are listed at the end of the chapter.

Theoretical Frameworks

Knowledge transfer refers to the portability of knowledge and/or skills between different settings (Perkins & Salomon, 1992). A successful transfer is determined by the following factors: amount of knowledge, quality of understanding, context relevance/similarity, and appropriate metacognition (Bransford & Schwartz, 1999). It is expected (e.g., Ennis, 2015) that knowledge and skills demonstrated in the physical education classroom can be transferred by students to their leisure time context. Hypothetically, if this transfer can take place, there should be a connection between what is demonstrated in physical education and what is performed in leisure-time physical activity. Furthermore, it may be hypothesized that some or all the factors that determine transfer (amount of knowledge, quality of understanding, context relevance/ similarity, and appropriate metacognition) can be observed in the leisure time (new) context.

Transfer Theory

Perkins and Salomon (1992) defined knowledge transfer as the portability of knowledge or skills between different settings, for example, knowledge and skills transfer from schools to the workplace. A positive transfer occurs when the knowledge and skills demonstrated in one context improves or enhances performance in another context. A negative transfer occurs when the knowledge and skills demonstrated in one context do not manifest in another context or undermine the performance in another context. According to Perkins and Salomon (1992), there are two pathways of transfer: near

transfer and far transfer. Near transfer refers to transfer between very similar contexts. On the other hand, far transfer refers to knowledge and skill transfer between two remote and alien contexts.

It has been postulated (Bransford & Schwartz, 1999) that a successful transfer is dependent on the following factors: amount of knowledge, quality of understanding, context relevance/similarity, and appropriate metacognition. The amount and type of knowledge and skills influence what and how much knowledge can be transferred to a new context (Halano & Greeno, 1999). The depth of understanding of knowledge and skill determines the quality of transfer. The deeper the understanding of the knowledge and skill, the more likely it can be transferred to a new context.

Context plays a crucial role in formulating transferability of a concept or skill. If the contexts are highly similar, near transfer will result, which leads to positive transfer (Perkins & Salomon, 1992). For instance, students' basketball skills demonstrated in physical education can be better transferred in a leisure time context that is similar to the physical education context (e.g., indoor, wood floor courts). On the other hand, if the leisure time context (e.g., outdoor, dirt courts) is not similar or relevant to the physical education context, far transfer may take place, where the dissimilarity between the two contexts may make the transfer difficult (Perkins & Salomon, 1992).

Metacognition refers to an individual's awareness and understanding of their own cognitive processes involved in planning and monitoring of actions (Veenman, Van Hout-Wolters, & Afflerbach, 2006). Metacognition has been described as a key aspect of transfer (Brooks & Dansereau, 1987; Marini & Genereux, 1995). Metacognition helps

individuals develop cognitive strategies. An individual's understanding of when, where, and why to use the knowledge and skills in one context can strengthen the process of knowledge and skills transfer to another context.

Knowledge and Skills Needed for a Physically Active Lifestyle

The knowledge and skills learned in schools, such as facts, concepts, principles, and procedures, are expected to be applied by students in their daily lives (Ennis, 2015). According to the transfer theory, if transfer has taken place, there will be a connection between what is demonstrated in physical education and what is performed in leisure time. With successful transfer of the knowledge and skills, students will be more likely to be physically active in leisure times, while failure to transfer the knowledge and skills may likely lead them to sedentary behaviors during leisure times.

Knowledge has been distinguished into two types: declarative knowledge and procedural knowledge (Alexander, Schallert, & Hare, 1991; Anderson, 1982). Declarative knowledge consists of facts, concepts, and principles. Procedural knowledge, on the other hand, refers to procedures, sequences, and actions required to carry out an action. In general, procedural knowledge is about how to apply declarative knowledge (Pairs, Lispson, & Wixson, 1983). This framework of knowledge provides a foundation for an understanding of knowledge (what) and knowledge application (how). Within the framework of declarative/procedural knowledge, students who are particularly interested in physical activities are considered to be attracted to procedural knowledge.

Health-related fitness knowledge. Research has revealed that health-related fitness knowledge is critical in developing children's healthful living behaviors (Ennis,

2010). Zapata, Bryant, McDermott, and Hefelfinger (2008) found that a lack of health-related fitness knowledge can be one of the factors for the continued obesity epidemic among middle school youths. Knowledge of fitness offers scientific explanations for physical fitness and well-being and enables individuals to understand and apply principles of exercise to their daily lives. However, if an individual does not understand the benefits of maintaining a healthy weight balance, it may affect their participation in physical activity. Therefore, increased health-related fitness knowledge can lead to an increase of physical activity behaviors (Zhu, Safrit, & Cohen, 1999), and promote exercise adherence and overall health.

The literature reviewed in Chapter II indicates that the relationship between health-related fitness knowledge and physical activity behavior is inconsistent. Elementary school settings showed little relationship between knowledge and physical activity behavior (Chen et al., 2014; Dilorenzo, Stucky-Ropp, Vander Wal, Gotham, 1998). A low to moderate positive relationship was found among middle school and high school students (Dilorenzo, Stucky-Ropp, Vander Wal, & Gotham, 1998; Haslem, Wilkinson, Prusak, Christensen, & Pennington, 2016; Thompson & Hannon, 2012). Although studies within K-12 settings reported mixed results, current evidence suggests that increased health-related fitness knowledge contributes to physical activity increases among upper-grade school students in comparison to those in the primary grades. Research examining these relationships in college settings is scarce and more is needed for us to understand if there is a connection between college physical education and students' leisure-time physical activity.

Motor skills. Motor skill competence is one of the cornerstones of a physically active lifestyle. Motor skills include fundamental motor skills and sport-specific motor skills (Stodden et al., 2008). Research has found that fundamental skills are the foundation of physical activity, as they enable individuals to move and actively engage in physical activity behavior (Li & Dunham, 1993). Research evidence has also found that children and adolescents with proficient motor skills in team sport-related activities are not only more likely to participate in diverse forms of physical activity, such as basketball, soccer, and volleyball, but also to persist longer and to engage in higher levels of moderate to vigorous physical activity (Stodden et al., 2008). Moreover, research found children and adolescents with proficient motor skills are less likely to be classified as overweight or obese based on body mass index (BMI) (Okely, Booth & Chey, 2004).

Chapter II also indicated that the relationship between motor skills and leisure time physical activity behavior is unclear. Some studies have revealed a moderate positive correlation between motor skills and physical activity (Robinson, Wadsworth, & Peoples 2012), while other studies indicated little to no association (McKenzie et al., 2002; Okely, Booth, & Patterson, 2001). The types of motor skills and the way physical activity is measured seem to influence the strength of the relationships. Among all the studies reviewed, motor skills are assessed on fundamental skills, such as locomotor skills and object control skills. Team sport-specific motor skills have rarely been examined in research. Houwen, Hartman, and Visscher (2009) found that children and adolescents with proficient sports skills in team sport-related activities are more likely to

develop a physically active lifestyle than low motor skills groups. The current thesis research included team sport-specific motor skills in the study.

Transfer between Physical Education and Leisure-Time Physical Activity

Physical education is believed to be an ideal place to learn knowledge and skills that can lead to a physically active lifestyle (Corbin, 2002). Evidence indicated that health-related fitness knowledge (Ennis, 2010), and motor skills (Humbert et al., 2006) are two principal components related to physical activity behavior. Ennis (2015) argued that these two variables enhance students' cognition and competence, which are critical factors for being physically active. According to transfer theory (Bransford & Schwartz, 1999), there is a possibility that knowledge and skill demonstrated in physical education may be transferred to leisure-time physical activity settings when (a) students accumulate a good amount of knowledge and skills, (b) they understand the knowledge in depth and perform the skills proficiently, (c) they realize the relevance of knowledge and skills to their leisure time setting (contextual relevance), and (d) they develop practical strategies to use the knowledge and skills to engage in leisure time physical activity (metacognition).

The amount of knowledge that students gain in school can influence how much knowledge and skills they apply in a new context (Halano & Greeno, 1999). For example, the fitness knowledge learned in physical education can include scientific explanations for physical fitness and exercise in different settings. Transfer theory implies that depth of understanding is a determinant of transfer. Providing students with both access to the skillfulness and to a level of mindfulness to experience the activity

deeply and meaningfully will improve the possibility of a successful transfer. Context plays a crucial role in formulating transferability of the concept or skill (Perkins & Salonmon, 1992). Flexibility is needed to apply skills learned in educational contexts to other more operational or functional contexts. Therefore, for physical education to facilitate leisure-time physical activity behavior, it should be focused on teaching knowledge and skills that will apply to similar contexts outside of school. Lastly, metacognitive approaches are another determinant of transfer; they help individuals develop strategies to transfer knowledge and skills in complex situations.

Statement of the Problem

Given the above literature summary and transfer theory, there is a need to study the connection between physical education and leisure time physical activity behavior. The primary goal of schooling is to prepare students for life after they graduate. Due to the limitations of instructional hours and resources, physical education seems to unable to provide a sufficient amount of physical activity for students to meet daily requirements. To promote leisure-time physical activity, individuals need to successfully transfer knowledge and skills from the context in which they are first gained to new contexts in which the individual engages in during leisure-time physical activity. If students can transfer the knowledge and skills demonstrated in physical education to leisure time, they would likely to be physically active during the leisure time.

Evidence has indicated that physical activity patterns established in college are more likely to be maintained for a long time, even into adulthood (Sparling & Snow, 2002). The finding of “carryover effect” from college students to adulthood has been

supported in a study by Calfas, Sallis, Lovato, and Campbell (1994). However, it was reported that only 20% of college students regularly participate in moderate physical activity (Douglas et al., 1997), and almost half of all college students report a decrease in physical activity after graduation. The research findings suggested that a need to study the connection between physical education and leisure-time physical activity behavior among college students. Thus, the purpose of this study was to identify the extent to which college students' knowledge and skills demonstrated in physical education are associated with leisure-time physical activity behavior.

Research Questions

This study is focused on the connection between physical education and leisure time physical activity by answering three research questions: (a) To what extent is health-related fitness knowledge, demonstrated in physical education, related to leisure-time physical activity behavior? (b) To what extent is amount of physical activity, demonstrated in physical education, related to leisure-time physical activity behavior? (c) To what extent are sport-specific motor skills, demonstrated in physical education, related to leisure-time physical activity behavior?

Research Hypotheses

Guided by transfer theory, I hypothesized first that students who have more health-related fitness knowledge in physical education are more likely to be active in leisure-time physical activity than students who have less health-related fitness knowledge. Second, within similar contexts, students who are physically active in physical education are more likely to be active in the leisure-time context. Third, students

who demonstrate proficient sport-specific motor skills in physical education are more likely to be active in leisure-time than students who do not demonstrate proficient sport-specific motor skills.

Significance of the Study

Identifying the connection between physical education and leisure time physical activity would provide empirical evidence to verify tenability of transfer theory. In addition, this study provide evidence to show whether sport-specific college physical education content can be applied in leisure-time physical activity. Lastly, the findings of this study may provide information to college physical education instructors in terms of the role of physical education in promoting campus-wide leisure-time physical activity.

Definitions of Key Terminologies

Conditional knowledge refers to conceptual understanding of the conditions required for one to successfully act upon declarative knowledge and procedural knowledge (i.e., knowing when and why) (Lawless & Kulikowich, 2006).

Declarative knowledge is defined as conceptual understanding about facts, concepts, and principles (i.e., knowing what) (Lawless & Kulikowich, 2006).

Health-related fitness knowledge refers to knowledge about overall well-being and health, including concepts of fitness (definitions, relationships to PA, relationships to health), scientific principles (physiology), components of physical fitness (cardio respiratory, muscular strength and endurance, flexibility, and body composition), effects of exercise on chronic disease risk factors, exercise prescription (frequency, intensity,

duration, mode, self-evaluation, adherence to exercise), nutrition, injury prevention, and consumer issues (Zhu, Safrit, & Cohen, 1999).

Inactive behavior is defined as performing an insufficient amount of moderate-intensity activities (i.e., not meeting specified physical activity guidelines) (Barnes et al, 2012).

Leisure time physical activity is defined as physical activities performed by a person that are not essential activities of daily living and are performed at the discretion of the person (US Department of Health and Human Services, 2008).

Moderate-intensity activities are defined as physical activities with energy expenditures between three to six metabolic equivalents (MET, see definition below). (Ainsworth et al., 2000).

Motor skills refer to locomotor skills that involve moving the body through space, including running, vertical jumping, galloping, skipping, hopping, sliding and leaping (Haywood & Getchell, 2005).

Metabolic equivalent (MET) is defined as "the quantity of oxygen consumed by the body from inspired air under basal condition and is equal on average to 3.5 ml oxygen/kg per min." (Morris et al., 1993, pp.175).

Physical activity refers to any bodily movement produced by skeletal muscles that results in energy expenditure (Caspersen, Powell, & Christenson, 1985).

Procedural knowledge refers to the conceptual understanding about applying the factual knowledge (i.e., knowing how) (Lawless & Kulikowich, 2006).

Sedentary behaviors are defined as any waking activity characterized by an energy expenditure less than 1.5 MET and in a sitting or reclining posture (Barnes et al, 2012).

Transfer theory refers to the portability of knowledge or skills, which are transferable from one setting to another (Perkins & Salomon, 1992).

Vigorous-intensity activities are defined as those activities with energy expenditure between three to six MET (Ainsworth et al., 2000).

CHAPTER II

LITERATURE REVIEW

This thesis research aims to determine the extent to which students' knowledge and skills demonstrated in physical education are associated with leisure-time physical activity behavior. In this chapter, I first articulate the theory of transfer (Perkins & Salomon, 1992) to explore a theoretical possibility of connecting knowledge and skills demonstrated in physical education to leisure-time settings. Second, I review findings of research on leisure-time physical activity, especially those activities connected with activities in physical education. The goal of this review is to identify connections between physical education and leisure-time physical activity behavior. Third, I substantiate the connections by examining research on the association between knowledge and skills demonstrated in physical education and leisure-time physical activity.

Section I: Transfer Theory

Knowledge and skill transfer has often been referred to as the ultimate goal of education (McKeough, Lupart, & Marini, 1995). Perkins and Salomon (1998) argued that the primary purpose of education is to transfer theoretical knowledge and skills to practical application settings to solve problems. Likewise, the knowledge and skills learned in physical education, such as facts, concepts, principles, and procedures, are expected to be applied by students in their daily lives (Ennis, 2015).

Knowledge can be conceptualized as declarative or procedural (Alexander, Schallert, & Hare, 1991; Anderson, 1976). Declarative knowledge consists of facts, concepts, and principles; in general declarative knowledge is about “what”. Procedural knowledge, on the other hand, refers to procedures, sequences, and actions required to carry out an action; in general procedural knowledge is about how to apply declarative knowledge (Pairs, Lispson, & Wixson, 1983). The connection between knowledge demonstrated in a setting to another setting may signify the beginning of knowledge (possible behavior). As Ennis (2015) pointed out, identifying and understanding this connection may lead us to teaching practices resulting in physical activity behavior transfer from physical education to leisure-time settings.

Transfer

Knowledge transfer refers to the portability of knowledge or skills from one setting to another (Perkins & Salomon, 1992). A positive transfer occurs when the knowledge and skills demonstrated in one context improve or enhance performance in another context or undermine the performance in another context. A negative transfer occurs when the knowledge and skills demonstrated in one context do not manifest in another context or undermine the performance in another context. According to Perkins and Salomon (1992), there are two pathways of transfer: near transfer and far transfer. Near transfer refers to transfer between very similar contexts. On the other hand, far transfer refers to transfer between two remote and alien contexts.

Bransford and Schwartz (1999) postulated that a successful transfer is dependent on the following factors: amount of knowledge, quality of understanding, context

relevance/similarity, and appropriate metacognition. The amount and type of knowledge and skills influence how much of the knowledge can be transferred to a new context (Halano & Greeno, 1999). The depth of understanding of knowledge and skill effects the likelihood of transfer. The deeper the understanding of the knowledge and skill, the more likely they can be transferred to a new context. In other words, individuals with a deeper understanding of the concept and skills would be more likely to transfer that concept to other contexts.

Context plays a crucial role in transferability. If the contexts are highly similar or relevant, near transfer will result; which leads to positive transfer (Perkins & Salonmon, 1992). For instance, students' basketball skills demonstrated in physical education can be better transferred in a leisure-time context that is similar to the physical education context (e.g., indoor, wood floor courts). On the other hand, if the leisure time context (e.g., an outdoor, dirt courts) is not similar or relevant to the physical education context, far transfer will be likely to take place, where the dissimilarity between the two contexts could make the transfer between them difficult (Perkins & Salonmon, 1992).

Metacognition refers to an individual's awareness and understanding of their own cognitive processes involved in planning and monitoring of and acting (Veenman, Van Hout-Wolters, & Afflerbach, 2006). Metacognition has been described as a key aspect of transfer (Brooks & Dansereau, 1987; Marini & Genereux, 1995). Metacognition helps individuals develop cognitive strategies. An individual's understanding of when, where, and why to use the knowledge and skills one used in another context may strengthen the process of knowledge and skill transfer.

Implications of Transfer Theory

Transfer theory has been applied to help educators design learning experiences for students to transfer what they learn in the classroom to other contexts (Corkill & Fager, 1995; Lerda, Garzunel, & Therme, 1996). It is expected among physical education scholars (e.g., Ennis, 2015) that knowledge and skills demonstrated in the physical education classroom will be transferred by students to their leisure-time context. Furthermore, it may also be hypothesized that some or all the factors that determine transfer (amount of knowledge, quality of understanding, context relevance/ similarity, and appropriate metacognition) can be observed in leisure-time (new) context.

Section II: Leisure-Time Physical Activity

Leisure-Time Physical Activity Behavior

Leisure-time physical activity is defined as physical activities performed by a person that is not required as essential activities of daily living and are performed at the discretion of the person (US Department of Health and Human Services, 2008). A variety of leisure-time activities including sports, homework, and electronic media and other sedentary activities are available during this period (Atkin et al., 2008). In short, it is a period that is characterized by its discretionary nature and is encompassing critical hours in which students can be active or inactive (Larson, 2001).

A compendium by Ainsworth et al. (2000) lists physical activities with their assigned intensity levels in metabolic equivalents. Metabolic equivalent refers to “the quantity of oxygen consumed by the body from inspired air under basal condition and is equal on average to 3.5 ml oxygen/kg per min.” (Morris et al., 1993, pp.175). Based on

intensity, active behavior can be categorized as the light physical activity, moderate physical activity, and moderator to vigorous physical activity (Rising et al., 1994). For example, active behaviors such as playing with dolls or action figures are considered to be the light physical activity (1.5 to 3 metabolic equivalent). Moderate physical activity is defined as those activities with energy expenditure between three to six metabolic equivalents (Ainsworth et al., 2000). Vigorous intensity activities refer to activities with energy expenditures greater than six metabolic equivalents, including behaviors such as bike riding, tag, and team or individual sports (Ainsworth et al., 2000).

Regular participation in physical activity has been reported to have numerous health benefits (Biddle, Gorely, & Stensel, 2004; Strong et al., 2005). A recent comprehensive review by Poitras et al. (2016) examined the relationships between physical activity and health indicators in school-aged children and youth. This study reviewed 162 studies that collectively included 204, 171 participants (aged 5-17 years) form 31 different countries. They found a positive relationship between physical activity and participants' health and disease prevention. They proposed that participating in a regular physical activity (60 minutes per day to moderate to vigorous physical activity) can be beneficial to youth for disease prevention and promotion of well-being. Furthermore, the United States Department of Health and Human Services (USDHHS) (2010) emphasized participation in regular physical activity as a preventative measure for chronic disease among males and females of all ages and conditions.

Despite these numerous benefits, physical activity participation rates are still unsatisfactory (Saillis, Prochaska, & Taylor, 2000). The U.S. national data indicates that

only 42% of six to 11-year-old children meet the current national guidelines for participating in at least 60 minutes of moderate to vigorous physical activity (Nader, Bradley, Houts, McRitchie, & O'Brien, 2008). Furthermore, there is a dramatic decrease in activity levels with age increase, as only 8% of 12-15-year-old adolescents meet the recommended current national guideline (Troiano et al., 2008). Researchers also reported that about 40% to 50% of college students are physically inactive (Keating, Guan, Piñero, & Bridges, 2005). Particularly, the study found that 54.1% of college students did not meet the American College of Sports Medicine and American Heart Association's recommendation for physical activity.

This inactivity behavior is likely to lead to inactivity in adulthood (Gordon-Larson et al., 2004). A longitudinal study by Telama et al. (2005) confirmed Gordon-Larson et al.'s (2004) finding; they tracked 2,309 subjects at ages three, six nine, 12, and 15. After 21years 1, 563 participants were measured at ages 24, 27, 30, 33 and 36. Telama et al. (2005) found that participants who were physically active over three contiguous years were four to five times more likely to be physically active in later life than people who demonstrated a participation period shorter than three years. The result seems to indicate that a longer period of participation in youth may lead to a more physical activity in later life.

Sedentary behavior is defined as "any working activity characterized by an energy expenditure below 1.5 metabolic equivalents and in a sitting or reclining posture" (Barnes et al., 2012, pp. 540). Research studies typically divide sedentary behaviors into two types; screen-based behavior and non-screen based behavior. Screen-based behavior

refers to time spent in such activities as watching television and playing computer and video games as a surrogate for active behavior (Olds, Maher, Ridley, & Kittel, 2010). Non-screen based behavior includes homework and reading.

The sedentary behavior prevention guidelines in many countries recommend children should limit their screen-based sedentary behaviors to less than two hours (120 minutes) per day (Bar-On et al., 2001). It is reported, however, that 47% of children and adolescents exceed the screen recommendation (Sisson et al., 2011). Excessive screen-based behavior is linked to overweight problems because research has found that television time not only increases sedentary behavior (Salmon, Campbell, & Crawford, 2006) but also displaces more active pursuits (Mutz, Roberts, & Vuuren, 1993).

To further understand the relationship between sedentary behavior and leisure-time physical activity, Sisson et al. (2011) investigated the associations among three leisure-time sedentary behaviors (television viewing, reading for pleasure, and non-school computer use) and overweight status. Participants were asked to complete questionnaires which measure their physical activity levels over the previous 12 months. The results indicated that television viewing was associated with being overweight. Reading and non-school computer use was not associated with being overweight. Results showed that males reported greater participation in physical activity and exercise than females. Most notably, this study found that the use of computers by males, as well as the watching of television by females, were both negatively correlated with exercise and physical activity.

Contributions of Leisure-Time Physical Activity Behavior

Physical education is taught in a curricular context in which students participate in physical activities planned for them. Schools are an ideal setting to promote regular physical activity in children and youths given that 95% of children and youths in the United States are enrolled in schools at various levels (Nayor & McKay, 2009). Although physical education provides a good amount of physical activity on the days it is offered, additional participation in physical activity is still needed for children and youth to meet the 60-minute daily requirement of moderate to vigorous physical activity (Riddoch et al., 2007). Therefore, leisure-time physical activity is a significant opportunity to supplement the physical activity received in physical education, especially on days that students do not have physical education classes.

Children and youths' leisure-time physical activity participation has two unique contributions (Pate & Neil, 2009). First, it provides additional opportunities for children and adolescents to accumulate 60 minutes of moderate to vigorous physical activity per day. Second, school-based leisure-time physical activity programs may provide a safe environment for youths to participate in moderate to vigorous physical activity, in which they might otherwise not participate.

Cumulated research evidence supports the potential of leisure-time physical activity in making a substantial contribution to promoting physical activity in children and youths (Olds et al, 2009). It is reported that leisure-time participation can contribute up to one-third of a child's recommended daily physical activity (Trost, Rosenkranz, & Dzewaltowski, 2008). Furthermore, Turdor-Locke, Lee, Morgan, Beighle, and Pangrazi

(2006) found that leisure-time physical activity accounted for almost 50% of total daily steps among 6th-grade children.

A recent study by Arudell, Hinkley, Veitch, and Salmon (2015) examined the association between leisure-time physical activity and achieving physical activity and sedentary behavior recommendations (more than 60 minutes of physical activity and less than 120 minutes of screen-based sedentary behavior, both per day). In this study, children (*N*=406, mean age=8.1) were assessed by the percentages of time spent in sedentary, light, moderate, and vigorous physical activity between the end of the school day and six pm. Activities were measured using the accelerometer. The researchers found leisure-time physical activity was positively associated with achieving physical activity recommendations. In contrast, leisure-time screen-based sedentary behavior was negatively associated with achieving the physical activity behavior recommendations.

To understand students' leisure-time physical activity behavior, Stone and Faulkner (2014) investigated children's physical activity in different segments of the day and week. They found that children accumulated a greater amount of physical activity, both in total and of the moderate to vigorous sort, on school days more than they did on weekend days. Consistent with the prior study, the meta-analytical literature review on school-age students (ages 14-18) conducted by Brooke, Corder, Atkin and van Sluijs (2014) showed that physical activity levels during and after school on weekdays differed from weekend levels. The researchers found that children were more active on weekdays than weekends. On the weekdays, an amount of physical activity in physical education was lower than the corresponding amount in leisure-time settings. However, it is

important to note that physical education, overall, still contributed a greater amount of physical activity to children and adolescents' total than that contributed by leisure-time settings. These findings support the need to examine the connection between the two settings in order to promote leisure-time physical activity behavior.

Measurement of Leisure-Time Physical Activity Behavior

Leisure-time physical activity behavior has been measured using subjective methods such as self-report and daily journal logs, as well as objective methods such as the accelerometer, heart rate monitoring, and direct observation (Pate & O'Neill, 2009). Self-report on physical activity is recognized as being cost-effective, easy to administer, and accurate in measuring intense activity; therefore, it has been used for physical activity measurement in a variety of timed studies. The Three-Day Physical Activity Recall survey was the most frequently used self-report technique in studies of leisure-time physical activity and sedentary behavior (Hager, 2006). However, self-report has been found to be less robust in measuring light or moderate activity (Jocobs et al., 1993) and assessing energy expenditure (Shephard, 2003) on a given day or within several days.

Objective methods of measuring leisure-time physical activity behaviors, such as the use of pedometers and accelerometers, are recognized as effective and accurate in providing valid and reliable data. However, limitations include the amount of time the device is worn and the inability to correctly record different types of physical activity. For example, it is difficult to use them to measure water-based physical activities such as swimming. Also, accelerometers do not accurately record certain physical activities, including biking, elliptical training, and weightlifting. These limitations may

underestimate the physical activity level of active participants in these select sports and activities.

Factors Impacting Leisure-Time Physical Activity Behavior

Although leisure-time physical activity helps accumulate moderate to vigorous physical activity, children and adolescents seem to spend the majority of their leisure-time sedentary and light physical activity behaviors (Beets, Rooney, Tilley, Beighl, & Webster, 2010; Trost, Rosenkranz, & Dzewaltowski, 2008). Weaver et al. (2015) identified activity structure and contextual elements as two factors that influenced students' accumulation of leisure-time moderate to vigorous physical activity.

Activity structure. The activity structure refers to how the activity is organized. Physical activity structure can be further divided into organized or un-organized (Trost, Rosenkranz, & Dzewaltowski, 2008). Organized physical activities include sports, games, and dance in school or in organized communities such as clubs. Un-organized physical activities refer to those in which an individual engages by themselves without an organization.

Research evidence has suggested that children accumulated more moderate to vigorous physical activity during un-organized physical activity than during organized physical activity (Trost, Rosenkranz, & Dzewaltowaski, 2008). For example, Coleman, Geller Rosenkranz, and Dzewaltowski (2008) examined 20 after-school programs serving 1,700 elementary-age children and found the structure of organized games, including basketball, tag, soccer, and football, discouraged moderate to vigorous physical activity. Their findings are also supported by a later study (Weaver et al., 2015).

Contextual factors. Contextual factors refer to the settings in which the activity takes place, including school, home, community centers, and other physical and social environments. Home, community (playground) and school (gymnasia) are identified as the three most important venues in which students accumulate physical activity.

Schools are important institutions for promoting physical activity, both in physical education and leisure-time physical activity (Trost, Rosenkranz, & Dzewaltowski, 2008). Reasons for this include the following: schools have an organized structure and facilities that can be used to promote physical activity; also, schools have the capacity to interact with community-based physical activity and other community groups. Thus, schools have become the focal point for interventions designed to increase physical activity among children and adolescents.

The home environment, where students spend much of their after-school hours, is also recognized as one of the most important places for promoting leisure-time physical activity in children (Trost, Loprinzi Moore, & Pfeiffer, 2011). This is because the home offers factors such as parental modeling of behavior, and support in terms of funding, transportation, encouragement and parental supervision (e.g., restricting television viewing time at home) (Davison, cutting, & Birch, 2003). Also, the home environment may support both indoor and outdoor activities. It is reported that higher amounts time spent on outdoor activities at home is associated with higher levels of moderate to vigorous physical activity (Wickel, 2013).

The community refers to a neighborhood or people who share values and institutions, and are situated in a given geographical area. Research has found that access

to physical activity equipment and to recreation centers correlates with higher physical activity for children and adolescents. For example, Gordon-Lersen et al. (2006) found that adolescents living in areas with more exercise facilities were 32% less likely to be overweight and 26% more likely to be highly active than those residing in areas with fewer facilities. Moreover, research showed that neighborhoods with greater proportional numbers of facilities are associated with increased physical activity in the young children, aged four to seven, who reside in those neighborhoods. (Weir, Etelson, & Brand, 2006).

Factors Facilitating Leisure-Time Physical Activity Behavior

Students at a young age are physically active in general. Under the influence of adults, home, and school environment, they either continue to be physically active or begin to adopt a sedentary lifestyle. Research has been focused on factors that facilitate leisure-time physical activity behavior, including personal and social factors. Significant findings among K-12 and college settings include: (a) Males tend to be more active than females (Buckworth & Nigg 2004; Hesketh, Graham, & Waters, 2008); (b) Adolescents are generally less active than young children (Arudell et al., 2013); (c) Those who perceive themselves as high in competence are more active than those who perceive themselves as low in competence (Humbert et al., 2006); (d) Children who play outdoors have higher physical activity (Stone & Faulkner, 2014); (e) Children whose family members are physically active tend to be more active than those whose family members are sedentary (Heitzler, Martin, Duke, & Huhman, 2006; Kargarfard et al., 2012). The above findings indicate that personal, social and environmental factors can have direct and indirect influences on the development of leisure-time physical activity behavior.

Environmental factors. Environmental factors refer to person's physical surroundings and may include the accessibility of facilities, availability of organized programs, and weather conditions. Studies report that factors such as temperature and overall weather conditions have an impact on children's physical activity (Beighle, Erwin, Morgan, & Alderman, 2012). Beighle et al. (2012) examined the relationship between children' physical activity levels in school and leisure-time during winter and fall. They found that children had higher daily activity in the fall, when the weather was more suitable for outdoor activities, than in the winter, when the temperature was much lower and not suitable for the same activities.

Social factors. Social factors refer to the interaction between the individual and many other things, including support networks and social norms. Social factors such as one's home environment and economic status were found that associated with children' physical activity (Heitzler, Martin Duke, & Huhman, 2006). Parents act as role models, sources of support, and gatekeepers by exercising control over their children's opportunities for physical activity. An empirical study by McMinn, Griffin, Jones and van Sluijs (2012) examined the associations between home-related factors and children's physical activity level (N=2064, age nine to 10 years old), and found that family social support is positively associated with the after-school physical activity. This is consistent with another study, Lau et al. (2015), which found that parental support was positively associated with leisure-time total physical activity and moderate to vigorous physical activity and, in addition, negatively associated with leisure-time sedentary activity in girls.

Studies also reported that children and adolescents who are considered to be lower social economic status are also associated with less physical activity. In one such study, Crespo, Ainsworth, Ketevian, Heath, & Smit (1999) found that participants of low socioeconomic status were less active than their more affluent counterparts. It is well-documented that children from low-income families often have limited resources, such as transportation or funds to purchase and/or otherwise access equipment (Sallis, Zakarian, Hovell, & Hofstetter, 1996). It can be reasoned that this lack of transportation and funds to pay facility fees may prohibit youths with low socioeconomic status from accessing local facilities. Studies found that children of low socioeconomic levels, as well as persons with lower levels of education, are likely to be less physically active during in leisure-time after school (Crespo, Smit, Andersen, Carter-Pokras, & Ainsworth, 2000).

Individual factors. Individual factors normally include psychological, biological, and demographic variables. Perceived competence and enjoyment were identified as the most important intrapersonal factors in developing leisure-time physical activity (Humbert et al., 2006; Weaver et al., 2015). Stodden et al. (2008) believed that motor skill competence is a primary underlying mechanism that promotes engagement in physical activity. Other studies have reported that overweight and sedentary children have inferior fundamental movement skills, which may hinder perceived enjoyment and competence (Okely, Booth, & Chey, 2004). Saksvig et al. (2005) suggested that students should learn knowledge and skills in their early years, which would enable them to develop and sustain an active lifestyle in the future.

Summary

Environmental and social factors have an impact on leisure-time physical activity behavior, but these factors cannot be easily manipulated to promote moderate to vigorous physical activity. For example, the government could mix residential with commercial or occupational environments so that most individuals walk to school or work instead of taking a bus or driving, however this change in the physical environment would be very time consuming and costly.

Since knowledge and motor skills are considered prerequisites to substantial participation in leisure-time physical activity, it is imperative to foster these precursors. Although a student might acquire knowledge and skills at home or in many public and private education institutions, there is a consensus that physical education is an ideal place to learn knowledge and skills needed for leisure-time physical activity participation. It is reasonable to assume that knowledge and skills acquired or demonstrated in physical education are essential to the pursuit of an active lifestyle beyond the school setting.

Section III：The Physical Education – Leisure-Time Physical Activity Connection

In this section, I reviewed research findings on leisure-time physical activity in order to illustrate the possible connection between skills demonstrated in physical education and participation in the leisure-time activity. By reviewing and critiquing the literature, I was able to provide a theoretically sound rationale and to portray the necessity for focusing on this connection of physical education on leisure-time physical activity behavior.

Transfer between Physical Education and Leisure Time

It has been argued that health-related fitness knowledge (Ennis, 2010), and motor skills (Humbert et al., 2006) are two principal components related to physical activity behavior. Ennis (2015) claims that these two variables enhance students' cognition and competence, which are critical factors for being physically active (Ennis, 2015). According to transfer theory (Bransford & Schwatz, 1999), there is a possibility that knowledge and skill demonstrated in physical education may transfer to leisure-time physical activity settings if that knowledge and those skills were in substantial amounts, as well as relevant (deeply understood), practical (contextually relevant) and ready to use (metacognition approach).

The amount of knowledge that students acquire in school may influence how much knowledge they apply in a new context (Halano & Greeno, 1999). For example, the fitness knowledge learned in physical education may include the scientific explanations for physical fitness and exercise to encourage activity in different settings. Transfer theory suggests that the depth of understanding is another determinant of transfer. Providing students in physical education with both access to the skills required to participate competently by giving them an opportunity to learn and to a certain level of mindfulness may improve the possibility of successful knowledge and skill transfer. Context plays a crucial role in estimating the transferability of the concept or skill (Perkins & Salomon, 1992). Flexibility is needed to apply skills learned in educational contexts to other more operational or functional contexts. Therefore, for physical education to facilitate leisure-time physical activity behavior, it should focus on teaching

knowledge that can be applied to similar contexts outside of school. Offering contextually transferable knowledge and skills may provide an engaging environment within which students can acquire and demonstrate fitness knowledge with enhanced efficiency. Lastly, metacognitive approaches are another determinant of transfer; they help individuals develop strategies for transferring knowledge and skills in complex situations (Brooks & Dansereau, 1987; Marini & Genereux, 1995).

The Goal and National Standards in Physical Education

The ultimate goal of physical education is to develop physically literate individuals with the knowledge, skills, and confidence necessary to enjoy a lifetime of healthful physical activity (The Society of Health and Physical Educators [SHAPE], 2014). This goal has been further simplified into five standards. Specifically, students are expected to demonstrate, among other things, the knowledge and skills required to achieve and maintain a health-enhancing level of physical activity and fitness (SHAPE, 2014). This standard indicates that knowledge and skills are determinates of physical activity behavior and life-long healthful living.

Knowledge Needed for a Physically Active Lifestyle

Knowledge can be broken down into three forms: declarative, procedural, and conditional. Declarative knowledge refers to factual information in various forms such as rules, relations and conceptions (Smith & Ragan, 1999, pp. 79). It is knowledge about a "what" or particular thing (Gagne, Yekovich, & Yekovich, 1993), and influences the development and execution of skilled action/behaviors (Wall, Bouffard, McClements, Findlay, & Taylor, 1985). For example, in physical education, knowing how to define

vigorous intensity activity is an example of demonstrating one's declarative knowledge. Procedural knowledge refers to the steps, procedures, sequences, and actions required for task performance (Smith & Ragan, 1999, pp. 79). It is knowledge about how to achieve the "what" described by declarative knowledge (Gagne, Yekovich, & Yekovich, 1993). For example, understanding how to correctly position the body for sit-ups to maximize the use of abdominal muscles demonstrates one's procedural knowledge. Conditional knowledge is a conceptual understanding of the conditions required for one to successfully act upon declarative knowledge (i.e., knowing when and why) (Lawless & Kulikowich, 2006). An example of this would be varying the intensity levels of the warm-up and cool-down portions of a fitness workout so that they are lower than those for the main activity session. This enables a person performing the workout to make the best use of their time, as well as perform their physical exertion safely.

Anderson (1982) suggests that, in general, acquisition of declarative knowledge provides the foundation for the development of procedural knowledge such as what to do in a specific game situation. The framework of declarative, procedural, and conditional knowledge/skill helps from a platform to examine decisions pertaining to leisure-time active physical behavior. Procedural knowledge is recognized as underlying the performance of skills within a given domain. Within the framework of declarative/procedural knowledge, it can be assumed that students who are knowledgeable are likely to learn procedural knowledge.

Implications of Knowledge and Skills on Behavior

Research findings suggested that knowledge about activities and actual physical activity are strong predictors of healthy lifestyle development (Dominick, Dunsiger, Pekmezi, & Marcus, 2013). The poor knowledge representations in children are related to those children's inability to understand when and how to execute particular skills in complex game environments (McPherson & Thomas, 1989). Thompson and Hannon (2012) reported evidence that reinforces the need for students to acquire physical activity knowledge (knowing the concepts, principles, and strategies about health-related physical fitness) to develop an active lifestyle.

Health-related fitness knowledge. Health-related fitness knowledge has become critical in developing healthful living behavior in students (Corbin & McKenzie, 2008). Zhu, Safrit, and Cohen (1999) defined health-related fitness knowledge in terms of the overall health and categorized the knowledge into the following domains: (a) concepts of fitness (definitions, relationships to physical activity, and relationships to health), (b) scientific principles (physiology), (c) components of physical fitness (cardiorespiratory measures, muscular strength and endurance, flexibility, and body fat), (d) effects of exercise on chronic disease risk factors, (e) exercise prescription (frequency, intensity, duration, mode, self-evaluation, and adherence to exercise), (f) nutrition, injury prevention, and consumer issues. Although knowledge itself may not be enough to change behaviors (Ennis, 2007), improving and developing health-related fitness knowledge can be the first step towards establishing healthy behaviors that promote physical activity (Keating, 2003). It is reasonably postulated that students who possess

and understand health-related fitness knowledge may not only develop behaviors promoting physical activity, but also may participate in physical fitness safely and effectively.

Inadequate health-related fitness knowledge may influence an individuals' ability to sustain a physically active lifestyle. Research has found that a lack of health-related fitness knowledge may be a contributing factor to the ongoing obesity epidemic among middle school youth (Zapata, Bryant, McDermott, & Hefelfinger, 2008). Failure to understand the benefits to maintaining a healthy weight may affect participation in physical activity. Therefore, it is crucial to note that increasing health-related fitness knowledge may enable individuals to understand these benefits and apply principles of exercise to their daily lives (Zhu, Safrit, & Cohen, 1999).

Research into the link between health-related fitness knowledge and behavior in youth has reported mixed findings (Keating et al., 2009). Chen, Sun, Zhu and Chen (2014) examined the relationship between the achievement of health-related fitness knowledge in physical education classes and leisure-time physical activity. This study included 293 fourth and fifth grade participants from six elementary schools. Health-related fitness knowledge was determined using a standardized written test intended to assess the participants' pre-and post-knowledge. Leisure-time physical activity was measured by a shortened Three-Day Physical Activity Recall. The researchers found no relationship between achieved knowledge and students' leisure-time physical activity. These results were similar to an earlier study, which found a low correlation between the two measures (Dilorenzo et al., 1998). Dilorenzo et al. (1998) tested the health-related

fitness knowledge of 5th and 6th graders and then assessed the same students three years later as 8th and 9th graders (54 girls, 57 boys). In this study, participants' knowledge was measured by a true-false factual test, and leisure-time physical activity was measured by interviewing each participant (Physical Activity Interview) and a self-report questionnaire (Children' physical activity questionnaire). They found no association between fitness knowledge and leisure-time physical activity in 5th and 6th grade students, and a small association among the 8th and 9th graders (r=.26).

In middle and high school settings, Ferguson, Yesalis, Pomrehn, and Kirkpatrick (1989) found that no correlation existed between middle school students' health-related knowledge and physical activity behavior. In Ferguson et al.'s study, sixth to eighth grade students' (N=603) health-related fitness knowledge and physical activity were both measured by a 45 question survey (health-belief model). However, Chen, Liu, and Schaben (2017) found that health-related fitness knowledge is significantly correlated with leisure-time physical activity behavior. They examined the relationship between 8th graders' (N=660) physical activity/fitness knowledge and leisure-time physical activity. In this study, health-related fitness knowledge was measured by conducting a standardized written test enclosed in the PE Metrics. Physical activity and sedentary behavior were measured with the Youth Activity Profile. They found that students in the high knowledge group reported the higher level of leisure-time physical activity (means =3.57, $p < .05$).

Haslem et al. (2016) examined 280 high school students to assess the relationship between health-related fitness knowledge in physical education and leisure-time physical

activity. Assessment was carried out by way of a 22-item, multiple-choice test to measure health-related fitness knowledge and the Godin Leisure-time Exercise Questionnaire, a 7-day recall survey to measure their leisure-time physical activity behavior. The researchers found that there was no correlation between high school students' health-related fitness knowledge and leisure-time physical activity. However, Thompson and Hannon (2012) reported a moderate positive association ($r = .438$, $p < .001$) between health-related fitness knowledge and leisure-time physical activity. Students' (88 males, 77 females, average age = 16) leisure-time physical activity was measured by using the self-report Physical Activity Questionnaire for Adolescents, and health-related fitness knowledge was measured by a 100-point written test. Results showed a moderate positive correlation between health-related fitness knowledge and physical activity ($r = .438$, $p < .001$), indicating that the students with more health-related fitness knowledge reported higher levels of physical activity. This finding supports the need for students to acquire health-related fitness knowledge in order to cultivate an active lifestyle (Kloeppel & Kulinna, 2012).

In conclusion, the above five empirical research articles have systematically examined the relationship between health-related fitness knowledge in physical education classes and leisure-time physical activity behavior in various settings from ages K-12. Research findings as to the link between health-related knowledge and leisure-time physical activity behavior have been inconclusive; little correlation was observed within the primary school setting, and only a low to moderate positive relationship was seen within the middle and high school setting. Because of these findings, the relationship

between health-related knowledge and leisure-time physical activity among college students is still unclear.

Motor skill. Motor skill competence is one of the cornerstones of a physically active lifestyle. Motor skills include both fundamental motor skills and sport-specific motor skills (Stodden et al., 2008). Fundamental motor skills include locomotor skills and object control skills. Locomotor skills involve moving the body through space and include running, vertical jumping, galloping, skipping, hopping, sliding and leaping (Haywood & Getchell, 2005), while object control skills consist of manipulating and projecting objects; this includes skills such as throwing, catching, bouncing, kicking and rolling. Research has found that fundamental skills form the foundation of physical activity, which enables learners to move and actively engage in physical activity (Li & Dunham, 1993). Research also suggests that children and adolescents with proficient motor skills in sports-related activities are more likely to participate in more diverse forms of physical activity, participate for a longer period of time, and engage in higher levels of moderate to vigorous physical activity (Stodden et al., 2008). They are also less likely to be classified as overweight or obese based on body mass index (BMI) (Okely & Booth, 2004).

A growing body of evidence suggests that many children do not achieve proficiency in fundamental motor skills (Goodway, Suminski, & Ruiz, 2003), which may hinder their abilities to become skillful adults (Goodway & Branta, 2003). It has been suggested that children who participate in sport and achieve greater levels of motor skill competence during childhood and adolescence will remain active participants in physical

activity into and throughout adulthood (Malina, 1996). That being said, it is imperative to help students to master appropriate physical skills in physical education classes at all levels of education.

Research on the relationship between motor skill competence and physical activity have showed mix results. Some studies have shown a moderate, positive correlation (r=.461) between motor skill competence and physical activity (Robinson, Wadsworth, & Peoples, 2012). Other studies indicate little to no association (McKenzie et al., 2002). Robinson et al. (2012) examined the relationship between motor skill competence and perceived physical competence for school-day physical activity. This study included 34 preschool children, whose motor skill competence was assessed via the Test of Gross Motor Development-2nd Edition. Participation in physical activity was measured by SW-200 Digiwalker® pedometers worn for three consecutive days. They found a moderate, positive association between locomotor skills and leisure-time physical activity participation (r=.461), which suggests that cultivating motor skills in physical education class likely help children develop and sustain a physically active lifestyle. The work of Houwen, Hartman, and Visscher (2009) demonstrates that children between the ages of six and twelve with high locomotor and object-control skills spend more time engaged in non-sedentary behaviors and moderate to vigorous physical activity than children with low skills. Evidence indicated that children and adolescents with proficient motor skills in sport-related activities are more likely to develop a physically active lifestyle than groups with overall poorer proficiency in motor skills.

However, others studies indicate a weak association, or no association at all, between motor skills competency and physical activity behavior. McKenzie et al. (2002) assessed the relationship between young children' movement skills and their physical activity at the ages of four, five, and six and twelve years. Participants' fundamental skills such as jumping, catching and balancing were assessed. The measurement of physical activity utilized 7-day physical activity Recall. McKenzie et al. found that children's early childhood skills were not related to their physical activity six years later at age 10, 11, 12, 18 years. With results consistent with the Okely, Booth and Patterson' (2001) study, there was no significant correlation between skill in fundamental movements and leisure-time physical activity.

In conclusion, a mixed relationship was found between motor skills and leisure-time physical activity in the above empirical articles. The types of motor skills and physical activity that were assessed seemed to influence the strength of the relationships. In all these studies, motor skills were assessed in terms of fundamental skills, such locomotor skills and object control skills; sport-specific motor skills were rarely examined.

Summary

Research indicates that: (a) knowledge about physical activity and fitness is not associated with leisure-time physical activity behavior among elementary school students; (b) findings are mixed (low to moderate correlations) as to the impact of physical activity and fitness knowledge on leisure-time physical activity among high school students; (c) findings are mixed (low to moderate correlations) on the degree of

impact of sports-related skills on leisure-time physical activity among K-12 students; (d) Health-related fitness knowledge and sport-related motor skills have rarely been examined in a college setting.

The review illustrates two gaps in the literature which may be targeted by this thesis research. First, it has been shown that educational physical education can positively influence the students' leisure time physical activity (Adams 1993; Ennis, 2010). To promote leisure time physical activity, individuals need to successfully transfer knowledge from the context in which it is first gained to the new context. Specifically, successful transfer requires applying students' knowledge from physical education to leisure time settings. Even though the transfer theory supports the above assumptions, the connection between physical education and leisure time physical activity behaviors is still unclear.

Second, prior research has focused predominantly on elementary and middle school students. However, there is evidence that physical activity patterns established in college are more likely to be maintained for a long time than those established at a younger age (Calfas, Sallis, Lovato, & Campbell, 1994; Sparling & Snow, 2002). Thus, there is a need to examine the connection between physical education and leisure-time physical activity behavior among college students.

The purpose of this study is, based on the above review, to describe the extent to which students' knowledge and skills demonstrated in physical education are associated with leisure-time physical activity behavior. Specifically, this thesis attempts to answer the following three research questions: (a) To what extent is health-related fitness

knowledge, as demonstrated in physical education settings, related to leisure-time physical activity behavior?; (b) To what extent is the amount of physical activity, as demonstrated in physical education settings, related to leisure-time physical activity behavior?; (c) To what extent are sport-specific motor skills, as demonstrated in physical education settings, related to leisure-time physical activity behavior?

CHAPTER III

RESEARCH METHODS

The purpose of this thesis was to identify the extent to which students' knowledge and skills demonstrated in physical education were associated with leisure-time physical activity behavior. Based on the transfer theory, this study was focused on the connection between physical education and leisure-time physical activity by answering three research questions (a) To what extent was health-related fitness knowledge, demonstrated in physical education, related to leisure-time physical activity behavior? (b) To what extent was the amount of physical activity, demonstrated in physical education, related to leisure-time physical activity behavior? (c) To what extent were sport-specific motor skills, demonstrated in physical education, related to leisure-time physical activity behavior? In this chapter, I described in detail my research methodology including the research design, the research setting and participants, sampling procedure variables and measures, the procedures of data collection, analysis, threats to reliability and validity and strategies to address these threats.

Research Setting and Participants

A correlational design was used to answer the research questions. The correlational design allowed me to describe the potential associations between college students' knowledge, in-class physical activity, and sport-specific skills demonstrated in physical education and their leisure-time physical activity behavior.

The Research Setting

The study was conducted at one of the University of North Carolina. This university offers physical education courses to undergraduate students in its instructional physical activity program through the Department of Kinesiology. This program delivers purposeful and structured physical activity courses. These courses are instructed in a variety of settings on campus. Badminton, basketball, and volleyball classes are taught in indoor spaces. Swimming classes are taught in the 25-yard pool in the university's wellness and recreation center. Soccer is taught on the outdoor athletic fields. All classes are taught at the facilities designated for physical education instruction during instructional times. The student wellness and recreation center serves as alternate space for some outdoor classes during inclement weather. The facilities are well maintained. The facilities that also can be used by students during their leisure times.

Approximately 40 different physical activity courses are offered. Different levels and sections are offered in each semester to meet students' interests and schedules. These courses are electives for non-kinesiology students but are required courses for kinesiology majors who need four activity courses for graduation requirements. Most courses are scheduled from Monday to Friday in the mornings, only a few in the afternoons. Most courses are taught by graduate assistants as a form of assistantship. Most of the graduate assistants have previous teaching and coaching experiences, and a few of them have a degree in physical education pedagogy.

Sampling Size and Sampling Procedure

Borg and Gall (1989) sample size table for correlation studies, see Table 1 below, was used to determine the sample size. A literature review of studies was conducted in high schools (e.g., Haslem et al., 2016; Thompson & Hannon, 2012) and, calculated on average correlation coefficients *r*=.22. Using the Borg and Gall sample size table, it was determined that a sample size between 70 to 153 would suffice the needs of this study.

Table 1

Borg and Gall Sample Size Table for Correlational Studies

r	*N*
.80	9
.70	13
.60	18
.50	26
.40	42
.30	70
.20	153

Participants were recruited from six basketball classes (*n*=124), four volleyball classes (*n*=89), and two soccer classes (*n*=65) in the fall semester, 2017. These three courses offer sports-related motor skills often used by college students in leisure time activity. In addition, they are among the most frequent offering in college programs.

Focusing on these activities may have ramifications for both program development and leisure-time physical activity behavior change.

Table 2

Demographic Characteristics

Characteristics	*N*	*Percentage (%)*
Race		
Asian	17	9.1
Black	69	37.1
Hispanic	22	11.8
Caucasian	75	40.3
Other	3	1.6
Year in College		
Freshmen	20	10.9
Sophomore	21	11.4
Junior	62	33.7
Senior	62	33.7
Other	19	10.3

To recruit the participants, I sent an email to program coordinator to ask his permission to reach out each instructor. Then I sent emails to the instructors to inform them of the purpose of my study and ask their help in recruiting students in their class. The description of this letter is shown in Appendix F. After receiving their replies, I

scheduled an appointment to meet each of the instructor to talk about my recruitment plan and determine a time for me to visit that minimally interrupted their lesson plans.

The Sample

A total of 195 participants were recruited, 186 (male=99, female=87) participants provide completed data sets. Table 2 represented the frequency and percentage of demographic characteristics.

Variables and Measures

Health-Related Fitness Knowledge

Health-related fitness knowledge was defined as knowledge about overall well-being and health (Zhu et al., 1999). The knowledge domains include concepts of fitness (definitions, relationships to physical activity, relationship to health), scientific principles (physiology), components of physical fitness (cardiorespiratory, muscular strength and endurance, flexibility, and body composition), effects of exercise on chronic disease risk factors, exercise prescription (frequency, intensity, duration, mode, self-evaluation, adherence to exercise), nutrition, injury prevention, and consumer issues (Zhu et al., 1999). Students' knowledge was measured using the FitSmart knowledge test (Zhu et al., 1999). This test includes 50 weighted multiple-choice questions with the following content specifications: (a) concepts of fitness (20%), (b) scientific exercise principles (20%), (e) effects of exercise on chronic disease risk factors (5%), (f) nutrition, (g) injury prevention, and (h) consumer issues. The FitSmart test is validated measure of health-related fitness knowledge for high school students (Zhu, et al., 1999). The reliability

developed for this test was establishing through pilot testing of 600 students ranging from grades 9-12 (Zhu, et al., 1999).

In-Class Physical Activity

In-class physical activity is defined as any bodily movement produced by skeletal muscles that result in energy expenditure (Caspersen, Powell, & Christenson, 1985) during a physical education lesson. In-class physical activity was measured using ActiGraph GT3X accelerometers (ActiGraph, Shalimar, FL). ActiGraph GT3X accelerometers have been used to objectively assess the total amount of physical activity and intensity, such as time spent in moderate physical activity and vigorous physical activity. The accelerometers measure and record physical activity and vigorous physical activity. The accelerometers measure and record physical activity counts on three physical axes. The recorded physical activity counts can then be categorized into low, moderate, high or very high-intensity. Ssaki's (2010) cutoff standards per minute: light <1952/min, VM counts, moderate: 1953-9498/min., High: 5724-9498/min., and very high>9498/min. The accelerometers demonstrates high intra-instrument reliability (r=.86) and inter-instrument reliability between r=.86 to r=.89 (Melanson & Freedon, 1995).

Sports-Specific Motor Skills

Motor skills included fundamental motor skills and sports-specific motor skills (Stodden et al., 2008). Basketball, volleyball, and soccer are among the most popular choices of physical activities among college students. Buckworth and Nigg (2004) found college students formulated more vigorous physical activity through group exercise such intramural sports. In the current study, motor skills were operationally defined as the

sports-specific skills in those three sports (basketball, volleyball, and soccer) taught in the respective courses at university.

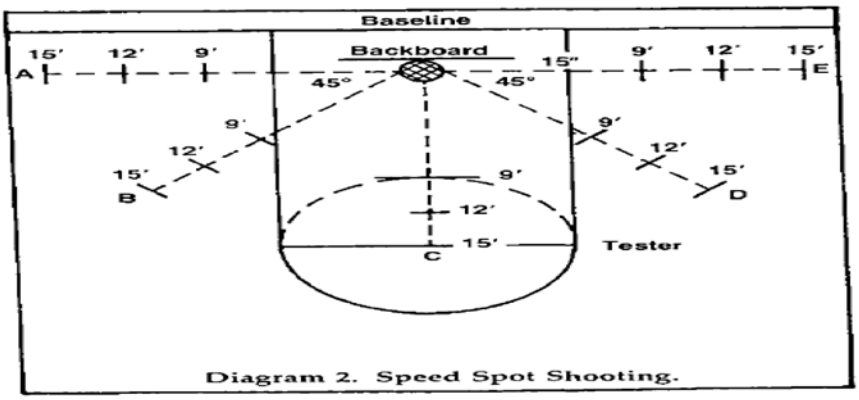

Figure 1. Basketball Shooting Test Diagram. Adapted from court marking for the speed shot shooting test. (Hopkins, Shick & Plack, 1984).

Basketball shooting skill. In basketball, I tested participants' shooting skill. Not only is shooting one of the most important skills in basketball, it is also the skill that people practice the most when playing at leisure times. The speed spot shooting test (Hopkins, Shick, & plack, 1984) measures shooting skill using rapidly shooting form specific position and, to a certain extent, agility and ball handing.

Shown in Figure 1, participants begin the test with on foot behind any one of the five markers. Participants need to shoot, retrieve the ball, dribble to the next marker and shoot again. One point is given for each unsuccessful shot that still manages to hit the rim. Two points are awarded for each successful shot. The first trial is practice trial. The total score amounts to the sum of the two trails after practice. As reported by Hopkins et al. (1984), the validity coefficients were between .37 and .91 for all ages in individual

testing. The reliability coefficients ranged between .87 to .95 for females and between .84 to .95 for males using the test-retest method.

Volleyball serve skill. In volleyball, I tested participants' serve skill. Volleyball serve skill is one of the most important skills that people practice the most in leisure times. The serving skill test (Bartlett et al., 1991) was used to measure the basic volleyball skill of serving. The test taker attempts 10 overhand or underhand serves form the serving area. Shown in Figure 2, the test taker attempts 10 overhand or underhand serves form the serving area. Balls landing in different areas receive either 4 or 3, 2 or 1 points. Balls landing out hounds receive 0 points. The final score is the sum of points received from all 10 trials (Maximum score =40). Bartlett et al. (1991) reported that the test-retest reliability coefficient from 313 college-aged males and females was .65.

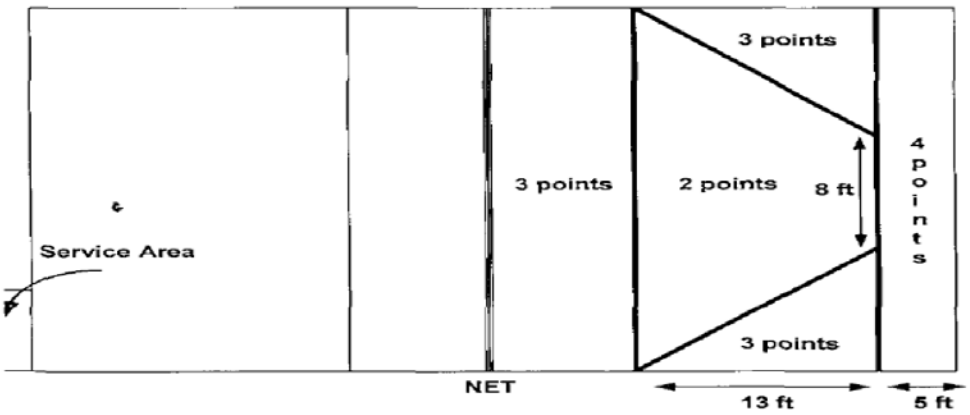

Figure 2. Volleyball Serve Test Diagram. Adopt from court markings for the North Carolina State University Volleyball Serve Test. (Bartlett et al., 1991).

Soccer kicking skill. In soccer, I tested participants' kicking skill. Soccer kicking skill is also recognized as one of the most important skills that people practice the most leisure times. The soccer kicking skill test measure the general soccer ability (McMorris, 1994). In the test, the test taker attempts to kick the ball toward a wall 7.6 meters away as many as possible within 90 seconds. Any kicking techniques may be used. Any part of the body, including hands, can be used to retrieve the ball. The first trial is a practice trail. One point is awarded for each successful shot on the wall. The total score is the sum kicks on the wall in 90 seconds. McMorris (1994) reported intra-class correlation coefficient of .79 among 11 amateur players.

Leisure-Time Physical Activity

Leisure-time physical activity behavior refers to voluntary participation in light, moderate, or vigorous physical activity. It was measured using the Three-day Physical Activity Recall survey (Weston, Petosa, & Pate, 1997) as the primary measurement. The original instrument provides a 24-hour grid with each hour divided into four 15-minute segments. The instrument allows an individual to log in all types of activities he/she engaged in during the past 24 hours. The entries on the instrument could be divided into eight categories of physical activity patterns: sport, fitness, other physical activities, academic/homework, rest, entertainment, socialization, and other sedentary behaviors. The entries can also provide information on specific sport or fitness activities (Weston et al., 1997). The Three-day Physical Activity Recall survey was previously validated with middle school students (grade 7-12) and was reported demonstrating high inter-rater and

test-retest reliability (*r*=.99, *r*=.98), and concurrent validity pedometer (*r*=.88) and Caltrac courts (*r*=.77) (Weston et al., 1997).

Data Collection

IRB Approval

The Institutional Review Board (IRB) application was initially submitted to the Research Review Committee. Two minor revisions were made, and final approval was received prior to data collection. The officially approved letter, consent, and assent forms can be found in Appendix G.

Conducting the Consent Process

Table 3

Timeline for Data Collection

Weeks	Activity
Oct 3-Oct 22	IRB and instructor approvals
Oct 23-Nov24	Data collection
Oct23-Oct27	Obtaining students consent forms
Oct30-Nov 4	Administering knowledge and demographic questionnaires
Nov 6-Nov 10	Collecting leisure-time physical activity data
Nov13-Nov 21	Collecting skill assessment data
Nov22-Nov30	Data collection make-up

Data collection began with the consent process per IRB guidelines. During the recruitment of the participants, I read a prepared statement to inform students of the research purpose, procedures and potential benefits and risks of participation. I informed them of their rights, including the right of unconditional withdrawal from the study at any time. I then gave the consent form and a demographic and background questionnaire to the students who agreed to participate. I also assured those who chose not to participate that their participation in physical activity classes would not be interrupted by the data collection. A general timeline for data collection was listed in Table 3.

Administering the Knowledge Data Collection

The FitSmart knowledge test was administered on the side of the gymnasium during the class. I provided the test with an answer sheet and a pencil to each participant. The participants were asked to complete the test independently; without talking to each other or use of electronic devices. The participants were asked to raise their hands if they wished to ask a question. They were asked to submit their answer to me once they finished. To minimize missing data, I checked for missing responses on each answer sheet to ensure all questions were answered. If there were missing information, they were asked to refill the answer. Students who did not participate in this study, they were asked to sit quietly while the participants took the test.

In-Class Physical Activity

Before data collection, the participants were taught and practiced the way to securely wear the accelerometers on the waistband directly above the right knee. They were asked to move around to make sure that the accelerometer were securely fastened

and did not interfere with their movement. Before each data collection session, the accelerometers were initiated to start recording in terms of the scheduled starting time of a lesson. The epoch interval was set at 10 seconds. On the data collection day, the accelerometers were initiated to start recording in terms of the scheduled starting time of a lesson. The epoch interval was set at 10 seconds. On the data collection day, the accelerometers were distributed to the participants and were properly worn prior to the start of the lesson. In-class physical activity data were collected in two separate 75-minute lessons for activity classes of basketball, volleyball, and soccer. The accelerometers were collected for each lesson and recorded data were downloaded to data computer for reduction and analysis.

The Three-Day Physical Activity Recall Survey

The Three-day Physical Activity Recall survey was administered to collect the participants' leisure time activity one weekend day and two day weekdays. On the day following a targeted day for the recall, the participants filled out the survey before their activity lesson. Students were instructed to recall their activities during the day before and write the activities in the corresponding 15 minutes segment. The participants were reminded to fill in the information as accurately as possible. When they finished the survey, I reviewed each survey segment to make sure no empty segments on the survey. The same procedure was repeated in two other days until all surveys were completed.

Sports-Specific Motor Skills

Students in each of three activity courses were tested on the respective motor skills. All the equipment such as masking tape for court markings that described in Table

4 was prepared in advance. The tests were conducted in respective physical education classes. The test site was set up and equipment was prepared at least 10 minutes prior to the scheduled start of the test.

During the basketball shoot data collection, each participant had two trials with each of 60 seconds beside of practice trail. The first was a practice. The second and third were tests. Upon the start signal, the test taker started shooting behind a marker, retrieved the ball, dribbled to another marker, and shot again. A successful shot was awarded two points, a shot that hit the rim but did not go in the basket was one point. During the test, a student helped keep time. The participants were divided into several groups to take the tests. Those who were not in the test were following the activities of their lesson.

Table 4

Sports-Specific Motor Skills Equipment Preparation

Physical Activity Class	*Equipment*	*Test Area*
Basketball	Basketball, a stop watch, marking tape, tape measure, and scoresheets	One half size basketball court
Volleyball	Volleyballs, marking tape, two 8-foot and two 10-foot vertical poles, 30-inch-long string, 11-foot-long string	A volleyball court with height at 7 feet and 11 inches
Soccer	Three soccer balls, a stop watch and tape measure	A 30ft x 11.5ft wall with target markings

During the volleyball serves data collection, the participants were organized lining up to serve one by one. Each participant performed five serves form the right side of the court in the serve area, then moved to the left side to serve five times. During the test, the instructor helped monitor that each serve was made behind the service line while I was on the other side to record the points. Participants served in different areas received different scores (4, 3, 2, and 1). I recorded the sums of 10 trails (maximum score =40).

In the soccer skill data collection, participants were also divided into several groups. Each group was composed four participates. One participant who was not being tested helped keep the time. The first trial was a practice trial (90 seconds); I began to record the point at the start of the second trial (90 seconds). Each successful shot into the wall was awarded for one point. I counted the total scores as the sum of the second trial that took place within the 90 seconds.

Data Reduction

Knowledge

There were 50 multiple-choice in the FitSmart test. Each correct answer received a point of 1; incorrect answer received a point of 0. The total possible score was 50 points. For each participant, a percent correct score was calculated by dividing the sum of points earned form correct responses by the total number of questions. A similar percent correct score for each domain was calculated by dividing the sum of points earned in the domain by the number of questions.

In-Class Physical Activity

The activity counts (Vector magnitude, VM) were converted into activity count per minutes to reflect the intensity of in-class physical activity. VM recorded into every 60 seconds were added together as the VM count/min. The VM/min data were used in the subsequent data analysis to calculate the mean VM per lesson.

Three-Day Physical Activity Recall Survey

The Three-day Physical Activity Recall survey elicited 70 different activities that the participants did during leisure times. The data were coded into eight categories: sport, fitness other physical activities, academic/homework, rest, entertainment, socialization, and other sedentary behavior. The detail of this survey can be found in Appendix C and D. Then the total number of 15-minute segments in each category were aggregated into total minutes of the activity. A student's average minutes in leisure-time physical activity were computed by averaging minutes in sports, fitness and other physical activity for three days.

Sports-Specific Motor Skills

The motor skill data were reduced by classes. The point of the two trials in the basketball shooting test was added as the total score, I use each participant's total raw score to conduct basketball skill data analysis. In volleyball class, I added the sums of 10 trials (maximum score=40) as the total score. Each participant's total score was used conduct volleyball skill data analysis. In soccer class, the point of the one trial was added as the total score for each participant to conduct the soccer skill data analysis.

Data Analysis

A data analysis strategy was developed to answer the three research questions: (a) To what extent was health-related fitness knowledge, demonstrated in physical education, related to leisure-time physical activity behavior? (b) To what extent was the amount of physical activity, demonstrated in physical education, related to leisure-time physical activity behavior? (c) To what extent were sport-specific motor skills, demonstrated in physical education, related to leisure-time physical activity behavior?

To answer the first and second research questions, Pearson-Product Moment bivariate correlation analysis was conducted on the data from the entire sample. In the analyses, I particularly paid attention to the correlation coefficients among the variables specified in each question. To answer the third question, the Pearson-Product Moment bivariate correlation was calculated class by class because the students in each activity class were not tested on the skills taught in other two classes. Multiple regression was also conducted in each of class to predict the relationship between physical education and leisure-time physical activity behavior. Among each of class (e.g. basketball, volleyball, and soccer), knowledge, in-class physical activity, and sport skill as the predictors for sport-specific leisure time physical activity and non-sport-specific leisure time physical activity.

When the above data analyses were complete, I pursued a canonical correlation that allowed me to further examine the relationship between physical education and leisure-time physical activity on the basis of collective variable sets to understand the relationship from a holistic perspective. Using canonical correlation analysis allowed me

to further explore the relationship between physical education and leisure-time physical activity not only on the variable to variable level but also on the set-to-set level. I conducted the canonical correlation in three different datasets (Basketball, volleyball, and soccer), consequently, I obtained three sets of results.

Threats to Validity and Reliability and Strategies

There were two major threats to the reliability of the measurements. First was the possibility of variation in scoring knowledge test. To ensure the reliability, Cronbach alpha was calculated on 50 multiple-choice items in the FitSmart test. The internal consistency of these items as measured was 0.78, which can be considered a good reliability. Second, participants' reactions to accelerometers might be a threat to data reliability. They might take them off, shake them in class, or set them aside during activities. To minimize this threat, I provided students with additional time to practice fastening and unfastening the accelerometer; wearing it in practices, and repeatedly reminded them of ignoring it during class. These helped them become familiarized with the accelerometers. During the data collection. I monitored them carefully when they were practicing.

The validity of the self-report data from Three-day physical Recall completely relied on the participants' memory, which could be a source of threat to validity. To address this threat, I administered the self-report survey one day at a time rather than asking students to recall all three days at once. I provided adequate time during data collection sessions for them to recall their activities in a previous day.

CHAPTER IV

RESULTS

The purpose of this research was to identify the extent of association between students' knowledge and skills demonstrated in physical education and leisure-time physical activity behavior. Data were analyzed to answer three research questions: (a) To what extent was health-related fitness knowledge, demonstrated in physical education, related to leisure-time physical activity behavior? (b) To what extent was the amount of physical activity, demonstrated in physical education, related to leisure-time physical activity behavior? (c) To what extent were the sport-specific motor skills, demonstrated in physical education, related to leisure-time physical activity behavior?

Results

A Total of 195 participants agreed to participate in the study, 186 of them (99 males, 87 females) completed all measures including fitness knowledge, in-class physical activity, sports skills, and leisure-time physical activity. To answer the first and second research questions, the bivariate correlation analysis was conducted the data from the entire sample. The analysis included the correlation coefficients among the variables specified in each of the above questions. To answer the third question, the bivariate correlation analysis was calculated for each of the three classes (basketball, volleyball, and soccer) separately to address the association between sport skills demonstrated in each class and sport-skill related behavior in leisure time.

Relationship between Knowledge and Leisure-Time Physical Activity

Students' knowledge about health-related fitness and benefits were assessed using the FitSmart test (Zhu et al., 1999). Table 5 presents the total percentage correct scores and percentage correct scores from the knowledge sub-domains. The average percentage correct score (64%) was consistent with findings from previous research ranging from 60% to 70% (Losch & Strand, 2004; Petersen & Cruz, 2003). The descriptive statistics of the sub-domain scores showed that the participants scored highest on the nutrition, injury prevention, and consumer issues domains (mean=72%) and lowest on the effects of exercise on disease risk factors (mean=47%) and the exercise prescription (mean=58%) domains.

Table 5

Descriptive Results Knowledge and Overall Percentage Correct Scores (%)

Domain & (Raw score)	*M*	*SD*	*Min*	*Max*	*Skewness*	*Kurtosis*
Total score (50)	64	12.76	24	88	-.87	.97
Fitness concepts (4)	64	23.73	00	100	-.31	-.36
Exercise principles (11)	61	16.54	9	91	-.57	-.05
Fitness components (12)	69	16.99	8	100	-.78	.69
Exercise effects on disease (3)	47	25.98	9	100	-.19	-.49
Exercise prescription (11)	58	18.43	0	91	-.46	-.07
Nutrition, injury prevention & consumer issuers (9)	72	21.88	0	100	-1.08	1.36

Table 6

Descriptive Results of Leisure-Time Activity (Minutes)

Variable	*M*	*SD*	*Min*	*Max*	*Skewness*	*Kurtosis*
Leisure-time PA	94.33	59.43	.00	315	-.02	-.01
Sport	33.98	42.43	.00	210	1.65	2.97
Fitness	43.48	44.06	.00	220	1.60	2.67
Other PA	18.72	27.06	.00	135	1.85	3.31
Sedentary activity	1255.11	239.31	.00	1470	-.38	.99
Academic	217.97	106.05	.00	620	.64	-.42
Resting	691.63	161.95	.00	635	-1.03	2.48
Entertainment	120.00	100.84	.00	495	1.21	1.60
Socializing	12.04	24.036	.00	140	2.61	7.86
Other	212.51	126.83	.00	580	.54	-.123

Leisure-time physical activity was measured using the Three-day Physical Activity Recall Survey (Weston, Petosa, & Pate, 1997). The entries on the survey can be divided into eight categories of activity patterns: sport, other physical activities, academic/homework, rest, entertainment, socialization, and other sedentary behaviors. As shown in Table 6, the students reported 94 minutes per day participating in sports, fitness,

and other physical activity during their leisure time, exceeding the recommended 60 minutes per day for adolescents and adults (USDHHS, 2000). Of all the leisure-time physical activity minutes, the students spent more time on fitness and sports than other physical activities. The correlation analysis rendered a result of no relationship between knowledge and leisure-time physical activity behavior (r=-.21, p=.773).

Relationship between In-class Physical Education and Leisure-Time Physical Activity

Table 7

Descriptive Results of In-class Physical Activity and Leisure-Time Physical Activity

Variables	*M*	*SD*	*Min*	*Max*	*Skewness*	*Kurtosis*
In-class PA (VM)	3467.25	1530.02	582.75	7384.72	-.65	.29
Total leisure-time PA (min)	94.33	59.43	.00	315	-.02	.01
Sport (min)	33.98	42.43	.00	210	1.65	2.97
Fitness (min)	43.48	44.06	.00	220	1.60	2.67
Other PA (min)	18.72	27.60	.00	135	1.85	3.31

In-class physical activity was measured using ActiGraph GT3X accelerometers (ActiGraph, Shalimar, FL). Table 7 reports the means and standard deviations of in-class physical activity in vector magnitude (VM) and leisure-time physical activities in minutes. Ssaki's (2010) criteria were used to determine the in-class physical activity intensity levels: light <1952/min, VM counts, moderate: 1953-9498/min., High: 5724-

9498/min., and very high>9498/min. The average VM counts form the students show a moderate physical activity level in the physical education class (VM mean=3467.25/min). Pearson's bivariate correlation analysis shows a weak correlation (r=.161, p=.028) between in-class physical activity intensity and leisure-time physical activity minutes.

Relationship between Sports-Specific Motor Skills and Leisure-Time Physical Activity

Sport-specific motor skills were assessed separately in basketball (N=68), volleyball (N=70) and soccer (N=39) classes. Basketball shooting skill was measured by the Speed Spot Shooting test (Hopkins, Shick, & Plack, 1984). The volleyball skill test was measured the Basic Serving Skill test (Bartlett et al., 1991). The soccer skill was measured by the Kicking Skill test (McMorris et al., 1994). Table 8 describes the specific time in minutes that the students played their respective sports in their leisure time.

Table 8

Descriptive Results Sport-Specific Motor Skills in Leisure Time(Minute)

Variable	*N*	*M*	*SD*	*Min*	*Max*	*Skewness*	*Kurtosis*
Basketball time	68	26.23	41.06	.00	185	1.76	2.90
Volleyball time	77	5.06	13.84	.00	75	3.02	9.60
Soccer time	39	8.57	21.65	.00	85	8.57	5.89

Basketball skill. Correlation analysis revealed a weak negative correlation between basketball skill and non-basketball leisure-time minutes (r=-.273, p=.024). A weak correlation was also found between basketball skill and basketball leisure-time minutes (r=.137, p=.246).

Volleyball skill. The correlation between volleyball skill non-volleyball physical activity minutes was also weak (r=.101, p=.383). The relationship between volleyball skill and volleyball leisure-time minutes was also to be weak (r=.135, p=.243).

Soccer skill. Correlation analysis revealed a weak correlation between soccer skill and non-soccer leisure-time physical activity minutes (r=.234, p=.135). It was also found to have a weak moderate relationship with soccer leisure-time minutes (r=.309, p=.056).

Multiple Regression Analysis

The result of the multiple regression on non-specific leisure-time physical activities rendered non-sport specific leisure-time physical activities rendered no meaningful relationships for basketball (R^2=.028, F (3, 64) =.608, P>.05). Volleyball (R^2=.023, F (3, 73) =.57, P>.05), and soccer (R^2=.092, F (3, 35) =1.19, P>.05). No meaningful relationships were identified between physical education variables (knowledge, skill, and physical activity intensity) and sport-specific leisure time physical activity of basketball (R^2=.142, F (3, 35) =3.54, P>.05), volleyball (R^2=.067, F (3, 35) =1.75, P>.05), and soccer (R^2=.104, F (3, 35) =1.36, P>.05).

The multiple regression analyses were attempted to address the relationship between the set of variables demonstrated in the physical education and leisure-time

physical activity one at a time, either sport-specific or non-sport specific. The non-significant results may imply that the transfer may not likely rely on variable to variable associations. It is more likely to take place in a holistic way where individual factors, such as knowledge, skill, and physical activity amount in one setting work together to become associated with a set of factors in a different setting. To further explore this variable set-to-set association, I conducted a canonical correlation analysis.

Canonical Correlation Analyses

Canonical correlation analysis is a parsimonious way of breaking down the association between two sets of variables using linear combination (Stevens, 2012, pp. 471). The first step of canonical correlation procedure was to find the strongest linear combination that maximizes the correlation between the variable of each canonical variate pair. In the second step, the canonical correlation procedure then searches for a second pair of linear combination, uncorrelated with the first pair; then the third and fourth if necessary. The resultant linear combination provided evidence to indicate the extent to which the linear combinations account for most of the between-sets associations. I conducted the canonical correlation with each of the three classes due to the fact that the sport skill test scores are class specific (basketball, volleyball, and soccer).

Basketball class. The set of physical education variables consisted of knowledge, in-class physical activity, and basketball skills; and leisure-time physical activity variables included basketball sports-specific skill time and non-sports leisure-time. Table

9 reports standardized canonical coefficients of basketball class and leisure-time physical activity.

Table 9

Standardized Canonical Coefficients of Basketball Class and Leisure-Time Physical Activity

		Standardized Canonical Coefficients	
Variable Set	Variable	V1	V2
Physical education	Knowledge	-.90	.36
	In-class physical activity	.20	-.05
	Basketball skills	.53	.87
Leisure-time PA	Basketball skill leisure-time	.99	.29
	Non-basketball leisure-time	-.01	1.03

Note: V1= Functional coefficients 1 V2= Functional coefficients 2

The canonical correlation analysis revealed two canonical functions (Rc_1 =.38, F = 1.68, p =.14; Rc_2 =.02, F = .00 p = .99). Because neither canonical function was statistically significant the variable associations with the model should not be interpreted as meaningful.

Volleyball class. The data sets form the volleyball class for the canonical correlation analysis consisted of the same variables as that used in the basketball class. The only difference was the skill test scores were from the volleyball Basic Serving Skill

test. Table 10 reports standardized canonical coefficients of volleyball class and leisure-time physical activity.

Table 10

Standardized Canonical Coefficients of Volleyball Class and Leisure-Time Physical Activity

		Standardized Canonical Coefficients	
Variable Set	Variable	V1	V2
Physical education	Knowledge	-.85	-.44
	In-class physical activity	.03	-.62
	Volleyball skills	.54	.55
Leisure-time PA	Volleyball skill leisure-time	.96	-.21
	Non-volleyball leisure-time	-.02	1.02

Note: V1= Functional coefficients 1 V2= Functional coefficients 2

The results showed two canonical functions (Rc_1 =.26, F=1.00, p=.42; Rc_2 =.11, F=.46 p=.63). Similar to the results from the basketball class, neither canonical function was statistically significant, the variable associations with the model should be interpreted as meaningful.

Soccer class. The same canonical correlation analysis procedure was performed on the data set form the soccer class. Except the skills scores (Kicking skill), other variables were identical in kind as those from the basketball and volleyball classes. These were knowledge, in-class physical activity, and soccer skills form physical education; and leisure-time physical activity minutes and soccer sports-specific activity minutes form

leisure time. Table 11 report standardized canonical coefficients of soccer class and leisure-time physical activity. The canonical correlation analysis resulted in two canonical functions (Rc_1 =.52, F=1.81, p=.011; Rc_2 =.21, F=.65 p=.53). The first function (V1) then was interpretable (Rencher & Christensen, 2012) because its multiple canonical functions are statistically significant. It appears that the covariates in each set contributed differently to the function. Descriptive data demonstrated that a moderate relationship was found between skill in soccer and leisure time soccer time minutes (r=.309, p=.056). Noticeably, soccer skill demonstrated in physical education and leisure soccer time defined the relationship between the two sets of variables. In-class physical education and knowledge seem to be redundant contributors.

Table 11

Standardized Canonical Coefficients of Soccer Class and Leisure-Time Physical Activity

		Standardized Canonical Coefficients	
Variable sets	Variables	V1	V2
Physical education	Knowledge	-.19	.49
	In-class physical activity	.34	.86
	Soccer skills	.79	.47
Leisure-time PA	Soccer leisure-time	.84	.69
	Non-Soccer total leisure-time	.30	1.05

Note: V1= Functional coefficients 1 V2= Functional coefficients 2

Summary

In summary, the above analyses seem to suggest that when examining the association between physical education behaviors demonstrated in physical education and those being engaged in leisure time, a holistic view should be used to guide the inquiry. The analyzed data appear suggest that possible association may be based on sport-specific skills and the in-class physical intensity.

CHAPTER V

DISCUSSION AND CONCLUSION

The purpose of this research was to identify the extent to which college students' knowledge and skills, demonstrated in physical education, were associated with leisure-time physical activity behavior. The research addressed the relationship between physical education and leisure-time physical activity not only at the variable-to-variable level but also at the variable set-to-set level. There were three major findings. (a) There was no relationship between health-related fitness knowledge and leisure-time physical activity behavior at the variable to variable level. (b) In-class physical activity and sport-specific skill had a weak correlation with leisure-time physical activity behavior. (c) There was a variable set-to-set correlation between skill and leisure time sport-specific physical activity participation in soccer.

Discussion

These findings support the assumption of transfer theory that behavior transfer is not likely to rely on the variable to variable associations. It is more likely to take place in a holistic way, where individual factors in one environment (physical education) work together as a set which may interact with a set of factors in the different environment (leisure time activity). A holistic approach should be used to further examine the relationship between physical education and leisure-time physical activity.

Health-Related Fitness Knowledge and Leisure-Time Physical Activity

The first research question of the study aimed at discerning the extent to which health-related fitness knowledge, demonstrated in physical education, was related to leisure-time physical activity behavior. According to Pearson's bivariate correlation analysis, there was no correlation between knowledge and leisure-time physical activity behavior (r=.021, p=.773). This lack of a meaningful relationship between knowledge and leisure-time physical activity is consistent with previous findings of Haslem et al. (2016) and Goldfine and Nahas (1993) but differs from the findings of Tompson and Hannon (2012).

With respect to the health-related fitness knowledge test scores in this research, college students demonstrated 64% correct response. The average percentage correct score was consistent with those found in previous research, which ranged from 60% to 70% (Losch & Stand, 2004; Petersen & Cruz, 2003). The current result was also consistent with the K-12 students (Kulinna, 2004; Mccomick & Lockwood, 2006; Stewart & Mitchell, 2003). Since data was collected from team-sport classes (e.g., basketball, volleyball, and soccer), the low health-related fitness knowledge scores could be attributed to lack of health-related fitness content covered in these classes. It is reasonable to speculate that the low-level health-related fitness knowledge that college students demonstrated in physical education class could result in lack of finding a significant relationship between knowledge and leisure-time physical activity. It is likely that student who do not deeply understand the concepts procedures, and principles that

they gained from class so that they failed to apply them to settings outside of physical education.

In-Class Physical Activity and Leisure-Time Physical Activity

The second research question of the study found out the extent to which in-class physical activity was related to leisure-time physical activity behavior. The descriptive statistics that students were able to achieve moderate physical activity levels in physical education (VM mean=3467.25/min). The average VM counts are consistent with previous research findings that college students engaged in grater through group exercise (Buckworth & Nigg, 2004). It was reported that only 20% college students regularly participated in moderate physical activity (Douglas et al., 1997). Thus, the moderate physical activity levels in physical education (VM mean=3467.25/min) may also emphasize the importance of providing structured physical education to ensure physical activity day for college students.

The hypothesis that within similar contexts, students who are physically active in physical education were more likely to be active in the leisure time context, was not supported. The Pearson's bivariate correlational analysis showed a weak correlation (r=.161, p=.028) between in-class physical activity intensity and leisure-time physical activity minutes. This finding suggests that physical activity level in physical education leisure physical activity may not be associated. The result may imply that from the transfer theory perspective, physical activity in physical education unlikely to transfer leisure-time physical activity.

Sports-Related Motor Skills and Leisure-Time Physical Activity

The third question of this study was to find the extent to which sports-related motor skills, demonstrated in physical education, were related to leisure-time physical activity behavior. To answer this question, the Pearson-product moment bivariate correlation was calculated for each of the three class (basketball, volleyball, and soccer). Doing so allowed examination of the association between each class sport skill and its sports-skill related behavior in leisure time.

The hypothesis that students who demonstrated proficient sport-specific motor skills in physical education are more likely to be active in leisure time than students who not demonstrated proficiency in these skills was partially supported. Pearson's bivariate correlational analysis revealed a weak negative correlation between basketball skill and leisure-time physical activity minutes (r = -.273, p = .024). The results from volleyball (r = .101, p = .383), and soccer (r = .234, p = .135) revealed similar weak correlations between their respective sport skill and non-sport specific leisure-time physical activity behavior. Moreover, A moderate relationship was found between skill in soccer and leisure time soccer time minutes (r=.309, p=.056). No correlation was found between basketball skill and non-sport specific leisure-time minutes (r=.137, p=.246) or between volleyball skill and leisure-time volleyball minutes.

The above results demonstrate mixed findings from the three classes. The mixed finding may be suggested that context plays a crucial role in formulating transferability of the concept or skill (Perkins & Salomon, 1992). Without knowing how college students apply skills learned in educational contexts to leisure time contexts, the reasons that

results different for the three classes call for further research. Therefore, for physical education to facilitate leisure-time physical activity behavior it should focus on teaching knowledge that can be applied to similar contexts outside of school to elicit near transfer.

Transferability between Physical Education and Leisure Time

Based on the transfer theory (Bransford & Schwatz, 1999), it may be hypothesized that some or all the factors that determine transfer (amount of knowledge, quality of understanding, context relevance/ similarity and appropriate metacognition) can be observed in leisure time (new) context. Results from the basketball class (Rc_1 =.38, F=1.68, p=.14; Rc_2 =.02, F=.00 p=.99) and the volleyball class (Rc_1 =.26, F=1.00, p=.42; Rc_2 =.11, F=.46 p=.63) indicated no correlation between what the students experienced in physical education relationship. Results from the soccer class (Rc_1 =.52, F=1.81, p=.011; Rc_2 =.21, F=.65 p=.53) indicate a variable set-to-set correlation between physical education and leisure-physical activity. Also, the analyzed data suggest that possible associations may be based on sport-specific skills and the in-class physical activity. These findings support the assumption in the transfer theory that behavior transfer may not likely rely on the variable to variable associations. It is more likely to take place in a holistic way, where individual elements such as knowledge, skill, and physical activities in a learning setting work together to become associated with those in a different setting.

The amount of knowledge that student gain in school can influence how much they apply in a new context (Halano & Grreno, 1999). Chen and Liu (2017) found a high-knowledge groups demonstrated a significantly higher level of leisure-time physical

activity than low knowledge groups. They concluded that a good understanding of health-related fitness knowledge may influence students' engagement in leisure-time physical activity. Ennis (2014) argued that knowledge transfer between physical education and physical activity behavior relies on depth of understanding of knowledge. In the current study, college students achieved only 64% correct responses on the health-related fitness knowledge suggesting a shallow understanding. The lack of deep understanding of health-related fitness knowledge may prevent formation of significant association between knowledge and leisure-time physical activity behavior. The lack of association might also be explained by a premise that college students were not well educated about physical activity and did not fully understand why physical activity was needed.

The failure to transfer in other two classes (e.g. basketball and volleyball), may point to the likelihood that health-related knowledge and sport-specific skill in a de-contextualized physical education setting has limited implication for leisure-time physical activity. Voluntary physical activity in leisure time is determined by multiple factors. Context relevant plays a crucial role in formulating transferability of the concept or skill. The knowledge acquired from physical education in university might be perceived as remote transfer to leisure-time physical activity. The two disconnected context could undermine students' deep processing of knowledge. Therefore, for physical education to facilitate leisure-time physical activity behavior it should focus on teaching knowledge that can be applied to similar contexts outside of school to elicit near transfer.

Von Glaserfeld (1995) argued that voluntary behavior is guided by deeply processed cognition. This may compromise the learning process for students to

understand “when, where, or why they might use” the new knowledge (Brophy, 2008, pp.136). Once an individual’s understanding about when, where, and why to use the knowledge and skills one used in another context may strengthen the process of knowledge and skill transfer. Thus, providing students with both skillfulness and level of mindfulness to experience the activity deeply and meaningfully may also improve the possibility of the successful transfer.

Conclusion

This study has provided a snapshot of how students’ knowledge and skills, demonstrated in physical education, are related to leisure-time physical activity behavior. Health-related fitness knowledge was not found to be associated with the leisure-time physical activity. The assumption of the transfer theory that behavior transfer is not likely to rely on a variable-to-variable association is supported. The findings suggest that a holistic perspective should be used to guide the future research on the assumption.

Theoretical and Practical Implications

The transfer theory has been applied to help educators design learn experiences for the student to transfer what they learn in the classroom to other contexts (Corkill & Fager, 1995; Lerda, Garzunel & Therme, 1996). The findings support the assumption of transfer theory that behavior transfer is not likely to rely on the variable to variable associations. It is more likely to take place in a holistic way, where individual factors in one environment (physical education) work together as a set which may interact with a set of factors in the different environment (leisure time activity). A holistic approach was suggested to further examine the relationship between physical education and leisure-

time physical activity. Given that more and more students adopt the sedentary lifestyle (Keating, Guan, Piñero, & Bridges, 2005), Researchers should further examine the transferability of physical education content to improve the possibility of near transfer.

Strengths and Limitations

The strengths of this study include having a large sample size and using validated instruments. A large sample ensured adequate power for inferential statistical analyses. In addition, using valid instruments in this study increased the reliability of data collected from the participants.

There are also several limitations of this study. First, despite a large sample size, the sample was recruited from UNCG, where students have a relatively high average socioeconomic status. The findings may, therefore, be only generalizable to schools of similar characteristics. The second limitation of the study is that the findings were from team-sport classes; people in these classes are likely to be motivated to play these sports. The third limitation of the study is that the leisure-time physical activity behavior was measured using a self-report instrument. An objective measure such as the accelerometer would be more accurate. However, it would be difficult to use accelerometers in a large sample due to the high cost of this measurement method. The other limitation of the study relates to the correlational research design of the study. Limited by the design, it is cautioned that no cause-effect relationship between health-related fitness knowledge and physical activity behavior should be assumed.

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APPENDIX A

DEMOGRAPHIC AND BACKGROUND INFORMATION

Name:

APPENDIX A

DEMOGRAPHIC AND BACKGROUND INFORMATION

Demographic & Background Information

1. Gender **A**. Male **B**. Female

2. Race/Ethnicity **A.** Asian **B.** Black **C.** Hispanic **D.** White **E.** Other

3. Year in College **A**. Freshmen **B**. Sophomore **C**. Junior **D**. Senior **E**. Senior +

4. Age: ( ) years

5. How many physical activity classes do you take in the fall semester of 2017?

A. 0 **B**. 1 **C**. 2 **D**.3 **E**.4 or more

6. How frequent did you exercise once week?

A. 0 **B**. 1 **C**. 2 **D**. 3 **E**. 4 or more

7. How many years did you play competitive high school sports/club sports?

A. 0 **B**. 1 **C**. 2 **D**. 3 **E**. 4 or more

8. Where did you do your leisure time physical activity?

A. school gym B. home C community D other place

APPENDIX B

FITSMART TEST

Name: **Class:** **Instructor:**

APPENDIX B

FITSMART TEST

1. The most accurate indicator of cardiorespiratory fitness is
   A. percent body fat.
   B. maximal oxygen uptake.
   C. resting heart rate.
   D. vital capacity.
2. Which of the following principles about physical fitness is the most accurate?
   A. It is reversible and needs continuous exercise through moderate to vigorous activity.
   B. It is a permanent quality which carries over from youth into adulthood.
   C. It is maintained through heavy exercise.
   D. It is maintained through a person's normal lifetime activities.
3. What is the relationship between physical fitness and health?
   A. People who are highly fit are always healthier; people who have poor fitness are always unhealthier.
   B. People who are moderately fit typically enjoy good health.
   C. The relationship is more important for children than adults.
   D. There is no relationship between physical fitness and health.
4. An individual's heart rate immediately after exercise indicates
   A. the recovery rate of the heart.
   B. the strength of the heart.
   C. the intensity of the exercise.
   D. all of the above.
5. Which of the following occurs to muscle fibers with regular weight training?
   A. Increase in number
   B. Increase in size
   C. Increase in length
   D. Increase in fat
6. Threshold of training refers to the effort needed to increase fitness. It applies to which of the following?
   A. Minimum effort required
   B. Maximum effort required
   C. Level of effort when fitness begins to decline
   D. Level of effort associated with decreasing intensity of exercise
7. Which value of diastolic blood pressure is viewed by physicians as too high?
   A. 100
   B. 85
   C. 75
   D. 65
8. After several months of endurance training, a person's heart rate is expected to
   A. increase.
   B. decrease.
   C. remain unchanged.
   D. become irregular.

Name: **Class:** **Instructor:**

9. Which of the following is characteristic of the blood of highly fit individuals?
   A. Greater blood volume and more red blood cells.
   B. Greater blood volume and fewer red blood cells.
   C. Less blood volume and more red blood cells.
   D. Less blood volume and fewer red blood cells.
10. With regular moderate activity, such as walking half an hour, one can maintain
   A. sufficient health fitness.
   B. sufficient performance but not health fitness.
   C. continual improvement in performance.
   D. neither performance nor health fitness.
11. Which of the following exercises will most likely lead to an increase in muscle size?
   A. Weight lifting
   B. Walking
   C. Running
   D. Bowling

12. Identify this principle: Only those body systems stressed by exercise will benefit from exercise.
   A. Overload
   B. Intensity
   C. Specificity
   D. Frequency
13. Which one of the following types of activities burns the most calories?
   A. Resistance exercises
   B. Stretching exercises
   C. Calisthenics
   D. Aerobic exercises
14. Which two physiological systems are involved initially when a person encounters a stressor?
   A. Nervous and endocrine
   B. Muscular and circulatory
   C. Skeletal and circulatory
   D. Digestive and respiratory
15. Which of the following reactions to stress is most likely to occur following a single bout of exercise?
   A. Less need for sleep
   B. A temporary distraction from the stressor
   C. Better adaptation to the stressor
   D. Reduction of chronic stressor
16. To effectively increase muscular strength, use a resistance that can be lifted a maximum of
   A. 1 to 2 times
   B. 6 to 8 times
   C. 20 to 25 times
   D. 30 to 35 times

Name: **Class:** **Instructor:**

17. Which of the following is LEAST likely to be an aerobic activity?
    A. Jogging
    B. Rope skipping
    C. Weight lifting
    D. Swimming
18. How can a quick index of the capacity of the cardiorespiratory system be obtained?
    A. Measuring the heart rate immediately after vigorous exercise
    B. Running a long distance and measuring the time
    C. Measuring the workload while riding a bicycle ergometer
    D. Measuring maximum respiratory capacity during vigorous exercise
19. Shortness of breath after moderate physical activity most likely indicates limitations in
    A. body composition.
    B. muscular fitness.
    C. cardiorespiratory fitness.
    D. speed.
20. Isometric exercise, in which muscles work against stationary object or body part, contribute mostly to
    A. strength.
    B. agility.
    C. flexibility.
    D. balance.
21. Exercising your muscles repeatedly against a resistance requires
    A. strength.
    B. flexibility.
    C. coordination.
    D. muscular endurance.

22. The best definition of muscular strength is
    A. the ability to run the fastest, jump the highest, and throw the farthest.
    B. the maximal amount of force that a muscle or a group of muscles can exert in a single contraction.
    C. the ability to carry out heavy workloads over extended periods of times.
    D. the maximal power released within a unit of time.
23. What is the ability to move a body part through all or part of the full range of motion?
    A. Endurance
    B. Strength
    C. Flexibility
    D. Agility
24. Which of the following exercises may contribute to low-back problems?
    A. Half-knee bend
    B. Bent-knee curl-up
    C. Bent-knee leg-raises
    D. Straight-leg sit-ups
25. Which of the following limits flexibility?
    A. Tendon length
    B. Body weight
    C. Muscle density D. Bone density

26. People who exercise for six to eight weeks may actually gain weight because of an increase in

A. appetite.
B. muscle size.
C. body fat.
D. metabolism.

27. Which of the following is NOT a way to measure body fat?

A. Dynamometer
B. Skinfold caliper
C. Bioelectrical impedance
D. Hydrostatic weighing

28. After participating in exercise for a long time, fat is used from.

A. all the fat cells in the body.
B. recently stored fat cells.
C. fat cells in the waist and hips.
D. fat cells in the buttocks.

29. Which health problem is associated with obesity (a high percent of body fat)?

A. Diabetes
B. Hypertension
C. Lower exercise tolerance
D. All of the above.

30. What is the highest level of cholesterol recommended for young adults to avoid heart disease?

A. 240
B. 220
C. 200
D. 180

31. How frequently should flexibility exercises be performed for maximum benefit?

A. Daily
B. Every other day
C. Twice a week
D. Weekly

32. Exercise activities such as baseball, volleyball, badminton, walking, or tennis all differ in

A. frequency.
B. intensity.
C. duration.
D. mode.

33. Which activity best fits a 5 day a week, 30 minutes a day exercise schedule to maintain minimal good health?

A. Golf
B. Bowling
C. Walking
D. Archery

34. The primary purpose of circuit training, a systematic approach to rotating the muscle groups in weight training, is to

A. maintain variety in the exercise program.
B. make the training enjoyable.
C. provide an unique program of exercise.
D. delay the onset of fatigue.

35. The pulse on the wrist is found on the

A. thumb side when the palm is turned down.
B. thumb side when the palm is turned up.
C. little finger side when the palm is turned down.
D. little finger side when the palm is turned up.

36. Which of the following is a varied program of conditioning exercises?

A. Endurance training
B. Circuit training
C. Interval training
D. Strength training

37. Which of the following statements about exercise for the average woman is true?

A. Physical activity causes iron deficiency.
B. Exercise should be avoided during menstruation.
C. Exercise causes cessation of the menstrual cycle.
D. Women can safely participate in vigorous sports.

38. Jane has had difficulty sleeping since she started a regular exercise program. To take care of this problem, Jane should

A. increase the intensity and duration of her exercise program.
B. reduce the intensity and length of her exercise program.
C. avoid eating for at least two hours before exercising.
D. stop exercising immediately and quit her exercise program.

39. Your physical activity index is best determined by

A. frequency X activity.
B. intensity X activity.
C. intensity X frequency.
D. intensity X duration X frequency.

40. Which one of the following activities would be LEAST helpful to someone wishing to alter his or her body composition?

A. 30 minutes of bowling
B. 30 minutes of weight training
C. 30 minutes of basketball
D. 30 minutes of bicycling

41. What two substances supply most of the body's energy during vigorous physical activity?

A. Vitamins and proteins
B. Proteins and fats
C. Carbohydrates and fats
D. Fats and vitamins

42. The American Heart Association recommends that dietary cholesterol be limited to not more than 300 mg per day because cholesterol

A. is constipating.
B. is fattening.
C. isn't essential to the body.
D. may be a risk factor in heart disease.

43. The best way to stick to your daily food calorie goals is to

A. change your daily schedule.
B. stay out of the kitchen.
C. plan your weekly menus in advance.
D. don't think a lot about food.

44. Muscle stretching should be undertaken

A. before exercise only.
B. after exercise only.
C. both before and after exercise.
D. either before or after exercise, if muscle stiffness is felt.

45. If nausea is experienced after exercise, one should

A. extend the warm-up period and maintain the intensity of exercise.
B. extend the warm-up period and reduce the intensity of exercise.
C. reduce the intensity of exercise and increase the cool-down period.
D. increase the intensity of exercise and increase the cool-down period.

46. During exercise, the mineral iron is important for transport of

A. oxygen.
B. vitamins.
C. fat.
D. protein.

47. Drinking water during exercise is considered

A. desirable.
B. undesirable.
C. pointless.
D. toxic.

48. Headache and a sick feeling in the stomach during exercise usually indicate that one should

A. avoid all kinds of exercises.
B. try harder to overcome this feeling.
C. lie down immediately and call for medical aid.
D. decrease the intensity of the exercise.

49. Which of the following is the appropriate way to prevent muscle soreness?

A. A proper warm-up
B. Progressive increases in workload
C. No bouncing or jerking movements
D. All of the above.

50. The best time to visit a health club you are thinking of joining is

A. when a salesperson has the time to see you.
B. at the hour at which you plan to use it.
C. when it looks its best.
D. after you have made the decision to join

APPENDIX C

THE THREE-DAY PHYSICAL ACTIVTY RECALL SURVEY

Three Days Recall Physical Activity Survey

INSTRUCTION: The following table divides each hour from 00:00 p.m. to 24:00 p.m. into four 15-minute boxes. You task is to think about what you did yesterday during this time and fill in each 15-minute box with the activities listed below. If you did not do any of the activities during a 15-minute period, write "none" in that box. You can use a line to show the same activity you did in more than one 15 minute period. Do not leave any boxes blank.

EXAMPLE:

8:00-00:15 a.m.	0:16-0:30 p.m.	0:31-3:45 p.m.	3:46-4:00 p.m.
Getting dress	*Breakfast*	*Driving*	----------

Print: Name _____ Class _____

Grade:_____ Age:_____ Gender (circle one): Male / Female. Date:_____/_____/_____

Activities:						
	Eating	Reading	Baseball	Dance	Hockey	Swimming
	Homework	Sleeping	Basketball	Football	Karate	Tennis
(Read First)	Napping	TV	Bike	Golf	Ping pong	Volleyball
	On bus/car	Badminton	Bowling	Gymnastics	Running	Walking

0:00 - 0:15 a.m.	**0:16 - 3:30 a.m.**	**0:31 - 3:45 a.m.**	**0:46 - 1:00 a.m.**

1:00 - 1:15 a.m.	1:16 - 1:30 a.m.	1:31 - 1:45 a.m.	1:46 - 2:00 a.m.

2:00 - 2:15 a.m.	2:16 - 2:30 a.m.	2:31 - 2:45 a.m.	2:46 - 3:00 a.m.

3:00 - 3:15 a.m.	3:16 - 3:30 a.m.	3:31 - 3:45 a.m.	3:46 - 4:00 a.m.

4:00 - 4:15 a.m.	4:16 - 4:30 a.m.	4:31 - 4:45 a.m.	4:46 - 5:00 a.m.

5:00 - 5:15 a.m.	5:16 - 5:30 a.m.	5:31 - 5:45 a.m.	5:46 - 6:00 a.m.

6:00 - 6:15 a.m.	6:16 - 6:30 a.m.	6:31 - 6:45 a.m.	6:46 - 7:00 a.m.

7:00 - 7:15 a.m.	7:16 - 7:30 a.m.	7:31 - 7:45 a.m.	7:46 - 8:00 a.m.

8:00 - 8:15 a.m.	8:16 - 8:30 a.m.	8:31 - 8:45 a.m.	8:46 - 9:00 a.m.

9:00 - 9:15 a.m.	9:16 - 9:30 a.m.	9:31 - 9:45 a.m.	9:46 - 10:00 a.m.

10:00 - 10:15 a.m.	10:16 - 10:30 a.m.	10:31 - 10:45 a.m.	10:46 - 11:00 a.m.

11:00 - 11:15 a.m.	11:16 - 11:30 a.m.	11:31 - 11:45 a.m.	11:46 -12:00 a.m.

12:00 - 12:15 p.m.	**12:16 - 12:30 p.m.**	**12:31 – 12: 45 p.m.**	**12:46 - 1:00 p.m.**
1:00 - 1:15 p.m.	1:16 - 1:30 p.m.	1:31 - 1:45 p.m.	1:46 - 2:00 p.m.

2:00 - 2:15 p.m.	2:16 - 2:30 p.m.	2:31 - 2:45 p.m.	2:46 - 3:00 p.m.

3:00 - 3:15 p.m.	3:16 - 3:30 p.m.	3:31 - 3:45 p.m.	3:46 - 4:00 p.m.

4:00 - 6:15 p.m.	4:16 - 4:30 p.m.	4:31 - 4:45 p.m.	4:46 - 5:00 p.m.

5:00 - 5:15 p.m.	5:16 - 5:30 p.m.	5:31 - 5:45 p.m.	5:46 - 6:00 p.m.

6:00 - 6:15 p.m.	6:16 - 6:30 p.m.	6:31 - 6:45 p.m.	6:46 - 7:00 p.m.

7:00 - 7:15 p.m.	7:16 - 7:30 p.m.	7:31 - 7:45 p.m.	7:46 - 8:00 p.m.

8:00 - 8:15 p.m.	8:16 - 8:30 p.m.	8:31 –8: 45 p.m.	8:46 - 9:00 p.m.
9:00 - 9:15 p.m.	9:16 - 9:30 p.m.	9:31 - 9:45 p.m.	9:46 - 10:00 p.m.
10:00 - 10:15 p.m.	10:16 - 10:30 p.m.	10:31 - 10:45 p.m.	10:46 - 11:00 p.m.

11:00 - 11:15 p.m.	11:16 - 11:30 p.m.	11:31 - 11:45 p.m.	11:46 - 12:00 p.m.

APPENDIX D

LEISURE-TIME PHYSICAL ACTIVITY CODE

Leisure time physical activity codes

Old code	New code	Activity	Old code	New code	Activity	New code	Old code	New code
1	1	Basketball	26	2	Walking	51	3	Trampoline
2	3	Dance	27	1	Volleyball	52	5	Cooking
3	2	Bike	28	3	Shopping	53	1	Hockey
4	1	Football	29	3	Kickball	54	7	Volunteer work
5	4	Reading	30	2	Climbing	55	8	Photo shot
6	2	Running	31	2	Pushup	56	6	Baby-sitting
7	6	Watching TV	32	4	Music Instrument	57	1	Lacrosse
8	5	Eating	33	3	Soccer	58	1	Golf
9	5	Sleeping	34	1	Badminton	59	4	Drama practice
10	4	On bus	35	1	Tennis	60	7	Hanging out with friends
11	4	Homework	36	6	Taps	61	4	Choir
12	6	Listen to the music	37	6	Wall ball	62	7	Leisure time activity
13	3	Bowling	38	1	Tae Kwon Do	63	6	Circus
14	7	Phone	39	1	Swimming	64	2	Step
15	6	Games	40	3	Chore/year work	65	3	Getting Dress
16	5	Slower	41	6	Video game	66	8	Class
17	7	Chatting/Family time	42	6	Party	67	2	Weightlifting/Training
18	1	Gymnastics	43	4	Drawing	68	8	Standing
19	6	Playing Cards	44	7	Church	69	4	Driving
20	2	Jumping ropes	45	1	Karate	70	8	Working
21	6	Computer/Surfing Netflix	46	1	Baseball/softball	71	7	See doctor
22	2	Exercise	47	2	Stretching	72	8	Meeting
23	3	Skateboarding	48	2	Sit-up	73	3	Yoga
24	5	Napping	49	2	Fitness	74	8	instructing
25	3	Throwing /catching	50	1	Ping pong	75	3	Play with dog

Noted： 1=Sport, 2=Fitness，3=Other physical activity, 4=Sedentary-academic; 5 =Rest, 6=Sedentary-entrainment, 7=Sedentary, 8=Other sedentary activity

APPENDIX E

SITE APPROVED LETTER

THE UNIVERSITY *of* NORTH CAROLINA
GREENSBORO

HHP Building
1408 Walker Ave.
Greensboro, NC 27412
Phone: (336) 334-3694

School of Health and Human Sciences
Department of Kinesiology

Dear Mr. Deng:

I support your research endeavor for data collection with your IRB approved study, "The Relationship Between Physical Education and Leisure Time Physical Activity Behavior." You also have my permission to recruit from our Kinesiology courses.

Sincerely,

Scott E. Ross, PhD, LAT, ATC, FNATA
Associate Professor
Chair, Department of Kinesiology
Director, AT Program
University of North Carolina Greensboro
School of Health & Human Sciences
Department of Kinesiology
1408 Walker Ave
237 L Coleman Bldg
Greensboro, NC 27412-5020

APPENDIX F

REQUEST FOR COLLECTING DATA

Dear XX,

I am a master's student in the pedagogical kinesiology program. I am seeking your permission to collect data from your activity class for my thesis. I have outlined the pertinent details of the study below.

The purpose of my study is to describe the relationship between knowledge and motor skill demonstrated in physical education class and leisure time physical activity participation. I will measure the following variables in your class:

- Health-related fitness knowledge will assess how much knowledge students currently have about fitness and physical activity. Participants will be asked to complete the FitSmart Knowledge test.
- In class physical activity will be measured on the amount of physical activity that participants achieve through the entire physical activity class. Participants will be asked to wear under their clothes, on their right hips, an accelerometer, which is a small (1.50 × 1.46 × .71 inches), light (0.95 oz) device housed in a plastic case.
- Motor skills will be assessed in class. A skill test consistent with the sport taught will be administered to be collect skill data.
- Leisure time physical activity will be examined using the 3-days recall self-report survey. A small group of people will be chosen to wear an accelerometer to provide objectively measured activity data for three days. I will ask for cooperation to provide accelerometers to students. On the day following each of three target days I will administer the questionnaire in class. For those in the subsample, I will ask them to administer the survey in class. For those in the subsample, I will ask them to wear an accelerometer on the target day as well as filling out the 3-day recall survey.

This research may offer significant insight into how to promote a healthful physical activity program at UNCG. I will appreciate it very much if you can take part in the study.

If you agree to allow me to collect data from your class, I will make contact to discuss details of the procedures and a timeframe for collecting data. I look forward to your timely response. Thank you!

Sincerely,
Yangyang Deng

APPENDIX G

IRB APPROVED LETTER, CONSENT AND ASSENT FORMS

THE UNIVERSITY of NORTH CAROLINA
GREENSBORO

OFFICE OF RESEARCH INTEGRITY
2718 Beverly Cooper Moore and Irene Mitchell Moore
Humanities and Research Administration Bldg.
PO Box 26170
Greensboro, NC 27402-6170
336.256.0253
Web site: www.uncg.edu/ori
Federalwide Assurance (FWA) #216

To: Yangyang Deng
Kinesiology, Dept of
Kinesiology, Dept of

From: UNCG IRB

Authorized signature on behalf of IRB

Approval Date: 10/22/2017
Expiration Date of Approval: 10/21/2018

RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Submission Type: Initial
Expedited Category: 4.Noninvasive clinical data,7.Surveys/interviews/focus groups
Study #: 17-0356
Study Title: The relationship between physical education and Leisure time physical activity behavior

This submission has been approved by the IRB for the period indicated. It has been determined that the risk involved in this research is no more than minimal.

Study Description:
Due to limitations in instruction hours and resources, it becomes increasingly difficult for physical education to simultaneously provide knowledge and skills as well as sufficient physical activity to meet the daily requirement for physical activity. Consequently, leisure time physical activity is an important factor in achieving enough physical activity for students to meet physical activity requirements. Guided by transfer theory, this thesis research is going to explore a theoretical possibility of transferring knowledge and skills performed in physical education to out of school settings.

Investigator's Responsibilities

Signed letters, along with stamped copies of consent forms and other recruitment materials will be scanned to you in a separate email. **Stamped consent forms must be used unless the IRB has given you approval to waive this requirement.** Please notify the ORI office immediately if you have an issue with the stamped consents forms.

Please be aware that valid human subjects training and signed statements of confidentiality for all members of research team need to be kept on file with the lead investigator. Please note that you will also need to remain in compliance with the university "Access To and Retention of Research Data" Policy which can be found :http://policy.uncg.edu/university-policies/research_data/.

CC:
Ang Chen, Kinesiology, Dept of

page 1 of 1

UNIVERSITY OF NORTH CAROLINA AT GREENSBORO

CONSENT TO ACT AS A HUMAN PARTICIPANT

Project Title: the relationship between physical education and Leisure time physical activity behavior
Principal Investigator and Faculty Advisor (if applicable): Yangyang Deng
Faculty Advisor: Dr. Ang Chen

Participant's Name: _____

What are some general things you should know about research studies?

You are being asked to take part in the research study. Your participation in the study is voluntary. You may choose not to participate, or you may withdraw from the study, for any reason, without penalty. Research is design to obtain new knowledge and the new information obtained from research may help people in the future. There may not be any direct benefit to you for being in the research study. There also may be risks to being research studies. If you choose not to be in the study or leave the study before it was done, it will not affect your relationship with the researcher or the University of North Carolina at Greensboro. Details about this study are discussed in this consent form. It is important that you understand this information so that you can choose between being in this research study. You will be given a copy of this consent form. If you have any question about this study at any time, you should ask the researchers named in this consent form. Their contact information is below.

What is the study about?
The purpose of this study is to identify the association between knowledge and skill demonstrated in physical education and leisure time physical activity participation.

Why are you asking me?
You are being asked to participate because you are a college student at UNCG and are enrolled in physical education class selected for this study. To participate this study, you must be 18 or older to participate.

What will you ask me to do if I agree to be in the study?
You will ask to participate

1. Health-related fitness knowledge will assess how much knowledge students currently have about fitness and physical activity. Participants will be asked to complete the FitSmart Knowledge test.
2. In class physical activity will be measured on the amount of physical activity that participants achieve through the entire physical activity class. Participants will be asked to wear under their clothes, on their right hips, an accelerometer, which is a small (1.50 × 1.46 × .71 inches), light (0.95 oz) device housed in a plastic case (2 hour and 3 minutes).

UNCG IRB
Approved Consent Form
Valid from:
10/22/17 to **10/21/17**

3. Motor skills will be assessed in class. A skill test consistent with the sport taught will be administered to be collect skill data (Three to five minutes).
4. Leisure time physical activity will be examined using the 3-days recall self-report questionnaire. On the day following each of three target days I will administer the questionnaire in class.

Is there any audio/video recording?
No

What are the risks to me?
The potential of being physically injured in the data collection process will not be greater than that of participating in physical education. There will be minimal mental risks in responding to the self-reported instruments. If you have questions, additional information or have suggestions, please contact Yangyang Deng (336-500-4716, y_deng@uncg.edu) or Dr. Chen (a_chen@uncg.edu). If you have any concerns about your rights, how you are being treated, concerns or complaints about this study or benefits or risks associated with being in this study. Please contact the Office of Research Integrity at UNCG toll-free at (885)-251-2351.

Are there any benefits to society as a result of me taking part in this research?
At this time I cannot determine if there will be the immediate benefit to society. The results, however, might be used in the future to determine the effects of college physical education offerings on enhancing students' health benefits.

Are there any benefits to me for taking part in this research study?
There are no tangible benefits for the participants in this study.

Will I get paid for being in the study? Will it cost me anything?
There is no cost to you, and there are no monetary rewards for patriating in this study.

How will you keep my information confidential?
All the data collected will be stored in a locked file cabinet in the pedagogical Kinesiology Laboratory in UNCG. All electronic data will be password protected. Personal identifying information will be removed before data analysis; a master list will be created in order to protect confidentiality. The master list will be stored separately from data with password protected in another document. Each participant will be assigned a code for identification in the data set. No participants will be identifiable when the study is disseminated. After the study is finished, the electronic data sets will be permanently destroyed using specialized computer software. Hardcopy data will be shredded. All identity information obtained in this study is strictly confidential unless disclosure is required by law.

What if I want to leave the study?
You have the right to refuse to participate or to withdraw at any time, without penalty. If you do withdraw, it will not affect you in any way. If you choose to withdraw, you may request that any of your data which has been collected be destroyed unless it is in a de-identifiable state. The investigators also have the right to stop your participation at any time. This could be because you have had an unexpected reaction, or have failed to follow instructions, or because the entire

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study has been stopped.

What about new information/changes in the study?
If significant new information relating to the study becomes available which may relate to your willingness to continue to participate, this information will be provided to you without delay.

Voluntary Consent by Participant:
By signing this consent form, you agree with you have read, or it has read to you, and fully understand the contents of this document, and you are openly willing consent to participant in this study. By signing this form, you confirm that you are 18 years of age or older and agree to participate in this study describe to you by Yangyang Deng

Signature: _____ Date: _____

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APPENDIX H

LITERATURE REVIEW CHART

Author(s) & years	School & grade	Variables	Measures	Correlation
Chen, Sun, Zhu, & Chen's (2014)	Primary (4th , 5th) graders	Fitness knowledge & Physical activity	Standardized written test & Three-Day Physical Activity Recall	No correlation
Dilorenzo et al., 1998	Primary(5th, 6th) graders	Fitness knowledge& Physical activity	True-false Factual test & self-report questionnaire	No correlation
Dilorenzo et al.,1998	Middle (8th, 9th) graders	Fitness knowledge & Physical activity	True-false factual test & self-report questionnaire	*r*= .26
Ferguson, Yesalis, Pomrehn, &Kirkpatrick (1989)	Middle(6th to 8 th) graders	Fitness knowledge & Physical activity	45 question survey (health-belief model) & Physical Activity Interview	No correlation
Chen, Liu, & Schaben (2017)	Middle (8th) graders	Fitness knowledge &Physical activity	Physical education Metrics	*r* = .32
Haslem et al. (2016)	High school	Fitness knowledge & physical activity	The Health-Related Fitness Knowledge Questionnaire	No correlation
Thompson & Hannon (2012)	High school	Fitness knowledge & Physical activity	100-point written test & the Self-Report Physical Activity Questionnaire	(*r* = .438)
Robinson, Wadsworth, & Peoples (2012)	Pre-school	Motor skill	Gross Motor Development-2nd Edition & Pedometers	(*r*=.461)
Houwen, Hartman, & Visscher (2009)	Elementary	Locomotor & Object-control skills	Fundamental skill &7-days Physical activity recall	No correlation
McKenzie et al., (2002)	Elementary	Motor skill	Fundamental Skills &7-day Physical Activity Recall	No correlation

Okely, Booth & Patterson, (2001)	Middle and high (8th,10th)	Motor skill	fundamental movement's skill & Self-report Measure	No correlation