INTEGRATING GOAL-SETTING IN HEALTH AND PHYSICAL EDUCATION CLASSES TO INCREASE PHYSICAL ACTIVITY LEVELS AMONG MIDDLE SCHOOL STUDENTS

BY

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ABSTRACT OF THE DISSERTATION

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Background: Regular physical activity is essential to maintaining a healthy lifestyle. Being active can reduce the risk for many chronic diseases and disabilities, including heart disease, stroke, non-insulin dependent diabetes, and some cancers. **Objective:** To determine whether a theory-based physical activity curriculum addition to a school district's existing physical activity curriculum (in health and PE classes) targeting goal-setting, or the Social Cognitive Theory construct of self-regulation, increases middle school students' physical activity levels. **Methods:** Woodbridge Township School District, a large and diverse district located in central New Jersey, participated in this study. Four middle schools were randomly assigned to one of three treatment levels and one middle school was randomly assigned as a control group. Treatment schools implemented the study's theory-based goal-setting curriculum supplement which included five lessons. The study used a mixed-methods repeated measures randomized design. Quantitative and qualitative methods were used to collect data to evaluate the effectiveness of the physical activity intervention. The primary outcome variable was moderate-to-vigorous physical activity (MVPA) which was determined by the number of blocks reported by students on the 3-Day Physical Activity Recall (3DPAR). Data were analyzed using descriptive statistics, analysis of variance (ANOVA), and linear modeling. **Results:** Students in the three treatment groups (n=621) were similar in gender to the control group (n=334), but not for age and race/ethnicity. Aggregate baseline data revealed a mean of 4.48 30-minute blocks of MVPA.

More than two-thirds of the students in the study reported being physically active for at least 60 minutes per day on five (5) or more days during the seven (7) days prior to the survey; higher than the state and national averages. There were no statistical differences between the treatment and control groups when analyzing the outcome variable. **Conclusions:** Schools can play a significant role in positively influencing physical activity levels of children and adolescents. The use of the theory-based goal-setting curriculum supplement and self-report measures proved to be an affordable and easy to implement method to promote physical activity despite the lack of significant differences. Additional research focusing on increasing the sample size and reducing attrition rates is warranted.

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ABBREVIATIONS USED

3DPAR: Three-Day Physical Activity Recall

MET: metabolic equivalent

MVPA: moderate-to-vigorous physical activity

PE: physical education

PII: Program Implementation Index

SPAQ: Student Physical Activity Questionnaire

SOFIT: System for Observing Fitness Instruction Time

YRBS: Youth Risk Behavior Survey

CHAPTER ONE:

INTRODUCTION

Numerous rigorously designed studies have demonstrated that maintaining a physically active lifestyle results in a myriad of health benefits.[1-7] Regular physical activity throughout life reduces the risk for many chronic diseases and disabilities, as well as lowers overall mortality for adults of all ages.[8] In addition, physical activity can help to maintain a healthy body and enhance psychological well-being.[8]

Despite the well-known benefits of regular physical activity, many adolescents do not engage in physical activity. Only 27.1% of adolescents in the United States and 27.6% of New Jersey adolescents are presently meeting the recommended levels of physical activity (i.e., 60 minutes or more of physical activity daily).[9] Of particular importance is the evidence suggesting a dramatic decline of physical activity levels from early adolescence through high school and beyond.[10-13] The large percentage of adolescents who are physically inactive raises concerns about the nation's health for today and in the future – highlighting physical activity as a leading public health issue and underscoring the need for effective physical activity interventions.[14-17]

Schools can play an important role in ensuring students have regular physical activity, not only because they have access to large numbers of children who spend at least a third of their day in school,[18] but they also have the potential to create an environment supportive of physical activity.[19,20] While the *Guide to Community Preventive Services*, which reviewed interventions designed to increase physical activity, recommends school-based physical education (PE) as one of five strategies to increase physical activity levels and improve fitness, rigorously evaluated school-based physical activity interventions have generated modest and, in some instances, mixed results.[21,22] This limited impact may result from a number of factors, including the failure to implement theory-based interventions, especially among youth-targeted physical activity

studies;[16] the lack of employing evidence-based strategies as recommended by the Centers for Disease Control and Prevention (CDC);[23] insufficient knowledge about the effectiveness of providing instruction in health education classes to increase physical activity;[21,22] and a rudimentary understanding of the factors responsible for changing physical activity behavior among adolescents.[24-26]

While failure to implement theory-based physical activity interventions may be a factor in the limited success of these interventions, implementing theory-based interventions have had modest success in increasing physical activity behaviors. It is unclear whether this is due to inappropriately applied theoretical constructs, the use of unreliable and invalid measures, or the insufficient implementation of the intervention itself (i.e., participants are not exposed to the intervention's components in a dose that is sufficient to show a difference).[27,28]

Social Cognitive Theory (SCT) is an example of a theory commonly employed in theory-based physical activity interventions that are implemented in the school setting.[15] SCT explains human behavior as a function of personal factors, environmental influences, and behavior continually interacting with each other to influence behavior. This phenomenon is known as reciprocal determinism.[29] More research is needed to examine SCT constructs to better understand adolescents' physical activity patterns.[28] However, some SCT constructs have been shown to be predictive of physical activity behaviors among children and adolescents, including: environment, behavioral capability, reinforcement, and observational learning.[28] Another SCT construct, self-regulation, operationalized as goal-setting in this study, has been shown to have a positive impact on physical activity behaviors among adults but not adolsecents.[30-33] While self-regulation is an important component of SCT,[34] and when operationalized as goal-setting, can be a powerful tool in changing the focus, persistence, and exertion of a behavior,[35] little

research has been conducted to further our understanding in how self-regulation, using goal-setting strategies, influences physical activity among adolescents and children.

Purpose and Need of Study

Since the 1950s there has been considerable national concern about the low levels of physical activity among American youth. However, only recently has the focus shifted from ensuring youth are physically fit to developing youth who are physically active; instead of focusing on motor skill development, the focus is now on instilling an active lifestyle. As such, effective strategies are needed to promote physical activity among children and adolescents which may help curb the obesity epidemic.[36] Goal-setting is a strategy that may be effective in promoting physical activity among adults,[31] but it has not been fully investigated in adolescent populations. Most often, goal-setting has been investigated among adolescents as one component of a multi-component program (including targeting self-efficacy, the physical environment, the social environment, or policy and organizational changes) designed to increase physical activity. Specific research is needed to elucidate whether an individual construct may predict health-related behaviors[29] and to further our understanding in how self-regulation, using goal-setting strategies, influences physical activity among adolescents and children.

The purpose of this study was to determine whether a theory-based physical activity curriculum addition to a school district's existing physical activity curriculum (in health and PE classes) targeting goal-setting, or the Social Cognitive Theory construct of self-regulation, increases students' physical activity levels. The study explored whether the theory-based curriculum addition was more effective when implemented with or without corresponding lessons. This study focused on goal-setting to provide a better understanding of whether this strategy can be used to increase physical activity levels among adolescents and explore whether focusing on a single construct can successfully be targeted to increase physical activity levels.

Research Questions and Hypotheses

The primary hypothesis of this study is that the theory-based physical activity curriculum addition (i.e., goal-setting) in health or PE classes will increase students' physical activity levels.

Reflecting the primary aims of this study, the research design addressed the research questions (RQ) and hypotheses (H) outlined below.

RQ-1 Are teachers able to successfully integrate the goal-setting lessons into the school district's health and physical education curriculum?

H-1 – Teachers who implement the goal-setting lessons will demonstrate integration and application of the goal-setting lessons in their overall lesson plans.

RQ-2 Does integrating the goal-setting lessons into school health and physical education curriculum result in increased physical activity among middle school students?

H-2 – Goal-setting lessons integrated into health and physical education classes will produce significant gains in levels of physical activity, as measured by the 3-Day Physical Activity Recall, a valid and reliable measure of physical activity, among students receiving the lessons when compared to students receiving partial or none of the lessons.

RQ-3 Will targeting goal-setting, a physical activity determinant, produce greater positive effects for those students?

H-3 – Students who are exposed to part of the goal-setting lessons will show significant gains in measures of select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.

H-4 – Students who are exposed to the full goal-setting lessons will show significant gains in measures of the select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.

H-5 – Students of teachers who have higher levels of fidelity of the goal-setting lessons will show significant gains in measures of the select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.

Assumptions

The following assumptions were made for the purpose of the study:

- Increases in physical activity can be achieved over a 10-week period;
- The self-report questionnaires used in this study can measure the physical activity variables of interest;

- Participants completed self-report questionnaires honestly and to the best of their ability;
- Participants actively participated in the intervention; and
- Teachers assisted with program implementation.

Significance of Study

This study has the potential to make a significant contribution to the science base about increasing physical activity among adolescents. Since there is a decline in physical activity levels in adolescence, examining factors that have the potential to influence an adolescent's likelihood of being physical active is important. The study results will add to the research examining the impact of informational approaches (e.g., educational programs) to increasing physical activity through health and PE classes. This physical activity intervention is potentially cost-effective as it requires little in the way of additional expenditures and has the potential for broad application. Enabling schools to easily implement evidence-based strategies to increase physical activity without cost-prohibitive curricula, equipment, and specialized training is an important step to improve adolescents' health.[37]

This study may produce a better understanding of integrating theory into practice, thus enabling more informed interventions targeting physical activity behavior among adolescents to be conducted. Finally, applying the study design elements (e.g., using nonequivalent dependent variables;[38] and collecting data at multiple time points) may contribute to the knowledge base of how to strengthen experimental/quasi-experimental designs to determine causal inference in school-based health and physical activity inquiry.

Limitations

The primary limitation of the study was the use of self-reports to measure physical activity. Student responses may be biased as they may provide socially acceptable responses and/or

erroneous or inaccurate responses to study questionnaires. Students may have also inaccurately recalled and/or misinterpreted their activity levels. However, the questionnaires that were used in the study have been shown to be valid and reliable instruments among adolescent middle school populations. Physiological measures of activity provide the most valid data but were cost-prohibitive for this study. Therefore, the use of validated questionnaires offered a feasible and affordable means for measuring physical activity in this school-based intervention.

Having current teachers implement the theory-based physical activity curriculum addition, as well as administer the study instruments, in health and PE classes may also have limited the effectiveness of the program. Teachers' ability and willingness to implement the curriculum addition may have impacted the effectiveness of the program. In addition, teachers who did not fully support the study's importance also limited the program's effectiveness.

CHAPTER TWO:

LITERATURE REVIEW

Physical activity is important for overall good health and reduces the risk of premature death. Today's youth do not engage in the recommended amount of physical activity. Their physical inactivity adversely affects our nation's health and has the potential to cause even greater adverse health effects in the future by increasing the likelihood of unnecessary illness and premature death. The primary research question in this study was: Does integration of the theory-based physical activity curriculum addition into school health and physical education (PE) curriculum result in increased physical activity among adolescents?

This chapter reviews literature on the benefits and determinants of physical activity, and the guidelines and methods for measuring physical activity among adolescents. School-based intervention programs within health and PE classes are also examined in this chapter.

Physical Activity and Health

The Physical Activity Guidelines Advisory Committee (PAGAC),[39] established by the U.S. Department of Health and Human Services, completed its review and analysis of the scientific research on physical activity and health in 2008. The PAGAC was charged with "reviewing existing scientific literature to identify where there is sufficient evidence to develop a comprehensive set of specific physical activity recommendations and identify areas where further scientific research is needed."[39] The Committee concluded that people who maintain a physically active lifestyle are more physically fit, have a lower risk of developing disabling health conditions, and experience fewer chronic diseases than people who are inactive. Individuals can lower their overall risk of dying prematurely by 30% just by being physically active (i.e., at least 2 to 2.5 hours of moderate-intensity physical activity per week).[39] This inverse relationship between physical activity and all-cause mortality applies to men and women, white and non-

white populations, and young and older people alike. Physical activity is associated with reducing risk for several U.S. leading causes of death, including cardiovascular disease, cancer, stroke, and diabetes. Evidence also suggests that physical activity reduces the signs and symptoms related to other illnesses and disorders, such as osteoporosis, osteoarthritis, depression, and cognitive decline associated with aging (e.g., dementia), anxiety, and poor sleep.[39] In summary, the PAGAC concluded that being physically active benefits everyone as it can help people to stay healthy, as well as help people who have many different types of health problems become healthier.

Obesity and Physical Activity

Obesity is of special concern because many scientists believe that insufficient and declining levels of physical activity are primary factors in the high prevalence of overweight and obesity, especially among children and adolescents.[40-42] Obesity may be even more closely related to excess body weight than poor nutrition due to the consumption of calorie-dense foods.[43,44]

The prevalence of overweight and obesity in the United States has increased dramatically over the last 20 years and rates remain high. For 2011-2012, more than two-thirds of adults aged 20 or older were overweight (33.6%) or obese (34.9%); of children between the ages of 6-11 years 16.5% were overweight (between the 85th and 95th percentile on the body mass index charts) and 17.7% were obese (at or above the 95th percentile); and of adolescents between the ages of 12-19 years 14.0% were overweight and 20.5% were obese.[45] The 2011-2012 National Survey of Children's Health found that 14.7% of New Jersey children, ages 10-17 were overweight and 10.0% were obese.[46]

Being physically active is particularly important for those who are overweight or obese. Not only can being physically active help to reduce body weight, but the benefits of being physically active, such as lowering rates of overall mortality, cardiovascular disease, diabetes, and certain

cancers, can be independent of weight loss.[39] Efforts to increase physical activity among children, adolescents, and adults may be a key strategy to address the significant public health problem of obesity and overweight.[8]

Adolescents as the Target Population

Baranowksi, et al.[47] suggested that prevention efforts have a greater potential for success when differences can be more easily detected and when interventions target youth who are more cognitively mature, have more control over their physical activity choices, and have higher levels of obesity. Middle school students are more cognitively mature than elementary school pupils; begin to take on more independent responsibility, including making decisions regarding their eating and physical activity behaviors; and have sufficient adiposity levels from which changes can be detected. Behaviors, whether healthy or risky, as well as decisions about physical activity preferences, established during this time of life often persist into adulthood.[48,49] An adolescent who engages in regular physical activity is more likely to maintain an active lifestyle throughout adulthood.[36] Based on this scientific data, it would appear that middle school students are the ideal age group for this investigation.

Importance of Physical Activity among Adolescents

Adolescents who are inactive have higher body mass indices (BMIs) and adiposity levels, which increases their cardiovascular disease risk;[50] are physically less fit (poor cardiorespiratory and muscular endurance and strength); and may experience a myriad of comorbidities similar to those experienced by inactive adults, including metabolic syndromes (e.g., type 2 diabetes), orthopedic problems, depression, and sleep disorders.[39,51] Research has shown improvements in overweight adolescents' triglyceride and glucose levels after a six-week increase in activity levels, and blood pressure and adiposity after an eight-month increase in activity levels.[52,53]

Efforts to increase physical activity among adolescents are critical to not only ensure adolescents' current health, but also to positively influence their health in the future. Research by Kelder et al[54] suggest that chronic disease risk factors begin in childhood and Burke et al[55] demonstrated that emphasizing healthy behaviors during adolescence may have long-term benefits throughout adulthood. Reducing chronic disease risk factors, such as obesity during adolescence, may result in decreased morbidity and mortality in middle and late adulthood.[54,56] For example, adolescent obesity is predictive of adult obesity;[57,58] helping individuals to maintain a healthy weight while they are young is expected to decrease adult obesity.[19,47,59] Students who are stigmatized because of their weight, which may have increased their feelings of depression and anxiety, may also experience immediate health and social benefits from participating in physical activity intervention strategies during adolescence. Beyond the physical and psychological benefits, physical activity can also positively impact academic achievement, including improving grades and standardized test scores.[60,61] Physical activity may affect cognitive functioning by increasing 1) oxygenation, 2) brain neurotransmitters, 3) neurotrophins production (proteins that support brain plasticity), and 4) growth of nerve cells in the hippocampus (center of learning and memory). [61,62]

Physical Activity Guidelines

While development of physical activity guidelines for adults began in the 1970s, guidelines for physical activity for children and adolescents have only been developed within the last few years. Both the National Association for Sport and Physical Education (NASPE) [now called the Society of Health and Physical Educators] and the U.S. Departments of Health and Human Services and Agriculture have published their own physical activity guidelines for children and adolescents.[63,64] These guidelines are similar, each recommending children engage in at least 60

minutes or more of physical activity daily. NASPE's guidelines also include discouraging extended periods of inactivity (i.e., lasting 2 hours or more) during the day.

Measuring Physical Activity

Physical activity is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure."[65] Categories commonly used to classify physical activity by its purpose (the context in which the activity is performed) include occupational, leisure-time, recreational (sports), household, and transportation (e.g., commuting activities). Physical activity can be measured in terms of the type, intensity, frequency, duration, the amount of energy expended as a result of the activity, or other arbitrary units (e.g., number of steps taken per day). There are six techniques that are primarily used to measure physical activity: doubly labeled water, direct calorimetry, indirect calorimetry, direct observation, electronic or mechanical monitoring, and self-report.[66]

Self-reports are the most common method used to measure physical activity. Self-reports are either self-administered (in-person or mail) or interviewer-administered (via in-person or telephone). The four types of self-reports include diary surveys (typically covering a 24-hour interval), recall surveys (covering the past one to seven days), quantitative history (typically covering the past year), and general surveys (have no timeframe).[67] Thomas[22] noted that among the most frequently reported reliable and valid outcomes used in physical activity interventions are self-reported changes in physical activity overall and self-reported changes in the duration, frequency, and intensity of physical activity. The advantages of self-reports include nominal cost, relatively minimal participant burden, ease of administration, and flexibility of use.[66,68] While using self-reports has many advantages, many limitations exist as well. Disadvantages include, but are not limited to, participants may misinterpret questions, provide deliberate misinformation and/or incorrectly recall the time and/or intensity of the physical activity.[68]

Determinants of Physical Activity in Adolescents

Many individual, psychosocial, and environmental factors have been found to be associated with physical activity levels in adolescents and these factors appear to be the same for normal weight and overweight youth.[69] The most consistent variable is gender with boys more likely to be active than girls.[14,70] Socio-economic status does not appear to be associated with physical activity; however, more research is needed to determine whether age, ethnicity, BMI, or parental education influence adolescent physical activity patterns.[14,70] In addition, a positive but inconsistent association has been found between opportunities to exercise in the environment and physical activity.[14,71] With the exception of BMI and adding opportunities to exercise in the environment, which can be cost-prohibitive, the aforementioned variables are not modifiable with physical activity interventions.

Psychosocial variables positively associated with physical activity that are modifiable include attitude, self-efficacy, goal orientation, physical education/school sports participation, family influences, and friend support.[14,70,72] There is also recent evidence that enjoying PE class may be a stronger predictor of being physical active than enjoying the act of the physical activity itself.[25,69,72,73] Enjoying PE class may increase adolescents', and in particular girls', comfort level in and willingness to participate in group-based activities suggesting that physical activity interventions should be designed to ensure students enjoy PE classes.[73] Of the six psychosocial determinants known to be positively associated with physical activity, self-efficacy, and family influences are the most common determinants targeted in physical activity interventions.[70] However, the body of research examining physical activity determinants for children and adolescent has predominantly been evaluated via cross-sectional studies; therefore, the research has only been able to demonstrate the directionality of the associations-not the cause and effect.[70]

School-Based Setting

The school setting is a convenient choice for physical activity interventions geared toward children and adolescents as schools have daily access that is continuous and intensive to large numbers of children and adolescents with over 90% of U.S. children enrolled in school.[47,74] Further, schools' access to students occurs during their formative years,[75] which provides the opportunity to instill healthy behaviors which may persist into adulthood.[48,49] Schools can promote physical activity and a positive self-image among students as they deliver health and PE instruction, offer opportunities for physical activity, and provide after-school programs. In addition, implementing school-based physical activity interventions is less expensive at both the individual level and community level than providing treatment for the adverse health effects on physical inactivity, and also places the focus of prevention in the context of education rather than treatment or medicine.[76]

Health and Physical Education (PE) in Schools

Classroom-based health education focused on information provision to increase physical activity is more common than providing daily PE in middle schools. The 2012 School Health Policies and Practices Study found that 58.7% of middle schools required health education instruction for students with the majority of these schools covering physical activity and fitness.[77] However, additional research is needed about how to effectively increase physical activity by providing enhanced curriculum learning opportunities in health education class.[21]

Modifying school-based PE curricula and policies to increase the amount of time students spend in moderate or vigorous activity is an intervention strategy that has been shown to increase physical activity among youth.[21] However, the pressures of student academic success and achievement through federal and state mandates, such as the Elementary and Secondary Education Act, are impacting whether schools even offer daily PE. Despite state-mandated

policies stating that schools must teach PE, the 2006 School Health Policies and Programs Study, the latest survey year with data available on schools providing daily PE, found that only 14.5% of middle schools provided daily PE or its equivalent for at least 18 weeks (or half of the school year).[78] Providing schools with simple evidence-based strategies that can be implemented within the time constraints of PE class may enable schools to offer daily PE and maximize effectiveness.

Use of Theory in Health and PE Programs/Curricula

Many health-related governmental agencies and non-profit organizations have called for using the school setting to increase students' physical activity levels; however, little guidance is provided to schools and teachers on how to accomplish this task effectively and how to use a comprehensive theoretical foundation and evidence-based practices.[79-81] While the Program Standards for Health Education,[82] which are used to make accreditation decisions about health education teacher preparation programs, notes that health education teachers should "describe the theoretical foundations of health behavior and principles of learning," teacher preparation programs have traditionally emphasized pedagogical skills and content knowledge in ten health instructional areas.[83] As a result, teachers possess a limited understanding of behavior change and learning theory, research, evaluation, and the implications for practice which restricts the number of schools that are then able to implement theory-driven health curricula.[18,83-86] In addition, textbooks are often not used in PE classes so teachers are responsible for ensuring the PE curriculum is theory-driven and standards-based rather than the textbook publishers, but teachers do not necessarily possess the educational background to do so effectively.[87,88] Teachers may also lack the skills to evaluate their own programs to document what is accomplished.[83] Thus, the challenge for teachers is to design and/or implement curricula using the best theoretical and empirical knowledge and to rigorously evaluate its effectiveness.

Research and evaluation on teaching practices dominates the field, while evaluation of curricular practices (e.g., lesson plans and activities) and implementation is insufficient.[89-91] Research driven by behavioral change theories to promote physical activity is limited and the use of behavioral change strategies have only recently been integrated into physical activity interventions in school-based settings.[92] Researchers and teachers need to work together to develop, document, and support effective theory-driven physical activity programs and focus on curriculum effects, in particular, rather than teacher effects.[93] By integrating theory, research and evaluation in this physical activity intervention study, health and PE teachers will obtain both reliable and valid data which may inform their teaching practices and physical activity programs.

Use of Social Cognitive Theory in Physical Activity Interventions (Middle School)

Social Cognitive Theory (SCT) is a theory commonly employed in theory-based physical activity interventions targeting school-age children and youth.[15] SCT explains human behavior as a reciprocal model of the personal factors of an individual, that individual's behavior and the environment in which the behavior is performed.[29] Personal factors reflect one's cognitions and include self-efficacy, outcome expectations, enjoyment, and self-regulation.[16] The environment includes elements in one's physical environment [e.g., access to facilities] and social environment [e.g., support from family and friends].[16] This reciprocal model suggests that a change in one concept/construct influences the others to affect behavior.[94] Health professionals have designed interventions using SCT to influence personal factors and/or environmental influences, thereby increasing the likelihood to affect behavior.

SCT has been applied to multiple school-based interventions[95] and has been shown to be moderately effective in increasing physical activity among children and adolescents.[19,96] These physical activity interventions have targeted upper elementary pupils (grades 3-5) or high school

students (grades 9-12) with only a few interventions targeting middle school students (grades 6-8). A recent systematic review by the Cochrane Collaboration concluded that more research is needed on obesity prevention interventions for adolescents.[97] The following is a brief review of middle school physical activity interventions that have used Social Cognitive Theory.

Planet Health (1995-1997).[19] A two-year, randomized, controlled trial, Planet Health was designed to reduce obesity in students in 6th-7th grades by changing four behavioral targets: 1) reducing television viewing to less than two hours per day, 2) increasing moderate and vigorous physical activity, 3) decreasing consumption of high-fat foods, and 4) increasing consumption of fruits and vegetables to five a day or more. Planet Health was conducted in 10 schools in the Boston, Massachusetts metropolitan area. With regards to SCT, Planet Health focused on developing cognitive and behavioral skills (such as how to choose foods from the five groups for a healthy, balanced diet) that included enhancing behavioral capability by providing opportunities for students to practice these skills. Planet Health lessons were infused into language arts, math, science, and social studies classes, as well as PE classes which focused on student self-assessment and goal-setting through 5-minute microunits. Study results related to physical activity showed Planet Health was effective in significantly reducing obesity among girls, but not for boys. Although obesity declined among boys, the decline was not significant. A significant reduction in television viewing time as self-reported for both girls and boys was also observed. However, the study did not impact students' physical activity patterns. While this study was innovative in its use of regular classroom teachers, the lack of effect on physical activity patterns may demonstrate the need for trained health education teachers to include additional physical activity lessons to students in class. The process evaluation revealed both regular classroom and PE teachers implemented fewer Planet Health lessons than expected and this lack of full implementation may explain the study's lack of total effectiveness.

EatFit (2002).[98] A repeated measures, quasi-experimental field trial, EatFit comprised 10, one-hour sessions which were delivered in a home economics classroom in a low-income middle school setting in central California. This nutrition and physical activity intervention targeted self-efficacy, outcome expectancies, and self-regulation constructs from Social Cognitive Theory. Physical activity topics covered in the sessions included fitness basics, fitness analysis, goal-setting, and energy balance. Eighth grade students participated in the field trial. While the field trial had a small sample size (N=50), preliminary results suggested a significant change in physical activity self-efficacy but no change in physical activity behavior.

Trial of Activity for Adolescent Girls [TAAG] (2003-2005).[37,42,99-104] A two-year, multicenter, randomized field trial, TAAG was designed to reduce the decline of physical activity in adolescent girls (6th, 7th and 8th grades) by making the environment and organization (e.g., school setting) more supportive of physical activity and disseminating cues, messages, and incentives to be more physically active. This multicenter, randomized field trial included six sites, one each in Arizona, California, Louisiana, Maryland, Minnesota, and South Carolina, with six schools per site. SCT was one of many theories that served as a theoretical foundation for TAAG. Specifically, TAAG targeted three SCT constructs (self-efficacy, outcome expectations, and behavioral skills) to increase physical activity. Study results showed a statistically significant, although moderate in practical terms, increase in physical activity levels among girls who participated in the intervention, and no difference in BMI among study participants. In addition, the TAAG study found that social groups played an important role in girls' attitudes toward physical activity and the types of activities they engaged in. While this study was innovative in its efforts to increase physical activity among girls, targeting only girls may not be feasible for all school districts.

Active by Choice Today [ACT] (2004-2009).[105-108] A 17-week after-school intervention, ACT was designed to increase physical activity levels by increasing intrinsic motivation and behavior skills for physical activity among 6th grade students in 24 middle schools in South Carolina. The theoretical framework included SCT constructs of behavioral capability and self-efficacy. ACT is unique in that it used a student-centered approach, which involved youth in developing ideas and making choices about their own physical activity. Study results demonstrated students assigned to the intervention group engaged in significantly more minutes of moderate-to-vigorous physical activity (MVPA) per day than students in the control group at mid-intervention as measured by accelerometry estimates. However, these positive results were not sustained at 2-weeks post-intervention as no significant differences in MVPA (measured by accelerometry estimates) were found post-intervention between intervention and control groups.

Latin Active (2008).[109] The primary goal of the Latin Active, a pilot test, was to increase the frequency of vigorous physical activity among Mexican-American adolescents in a low-income charter school in Arizona. The intervention targeted several Social Cognitive Theory constructs, including: self-efficacy, observational learning, reinforcements, self-regulation (goal-setting), and environment (neighborhood resources for physical activity). Two health/dance sessions were held in health and science classes each week over five weeks for a total of 10 sessions. Using a pre-test/post-test design with only the treatment (no comparison group), the Latin Active program significantly increased students' reported vigorous physical activity levels and increased self-efficacy among girls, and decreased perception of neighborhood barriers among boys. The generalization of the Latin Active findings is limited due to the small sample (N=73).

Central Texas Coordinated Approach To Child Health (CATCH) Middle School Project (2009-2012).[110] CATCH employed a group randomized serial cross-sectional design with 30 central Texas middle schools to test the effect of three program support conditions. CATCH employed

Social Cognitive Theory's triadic model by targeting behaviors, personal factors, and environmental influences. With regards to physical activity, CATCH aimed to increase MVPA and decrease sedentary activity by training PE teachers to integrate activities designed to engage students in higher levels of MVPA and incorporating physical activity lessons and activity breaks in other classes (science, math, and health). Study results regarding students' changes in physical activity levels have not yet been published.

Other Physical Activity Interventions (Middle School)

Increased physical activity has also been associated with environmental (physical) and policy factors but not consistently.[14,70] When environmental and policy approaches have been effective in increasing physical activity, the contribution of these factors in explaining the increased physical activity is much smaller than the contribution of cognitive and interpersonal variables.[111] The following is a review of middle school physical activity interventions that have used environmental and policy approaches.

The **Middle-School Physical Activity and Nutrition (M-SPAN)** study (1997-1999) was a randomized field trial of a health-related PE intervention, the first for middle schools.[112,113] Twenty-four middle schools in Southern California participated in the M-SPAN field trial. The physical activity portion of the study was designed to increase physical activity in PE classes through changing lesson context, lesson structure, and teacher behavior, and promoting physical activity throughout the school day (i.e., before school, after lunch and after school). The study was effective in increasing physical activity at school but the effect was statistically significant only for boys. While researchers designed PE lessons for all students and offered after-school activities that were believed to be attractive to girls, the lack of effect for girls suggest that additional research is needed to empirically explore strategies for targeting girls.

The **Intervention Centered on Adolescents' Physical Activity and Sedentary Behaviour (ICAPS)** study (2002-2006) was conducted in middle schools in France.[114,115] ICAPS was a multi-level, four-year intervention. While the study did not specifically state use of SCT, ICAPS focused on intrapersonal, social, and environmental determinants of physical activity. ICAPS comprised an educational component focusing on physical activity and sedentary behaviors, environmental changes to provide new opportunities for students to engage in physical activity during and after school, and organized physical activity events, such as biking and walking to school. Study results showed statistically significant increases in supervised leisure physical activity outside of PE classes among intervention students when compared with control students. Intervention students also had a statistically significant reduction in TV/video viewing time than control students.

Summary of Limitations from Physical Activity Interventions

The most common limitations noted in the above physical activity interventions were the participation rate of students when active consent was required and the measurement concerns associated with self-report questionnaires. Another limitation was using the multicomponent approach without being able to assess which components of the interventions were most effective and there are currently no data that demonstrate multicomponent approaches are any more effective in increasing physical activity than the single component approach.[116]

Targeting Self-Regulation from Social Cognitive Theory

Some SCT constructs have been shown to be predictive of physical activity behaviors among children and adolescents, including: environment, behavioral capability, reinforcement, and observational learning.[28] In addition, there is growing evidence that self-efficacy and outcome expectations may also be associated with physical activity.[14,70,73] Another SCT construct, self-regulation, has been shown to have a positive impact on physical activity behaviors among

adults.[30,31,33] The SCT construct, self-regulation, operationalized as goal-setting in this study, has been shown to have a positive impact on physical activity behaviors among adults.[30-33]

A distinctive feature of SCT is the central role self-regulatory processes, an essential personal factor of SCT, play in self-influencing behavior.[94] SCT posits that behavior is motivated and regulated by self-monitoring, judgment of one's behavior in relation to internal standards, and self-reaction – self-regulation.[34,94] In other words, self-regulation is an individual's ability to set goals, use effective strategies to achieve those goals, and monitor her or himself to evaluate success in achieving those goals.[117] In conclusion, self-regulation is an important component of SCT,[34] and when operationalized as goal-setting, can be a powerful tool in changing the focus, persistence and exertion of a behavior.[35]

Goal-setting and goal attainment scaling methods have been used for over 30 years in workplace settings[118] and research by Nothwehr and Fang[119] showed goal-setting to be associated with more successful weight management among adults. As previously discussed, goal-setting is a strategy that appears to have promise in promoting physical activity among adults,[31] but it has not been extensively investigated in an adolescent population. Therefore, more research is needed to elucidate how self-regulation, using goal-setting strategies, influences physical activity among adolescents.

One of the major purposes of health education is to enable an individual to take control of behaviors that lead to healthy outcomes. According to Bandura,[94] self-control involves several functions, including setting goals, which is the most important function. This process includes setting a goal and identifying methods to reach the goal and self-monitoring techniques to observe outcomes and evaluate whether the outcome meets personal expectations and standards. Therefore, self-control focuses on a specific behavior and establishes specific targets that the individual can monitor increasing the likelihood the goal can be reached. Along the way

the individual can identify incentives or self-rewards to help motivate and promote confidence (self-efficacy) that perpetuates continuation of the activities until the goal is successfully accomplished.

Focusing on goal-setting will provide a better understanding of whether this strategy can be used to increase physical activity levels among adolescents and whether focusing on a single construct can successfully be targeted to increase physical activity levels. In addition, integrating an SCT construct into the health and PE curricula will provide information about whether teachers who have had little or no training in psychology or behavior change theories can be trained to a level where they can be capable of delivering a theory-based component, such as self-regulation (goal-setting), and can implement the study lessons with proficiency.

Summary

Lack of physical activity is but one of the contributing factors to poor health and many adolescents do not engage in the recommended amounts of physical activity. Physical activity guidelines recommend adolescents engage in at least 60 minutes or more of physical activity daily. Additionally, adolescents should refrain from experiencing extended periods of inactivity (i.e., lasting 2 hours or more) during the day. The benefits of physical activity in adolescence have been well established. Adolescents who are active have lower BMIs and adiposity levels[50] and lower rates of depression, anxiety, and improved self-concept.[53] Beyond the physical and psychological benefits, physical activity can also positively impact academic achievement, including improving grades and standardized test scores.[60,61] Efforts to increase physical activity among adolescents may be a key strategy to address this significant public health problem[8] and improve the health of a generation.

School-based physical activity interventions have generated modest and, in some instances, mixed results[21,22] which may have resulted from the failure to implement theory-based

interventions. Social Cognitive Theory (SCT) is an example of a theory commonly employed in theory-based physical activity interventions that are implemented in the school setting.[15] The SCT construct of self-regulation, operationalized as goal-setting in this study, has been shown to have a positive impact on physical activity behaviors among adults but not adolsecents.[30-33] Goal-setting is a strategy that has not been fully investigated in adolescent populations. Therefore, research is needed to further our understanding in how self-regulation, using goal-setting strategies, influences physical activity among adolescents.

CHAPTER THREE:

METHODS

This study sought to determine whether a theory-based physical activity curriculum addition to a school district's existing physical activity curriculum (in health and PE classes) to target goal-setting, or the Social Cognitive Theory (SCT) construct of self-regulation, increased students' physical activity levels. This chapter provides a description of the methods used in this study, including research design, description of the school district, the theory-based goal-setting curriculum additions, teacher preparation, inclusion and exclusion criteria, instrumentation, process evaluation, data collection, protection of human subjects, power calculations, and statistical analysis.

Experimental Design

The study used a mixed-methods repeated measures randomized design[38] (see Figure 3-1). The design allowed for a comprehensive evaluation of the intervention's effects among the intervention and control schools. The school was the unit of randomization, common in school-based interventions.[96,120] Nonequivalent dependent variables (dependent variables predicted not to change) were also measured to reduce the plausibility of internal validity threats, thus strengthening the research design. (See complete description of nonequivalent dependent variables in the section on Instrumentation.)

Figure 3-1: Research Design

R	E_A	O_1	X	O_2	O_3
R	E_B	O_1	X	O_2	O_3
R	E_C	O_1	X	O_2	O_3
R	C_A	O_1		O_2	O_3

Description of School District and Middle Schools

Woodbridge Township is the oldest original township in the State of New Jersey being granted a charter on June 1, 1669 by King Charles of England.[121] With a population of 99,585 (2010 population), the township is New Jersey's sixth largest municipality. Woodbridge Township is located within Middlesex County and comprises ten communities, including Avenel,

Colonia, Fords, Hopelawn, Iselin, Keasbey, Menlo Park Terrace, Port Reading, Sewaren, and Woodbridge proper, covering approximately 27 square miles.[122] The Woodbridge Township School District is a model demographic; the eighth largest school district in New Jersey, with 16 elementary, five middle, and three high schools. The student population is comprised of a wide variety of racial, ethnic, and socio-economic groups. Table 3-1 displays a breakdown of the overall demographics, including gender, race/ethnicity, and socio-economic status (as measured by federal free/reduced lunch eligibility) for the district as a whole. Due to the small number of students of Native American and Hawaiian/Pacific Islander descent, these students were included within the Asian student category.

Table 3-1: Overall Demographics of Woodridge Township School District (2013-2014)

Total Enrollment (K-12)	13,449
Gender	
Female	48.1%
Male	51.9%
Race/Ethnicity	
White	38.0%
African-American	11.8%
Asian and Other	27.8%
Hispanic	22.4%
Socio-economic Status	
Free/Reduced Lunch	35.6%

The middle school setting was selected for this physical activity intervention study to capitalize on the easy access to adolescents and the potential for institutionalization within the community. This research study included active participation of the district's school personnel, including the Assistant Superintendent for Curriculum and Instruction; the Supervisor for Athletics, Art, Nursing Services, PE, and Health; and the principals, the vice-principals, and the 22 health and PE teachers from the district's five middle schools. The involvement of the health and PE teachers and school personnel, as well as school administrative support, helped to coordinate efforts within the district.

Theory-Based Physical Activity Goal-Setting Curriculum Supplement

The Woodbridge Township School District uses the quarter system comprising four quarters each with 45 days covering approximately 10 weeks each. Each middle school student enrolls in health for one quarter (equivalent to 45 school days) and PE for three quarters of the school year (equivalent to 135 school days). Each quarter, health is taught to 25% of the middle school student population and PE is taught to the remaining 75%.

Each middle school taught the District's approved fitness curricula in health or PE classes during the study timeframe. The district's PE classes seek to actively engage all students. For health classes, the District uses an 8-lesson fitness curriculum. The primary objectives of this curriculum are to promote development of behavioral skills associated with physical activity and encourage lifelong fitness. The curriculum was developed by the school district and does not formally integrate SCT or physical activity determinants. Topics addressed in the district's fitness curriculum include:

- Light, moderate and vigorous physical activity (intensity and physical activity);
- FITT (frequency, intensity, time and type) principles and target heart rate;
- Social support and physical activity (enlisting support and encouraging others to be physically active);
- Overcoming barriers to physical activity; and
- Reducing sedentary behaviors.

The theory-based goal-setting curriculum supplement used in this study included five lessons, each comprising two parts: a lesson and a physical activity goal that students sought to achieve. The five lessons of the goal-setting curriculum supplement were selected to address the district's physical activity curriculum and were developed and evaluated in the Trial of Activity for Adolescent Girls (TAAG),[123] a multicenter, randomized field trial funded by the

National Heart, Lung and Blood Institute, National Institutes of Health. (TAAG project leaders have approved the release of TAAG materials to assist others in their research as noted on the TAAG website: www.cscc.unc.edu/taag. Researchers must cite materials as coming from the TAAG project study.[123]) The five topics covered in the goal-setting lessons included:

1) Intensity and physical activity (students learn the differences between physical activities that are light, moderate and vigorous in intensity);
2) Enlisting support for physical activity [social support] (students learn how to enlist support and encourage others to be physically active);
3) Reducing sedentary behaviors (students learn and use behavior substitutions to decrease sedentary behaviors and increase physical activity);
4) Overcoming barriers to physical activity (students learn and use assertive communication skills to appropriately reduce barriers to physical activity); and
5) the FITT (frequency, intensity, time, and type) principles (students learn to use the FITT principles to help determine if their physical activity is adequate).

Three different levels of the goal-setting curriculum supplement were implemented and assessed: Level 1) lessons only (teachers use the lessons only; students did not seek to achieve the corresponding goals); Level 2) goals only (students sought to achieve the corresponding goals with teachers ensuring they understand and have the minimum knowledge necessary to do the goals without using the lessons), and Level 3) the complete goal-setting lessons (teachers use the lessons and students sought to achieve the corresponding goals). Examining these three levels allowed the investigator to determine whether the levels had a different impact on physical activity levels.

All of Woodbridge Township School District's five middle schools participated in this study. Four middle schools were randomly assigned to one of three implementation levels and one

middle school was randomly assigned as a control group. The implementation plan for each school is provided in Table 3-2. A table of random numbers was used to determine group assignment.[124] For schools randomly assigned to integrate the goal-setting curriculum supplement, they taught the lessons and/or goals in two grades (6th, 7th or 8th grade) at their school.

Table 3-2: Implementation Plan for Randomizing Intervention Components to Four Middle Schools

	Middle School 1 (Control A)	Middle School 2 (Experiment A)	Middle School 3 (Experiment B)	Middle School 4 (Experiment C)	Middle School 5 (Experiment C)
Length	One Quarter	One Quarter	One Quarter	One Quarter	One Quarter
Health /PE Class	Regular Curric	Regular Curric with Goal-Setting Supplement (lessons only, no goals)	Regular Curric with Goal-Setting Supplement (goals only)	Regular Curric with Goal-Setting Supplement (lessons and goals)	Regular Curric with Goal-Setting Supplement (lessons and goals)

Teacher Preparation

The Woodbridge Township School District teachers have already received training on the District's regular fitness curriculum; and, therefore, only needed to receive in-service training on the goal-setting curriculum supplement and survey administration. The investigator provided a short in-service training for all participating teachers on the study procedures for administering the study surveys. In schools assigned to implement any level of the goal-setting curriculum supplement (lessons only, goals only, or lessons and goals), teachers also received training during the short in-service training on implementing the study lessons and/or goals, as appropriate for their schools. The short in-service training was approximately one-hour in length for the control school and approximately 1.5 hours in length for the four intervention (experimental) schools.

Inclusion and Exclusion Criteria

Woodbridge Township middle school students enrolled in regular health or PE class in 6th, 7th or 8th grade during the fourth quarter of the 2013-2014 school year were eligible to participate in the study. Specific student exclusion criteria included:

- Unable to read and understand questions written in English;
- Been told by a physician or other licensed healthcare professional, such as a nurse, to avoid exercise for health reasons and have been excused from health and/or PE class;
- Unwilling to give assent;
- Parent unable to read the informed consent written in English; and/or
- Parent unwilling or unable to give informed consent.

Instrumentation

Quantitative and qualitative methods were used to collect data to evaluate the effectiveness of the physical activity intervention. Quantitative measures included questionnaires and physical activity recall surveys. Qualitative measures included structured observations and teaching logs. The physical activity intervention was expected to be effective in increasing the physical activity levels (primary outcome variable) through positively influencing the physical activity determinants, or mediators. Mediators are defined "as variables that are hypothesized to lie in the causal pathway between the intervention activities and the outcomes."[120] Additional independent variables that were not targeted or expected to change during the intervention but may have influenced the outcome variable, were also examined. Including these additional independent variables in the analysis allowed for examining differential intervention effects by subgroups. Nonequivalent dependent variables were identified and examined to address potential weaknesses of the research design, such as

maturation bias (students' health improves across all health measures). See Table 3-3 for a list of the intervention measures that were used. All of the instruments that were used had been shown to be reliable and valid with adolescent populations in other studies. (See Appendix A for measurement instruments.)

Table 3-3: Physical Activity Intervention Measures
Outcome variable: • Moderate-to-Vigorous physical activity (MVPA) levels as measured by the 3-Day Physical Activity Recall (3DPAR)
Goal-Setting Curriculum Supplement: • Lessons and/or physical activity goals
Determinants (Mediators): • Goal orientation • Self-efficacy for physical activity • Social Support (family support and friend support) • Perceived benefits of physical activity (outcome expectations) • PE Enjoyment
Independent Variables: • Gender • Age • Grade Level • Race/Ethnicity • Socio-economic status • Sports and activity history • Amount of time spent at home alone
Nonequivalent Dependent Variables: • Students' perceptions of available environmental and recreational facilities for being active • Student safety practices

Outcome Variable. The primary outcome variable was the mean difference in self-reported moderate-to-vigorous physical activity (MVPA) levels, as measured by the **3-Day Physical Activity Recall (3DPAR)**, between the three intervention schools and the control school. The 3DPAR has been previously used by Motl et al.[125] with middle school students. Also, the 3DPAR has been used as an outcome measure in previous school-based physical activity interventions.[72,106,126] The 3DPAR has been shown to be a valid estimate of physical activity based on correlations accelerometry, an objective measure of physical activity (r = 0.27 – r =

0.46, $p < 0.05$).[127] These correlations are similar to those found in validation studies of other self-report questionnaires which have ranged between $r = 0.30$ to $r = 0.50$.[66]

The 3DPAR is advantageous as it measures physical activity patterns over multiple days in a single reporting session, which reduced the reporting burden for students and the time burden for teachers. The 3DPAR is a self-report measure that requires respondents to recall and report their physical activity for two weekdays and one weekend day, which provides for a more reliable estimate of typical daily physical activity.[125] Each day is divided into 34 30-minute blocks of time from 7:00am to midnight. Students recorded the code number corresponding to the primary activity (58 common activities were listed for them to select with options to write in other activities, if necessary) in which he/she was engaged during each 30-minute block, and the intensity of the specified activity for each block of time. Intensity levels included: light (i.e., slow breathing, little or no movement), moderate (i.e., normal breathing and movement), hard (i.e., increased breathing and moderate movement), and very hard (i.e., hard breathing and quick movement).

The 3DPAR was administered to students at baseline and at follow-up after the intervention delivery. The 3DPAR was administered on a Wednesday or Thursday and students recalled their activity from the previous Tuesday, Monday, and Sunday. Data from the 3DPAR were converted to Metabolic Equivalents, known as METs, using the MET values from the TAAG study.[128] A MET is a unit used to estimate the amount of oxygen the body uses during physical activity. For example, one MET is the rate of energy expenditure while at rest. MET values are then used quantify the intensity of physical activity. The Centers for Disease Control and Prevention's (CDC) Physical Activity Guidelines Advisory Committee[39] defined physical activity intensity levels using the following MET ranges:

Light-intensity activities: 1.1 MET to 2.9 METs;

Moderate-intensity activities: 3.0 to 5.9 METs; and

Vigorous-intensity activities: 6.0 METs or greater.

The TAAG study established a MET value for each of the activities on the 3DPAR.[128] For example, walking at a moderate intensity is rated as 4.0 METs and watching television at any intensity level is rated as 1.5 METs. The average number of blocks of activity at or above 3.0 METS over the three-day reporting period was used as the primary outcome variable of moderate-to-vigorous physical activity (MVPA) for each student.

The physical activity items from the CDC's **2013 Middle School Youth Risk Behavior Survey** (YRBS) were used so that the study population's physical activity levels could be compared with national data.[9,129,130] The YRBS has also been used to assess students' physical activity levels in other school-based interventions.[131] The YRBS comprises five items on physical activity. One item is rated on an eight-point scale from 1 = "0 days" to 8 = "7 days." Two items are rated on an seven-point scale from 1 = "I do not watch TV or play video/computer games" to 7 = "5 hours per day." One item is rated on six-point scale from 1 = "0 days" to 6 = "5 days." The fifth item has four choices for a response, including 1 = "0 teams," 2 = "1 team," 3 = "2 teams," and 4 = "3 or more teams."

The YRBS was administered to all students participating in the study one time before the intervention and two times after the intervention was completed (approximately 1 week apart). To reduce the burden on the student and teacher and minimize intervention costs, only the YRBS was implemented at multiple time points.

Determinants (Mediators). Physical activity determinants (mediators) that have been positively associated with physical activity were also examined to determine whether exposure to the goal-setting curriculum supplement had an effect on them. The select determinants included students' goal orientation, students' perceptions of their self-efficacy related to being

active, students' perception of social support (family support and friend support) for being active, students' perceived benefits of being active (outcome expectations), and the degree to which students enjoy PE class (PE Enjoyment). The select physical activity determinants were measured using the **Student Physical Activity Questionnaire (SPAQ)**, adapted from the TAAG Student Questionnaire.[73,132] See Table 3-4 for a list of scales and corresponding number of items for each selected determinant. All factors used a 5-point Likert-type scale (e.g., "Disagree A Lot" to "Agree A Lot," or "Never" to "Very Often"). Physical activity determinants were assessed prior to (baseline) and after the intervention delivery (follow-up).

Table 3-4: Physical Activity Determinant Scales

Goal Orientation	One item
Social Support Scale	
Family Support Scale	Five items
Friend Support Scale	Three items
Self-Efficacy for Physical Activity Scale	Eight items
Perceived Benefits of Physical Activity Scale	Nine items
Enjoyment of PE Class	One item

- *Students' Goal Orientation.* Goal orientation was measured with one item. Students indicated how often they set goals to do physical activity using a 5-point Likert-type scale from "Never" (1) to "Very Often" (5).
- *Self-Efficacy.* Students' perceptions of their self-efficacy for being active through self-management strategies, which is related to goal-setting, was measured with eight items such as "I say positive things to myself about physical activity" and "I make back-up plans to be sure I get my physical activity." The eight items used a 5-point Likert-type scale from "Never" (1) to "Very Often" (5) and the self-efficacy scale was computed by summing the eight scores.
- *Social Support.* Students' perception of social support (family support and friend support) for being active was measured using five items for family support and three items for friend support. Three items were similar for both types of support: During a typical week,

how often (1) Has a family member (or friends) encouraged you to do physical activities or play sports?; (2) Do physical activities or sports with you?; and (3) Tell you that you are doing well at physical activities or sports? Items regarding family support included two additional items: During a typical week, how often (4) Has a family member provided transportation to a place where you can do physical activities or play sports?; and (5) Has a family member watched you participate in physical activities or sports? Each family and friend support item used a 5-point Likert-type scale from "Never" (1) to "Very Often" (5). Family support and friend support were computed by summing the five family support scores and the three friend support scores, respectively.

- *Outcome Expectations.* Students' perceived benefits of being active (outcome expectations) was measured with nine items, such as "If I were to be physically active during my free time on most days...it would help me spend more time with my friends;" "...it would help get or keep me in shape;" or "... it would be fun." Students indicated the extent to which they agreed or disagreed with the nine statements using a 5-point Likert-type scale from "Disagree a Lot" (1) to "Agree a Lot" (5). The outcome expectations scale was computed by summing the nine scores.
- *PE Enjoyment.* The degree to which students enjoy PE class was measured with one item. Students rated the extent to which they agreed or disagreed with the statement, "I enjoy PE" using a 5-point Likert-type scale from "Disagree a Lot" (1) to "Agree a Lot" (5).

Independent Variables. The independent variables included demographic variables: gender, age, grade level, race/ethnicity and socio-economic status (as measured by federal free or reduced lunch eligibility). Students were also asked to report their sports and activity history, and the amount of time spent at home alone without an adult. For race/ethnicity, each student responded to two items. The first item asked whether the student thought of him/herself as

Latino or Hispanic or Mexican American or of Spanish origin (yes or no). The second asked whether the student thought of him/herself as White, Black or African-American, Asian, Native Hawaiian or other Pacific Islander, American Indian or Alaska Native, Other, or Don't Know. (If students selected Other, they could write-in their response.) Students responded to a single question about whether they received free or reduced lunch at school (yes, no, or don't know).

Students reported whether they had participated in any programs that were physically active (like dance/karate lessons, clubs, or sports teams) through their school or community groups during the past 12 months (yes, no; if yes, students listed the programs) to indicate their sports and activity history. Two items were related to the amount of time they spend at home alone without an adult: (1) "How many days per week do you take care of yourself in the afternoon or evening after school without an adult being there?" and (2) "On a typical day, how many hours each day do you take care of yourself in the afternoon or evening after school without an adult being there?" Response options for these items was numbered from zero (0) to five (5). A home alone composite measure was computed by multiplying the responses to the two items and then categorized into three categories of amount of time spent home alone after school: 1) no time alone; 2) 1–2 hours a day and 1–2 days per week, and; 3) >2 hours a day, and >2 days a week, using the same method reported for the TAAG study.[133]

The investigator had also intended to examine education factors (attendance rates and health/PE grades), as well as body mass index (BMI) and health-related fitness of participating students; however, the school district did not release this data. (While the investigator had received pre-approval from the district regarding these data and the informed consent/assent forms provided permission to access these data, the district still did not release the data.) While significant changes in students' BMI and health-related fitness levels were not expected because

of the short duration of this physical activity intervention, the investigator had planned to include these factors in the analysis to examine differences among subgroups at baseline.

Additional Variable of Interest. Travel by walking/biking before and after school was also measured to determine whether this type of physical activity affects the primary outcome variable, MVPA levels as measured by the 3DPAR. One item was adapted from the Centers for Disease Control and Prevention's (CDC) KidsWalk-to-School program evaluation[134] to measure how many times per week did students use different modes of transportation to get to and from school. Students were able to identify how many times they walked, biked, or rode (in a bus or vehicle) to and from school. This item was included on the **Student Physical Activity Questionnaire (SPAQ).**

Nonequivalent Dependent Variables. Two nonequivalent dependent variables were measured. A nonequivalent dependent variable is defined by Shadish, Cook, and Campbell[38] as "a dependent variable that is predicted not to change because of the treatment but is expected to respond to some or all of the contextually important internal validity threats in the same way as the target outcome."[38] Shadish, Cook, and Campbell[38] recommended using this type of variable to strengthen the experimental design. The assumption of using a nonequivalent dependent variable is that if an effect is due to one or more of the threats of internal validity, both the dependent and nonequivalent dependent variables will show the effect. If a study's dependent variable changes in response to an intervention but the nonequivalent dependent variable does not change, the causal inference is strengthened. For example, two nonequivalent dependent variables (awareness of good nutrition and awareness of stress reduction) were used in a study assessing the effect of a media campaign to reduce alcohol use among college students.[38] Awareness of alcohol abuse increased, and awareness of the other health issues did not increase, as a result of the study. If the effects of the study had been due to better attitudes

toward health in general, then the nonequivalent dependent variables would have also increased.

Student perception of available environmental and recreational facilities for being active and student safety practices served as the two nonequivalent dependent variables. These variables were chosen as each were not predicted to change because of the intervention, but may respond to important internal validity threats.

- *Environmental and Recreational Facilities.* Student perception of available environmental and recreational facilities for being active was measured by the item, "Is it easy to get to and from this place from home or school?," from the TAAG Student Questionnaire.[135] Students responded to the item for 11 places such as basketball court, health club, martial arts studio, or playing field (football, soccer, baseball/softball). Scores were calculated by adding the number of items students noted as being easy to get to and from, with a score ranging from 0 to 11. This item was included on the **Student Physical Activity Questionnaire (SPAQ)**, adapted from the TAAG Student Questionnaire[73,132] and was measured prior to (baseline) and after the intervention delivery (follow-up).
- *Student Safety Practices.* Student safety practices was measured with four items. For two items, students rated how often they wore a helmet while biking or skateboarding using a six-point scale from "I do not ride a bike/skateboard" (0) to "Never Wear" (1) to "Always Wear" (5). The third item requested students to rate how often they wear a seatbelt when riding in a motor vehicle from "Never Wear" (1) to "Always Wear" (5). The fourth item measured whether they had ever ridden in a motor vehicle driven by someone who had been drinking alcohol? (Yes, No, Not Sure). The points for the four items were summed for an overall student safety practices index. A higher score on the safety practices index reflected more behaviors that contributed to being safer. The

safety practices items were included on the **Middle School Youth Risk Behavior Survey (YRBS)**[129] which was administered to all students once prior to (baseline) and twice after the intervention delivery (follow-up).

Content Validity. All of the instruments that were used in this study had been previously utilized to measure physical activity levels or the targeted physical activity determinants in adolescent populations. Assessing content validity specifically for this study was unnecessary.

Process Evaluation

The process evaluation model, structured observations, and the goal-setting curriculum supplement were used to assess implementation fidelity of the intervention components. The process evaluation was designed to avoid committing a Type III error. Basch[136,137] described a Type III error as occurring when a program has been inadequately implemented. The process evaluation model described by Windsor et al[138] was used to determine the Program Implementation Index (PII), a numeric value that provides an implementation index for the completion of each intervention component. This model documented the delivery and teacher implementation of and student participation in the physical activity intervention components as well as participant completion of pre-test and post-test study instruments at the middle schools. PII is a numeric index which is calculated based on participants' completion/exposure to the goal-setting curriculum supplement and the completion of study instruments compared with the expected participation rate of each component.[139] Taking student absences and mobility into account, performance standards were established for study components and instruments (see Table 3-5).

Table 3-5: Study Components and Performance Standards for PII		
Study Component	Unit of Analysis	Performance Standard
Informed Consent	Students	85%
Survey 1 (YRBS)	Students	90%
Survey 2 (SPAQ)	Students	90%
Survey 3 (3DPAR)	Students	90%
Lesson 1	Teachers	100%
Lesson 2	Teachers	100%
Lesson 3	Teachers	100%
Lesson 4	Teachers	100%
Lesson 5	Teachers	100%

Based on previous projects implemented by the investigator, the completion of the informed consent was set at 85% to address another reality of school-based projects in which student participants forget to return signed informed consent documents. In such cases, these students participated in the study as the goal-setting curriculum supplement and study instruments were used as part of the district's regular curriculum. However, student responses to the study instruments were discarded by the investigator and excluded from the analysis.

Structured observations of PE classes were conducted using the System for Observing Fitness Instruction Time, known as SOFIT.[140] SOFIT is an objective tool used to measure the quality of instruction in PE classrooms. The SOFIT instrument offers a comprehensive system that identifies an index of student activity, lesson context, and teacher behavior during classroom sessions. SOFIT utilizes direct observation by trained observers (of which the investigator is one) and has been used to measure PE classes in more than 1,000 schools in the United States. CATCH (Coordinated Approach to Child Health),[141] M-SPAN (Middle School Physical Activity and Nutrition),[112,113] and TAAG (Trial of Activity for Adolescent Girls)[37,102] are among the noted school-based intervention programs focused on physical activity that have used SOFIT. Each of these interventions studies were supported by the National Institutes of Health. SOFIT has also been used to measure physical education experiences in more than

1,000 children in a National Institute of Child Health and Human Development (NICHD) longitudinal study.[140]

The SOFIT instrument has been shown to possess acceptable reliability and validity through numerous validation studies.[140] SOFIT student activity codes have been validated by a number of physical activity scales, such as heart rate monitors, and Caltrac and Tritrac accelerometers. Reliabilities based upon observations of trained independent observers have exceeded 90% agreement on all SOFIT categories. Intra-class correlations in middle schools were 0.97, 0.99 and 0.97 for estimates of energy expenditure rates, total energy expenditure and total proportion of time students spent in moderate-to-vigorous physical activity (MVPA). Two measures, momentary time sampling and duration recording methods, have been shown to have a 97.4% correspondence for MVPA lessons. SOFIT has also been shown to be valid in both laboratory and field studies. Validity in laboratory studies, including heart rate monitoring, clearly distinguish SOFIT physical activity categories in children in first through eighth grade ($r = 0.80$ to $r = 0.91$; P value < 0.01). Validity in SOFIT field studies was correlated significantly with average heart rate ($r = 0.61$) and Tritrac monitoring ($r = 0.61$) in 56 3rd-5th grade PE classes. Combined recess plus physical education heart rate data and SOFIT data demonstrated significant relationships with correlations ranging from $r = 0.71$ to $r = 0.89$ for eight participants with mental retardation.[140]

The investigator used the SOFIT tool to observe and measure student activity levels in PE classes. While the study was not expected to change student activity levels during PE class, the investigator documented how much time students spent in MVPA in PE class. The current recommendation by the Institute of Medicine is for students to spend at least 50% of PE class time in MVPA.[79,142]

Using the SOFIT coding form, the investigator identified one code describing student behavior of the observed PE class in 10-second intervals using the SOFIT pre-recorded audiotape. Codes 1 to 4 (lying down, sitting, standing, walking) describe the body position of the student and code 5 (very active) indicates when the student is expending more energy than he/she would during ordinary walking.[143] A pre-recorded audiotape provides the observer with one of two prompts every 10 seconds. The first prompt is to observe activity for 10 seconds and the second prompt is to record the observation during the following 10 seconds—this is then repeated for the duration of the class period.

Two PE lessons at each intervention school were observed by the investigator and measured using SOFIT during the intervention period. A total SOFIT score for each observed PE class session was tabulated for each coding category as described above (codes 1 to 5). The main outcome variable was the proportion of activities that were coded as "4" (walking) or "5" (very active) for each class, which served as the percentage of time spent in MVPA for each class.

Teacher lesson plans (which are prepared and submitted by the teacher to his/her principal to document the focus of instruction in class each day) had been planned for review by the investigator; however, the district did not allow access to these lessons. Instead, the investigator reviewed the lesson-related materials, including the student goal cards and other student handouts, that were returned by the teachers to estimate the extent the goal-setting curriculum supplements was implemented in health and PE classes as intended documenting intervention fidelity.

Students in the current study were also asked to describe one or more events that they had experienced in health or PE class during the marking period that led them to like or dislike the same said class, as well as describe their perfect health or PE class. Students completed the **Student Experiences Questionnaire** after the intervention delivery only (follow-up).

Data Collection Procedures

Data were collected at various times before and after the intervention. Survey 1 comprised the physical activity items and safety practices items (one of the nonequivalent dependent variables) from the CDC's Middle School Youth Risk Behavioral Survey (YRBS). Survey 1 was administrated once before the intervention and two times after the intervention was completed (approximately 1 week apart). To reduce the burden on the student and teacher and minimize intervention costs, only Survey 1 was implemented at multiple time points. Survey 2 (SPAQ) collected data on the select physical activity determinants (mediators), the independent variables of interest, and the second nonequivalent dependent variable (student perception of available environmental and recreational facilities for being active). Survey 3 (3DPAR) collected data on the primary outcome variable, self-reported moderate-to-vigorous physical activity (MVPA) levels. Survey 2 and Survey 3 were both administered immediately before and after the intervention (within one week of the start and completion of the intervention). See Table 3-6 for the full Data Collection Plan and Schedule.

Table 3-6: Data Collection Plan and Schedule

Research Group and Variable Category	Collection Method	T1 (Pre)	T2 (Post)	T3 (Follow-up)
3-Day Physical Activity Recall (3DPAR)	Survey 3	X	X	
Middle School Youth Risk Behavior Survey (YRBS)	Survey 1	X	X	X
Self-Efficacy	Survey 2	X	X	
Social Support (Family Support and Friend Support)	Survey 2	X	X	
Outcome Expectations	Survey 2	X	X	
PE Enjoyment	Survey 2	X	X	
Sports and Activity History	Survey 2	X	X	
Amount of Time Spent at Home Alone	Survey 2	X	X	
Student Experiences of Health/PE Class	Survey 4		X	
Safety Practices	Survey 1	X	X	X
Student Perception of Available Environmental and Recreational facilities For activities	Survey 2	X	X	
Structured Observations of PE Class	Observations		X	
Goal-Setting Lesson-Related Materials	Lesson-Related Materials		X	

Protection of Human Subjects

Students enrolled in the District's middle school health or PE classes identified by the school (6th-8th grades) were active participants in the study since it was a formal part of the health and PE curricula implemented by the school district. Prior to the start of the study, informed consent letters were delivered to all parents/guardians through their child requesting that they participate in the study and to allow data already being collected (BMI and health-related fitness) by the school to be released to the investigator and to participate in the study surveys. Parents/guardians provided written consent and the child provided written assent. Efforts to retrieve consent and assent forms continued throughout the goal-setting implementation period. In particular, the investigator worked with the two schools with the lowest return rates of the consent and assent forms to conduct a second distribution of the forms to parents/guardians with a third distribution for the school with the lowest return rate. Those not consenting to the study received the intervention and participated in the data collection but their data were not included in analyses. This study was approved by the Rutgers University institutional review board.

Sample Size Calculations

Sample size estimates in other physical activity, school-based interventions have found that a sample of 300 students in each group would be sufficient to detect differences of power (1-Beta) at no less than 0.80, with an alpha level of 0.05.[144] The sample size and power estimates for this study represent the number of subjects need to detect differences on the primary outcome variable, physical activity levels as measured by the 3DPAR with a power = 0.80. With no preliminary or pilot study data for the current study, data from a similar school-based study[145] that compared the test-retest reliability, convergent validity, and overall feasibility/usability of the 3DPAR were applied to estimate sample size. The McMurray et al.[145]

study of adolescent girls and boys provided the best available data for the sample size estimation. The sample size estimates for this study are based on means with a correlation of r = 0.676 and variance of $\sigma^2 = 8.41$.[145] Using conservative estimates, the minimum detectable change was estimated to be 10% for Experiment A (Lessons Only), 15% for Experiment B (Goals Only) and 20% for Experiment C (Lessons and Goals). As a result of using the data from the similar study, the minimum detectable changes, and 80% power, sample sizes for the three experimental groups are 298 for Experiment A, 133 for Experiment B and 75 for Experiment C. The sample size recruited for the four experimental and control groups of this study will comprise approximately 300 students per group, for a total of 1,200 students.

Data Analysis

Students were used as the primary unit of analysis but were nested within schools, which was the unit of randomization. Comparisons were made between intervention and control students using a number of different statistical tests. Comparison of baseline descriptive data between the intervention and control schools were assessed using Chi-square test (χ^2), Fisher's exact test, and analysis of variance (ANOVA). Initial analysis on intervention effect was conducted using ANOVA with mean gain scores from baseline (primary outcome variables and study mediators). Linear modeling was used to analyze changes in physical determinants, as well as the nonequivalent dependent variables. Linear modeling allows for analysis of the classic two-level school effects study where data is collected on individuals (students) who are nested within schools (the unit of randomization). This approach is used more often in school-based interventions as it takes the cluster randomization into account. Cluster or nested designs are inherently present in school-based settings. The analyses for each of the three research questions (RQ) are outlined below.

RQ-1 Are teachers able to successfully integrate the goal-setting lessons into the school district's health and physical education curriculum?

H-1 – Teachers who implement the goal-setting lessons will demonstrate integration and application of the lessons in their overall lesson plans.

The goal-setting lesson-related materials from the health and PE classes, as well as data from the System for Observing Fitness Instruction Time (SOFIT), served as the primary data for analysis for Research Question 1. Trends across the lesson plans and from SOFIT for each class comprised the major analyses. Results provided insight into the extent that the teachers integrated the goal-setting lessons.

A total SOFIT score for each PE class session observed was tabulated for each coding category as described previously. The main outcome variable was the proportion of activities that were coded as "4" (walking) or "5" (very active) for each class, which served as the percentage of time spent in MVPA for each class, and the unit of analysis was PE class observed. Descriptive statistics were performed on these data.

RQ-2 Does integrating the goal-setting lessons into school health and physical education curriculum result in increased physical activity among middle school students?

H-2 – Goal-setting lessons integrated into health and physical education classes will produce significant gains in levels of physical activity, as measured by the 3-Day Physical Activity Recall, among students receiving the lessons when compared to students receiving partial or none of the lessons.

First, the effectiveness of the three intervention groups against the control group was assessed utilizing mean gain score (absolute change score) from pre-test (baseline) to post-test (follow-up) based on the 3DPAR for each student using ANOVA and then a linear model to account for the clustering effect of students nested within schools. These initial tests were a test of the overall effect of the intervention groups compared with the control group. Then utilizing a linear model with students as the unit of analysis, comparisons between the intervention groups and the control group were performed using the baseline MVPA and independent variables as covariates. Based on the literature, independent variables of interest

included demographic variables: gender, age, grade level, race/ethnicity and socio-economic status (free/reduced lunch program participation), as well as sports and activity history and amount of time spent at home alone. If any test was statistically significant, then pairwise comparisons between each intervention group and the control group, as well as between intervention groups, was performed utilizing a linear model with students as the unit of analysis. This would determine which (if any) of the interventions was more effective than the control and which intervention was most effective. Type-I error was set at $\alpha = 0.0167$ level of significance, using Bonferroni's correction (0.05/3 groups), to account for the three treatment groups involved in the study.

RQ-3 Will targeting goal-setting, a physical activity determinant, produce greater positive effects for those students?

H-3 – Students who are exposed to part of the goal-setting lessons will show significant gains in measures of select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.
H-4 – Students who are exposed to the full goal-setting lessons will show significant gains in measures of the select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.
H-5 – Students of teachers who have higher levels of fidelity of the goal-setting lessons will show significant gains in measures of the select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.

Similar to the analysis plan described above for Research Question 2, a linear model with students as the unit of analysis, was utilized to make comparisons between the intervention groups and the control group to examine participant characteristics associated with the select physical activity determinants. These determinants were examined to determine whether treatment effects differed among student subgroups.

Nonequivalent Dependent Variables. The differences between the three intervention groups and the control group was assessed utilizing mean gain score (absolute change score) from pre-test (baseline) to post-test (follow-up) based on the two nonequivalent dependent variables for each student. ANOVA was conducted first and then a linear model to account for

the clustering effect of students nested within schools. These initial tests were a test of the overall difference of the intervention groups compared with the control group. Type-I error was set at α = 0.0167 level of significance, using Bonferroni's correction (0.05/3 groups), to account for the three treatment groups involved in the study. If any test was statistically significant, then pairwise comparisons between each intervention group and the control group, as well as between intervention groups, was performed utilizing a linear model with students as the unit of analysis.

Statistical Analyses. All analyses were conducted using SAS software, version 9.4 of the SAS System for Windows, ©2002-2012 by SAS Institute Inc. (Cary, NC, USA). For descriptive analyses, SAS PROC FREQ and PROC MEANS were used to calculate frequencies and means for demographic variables as well as the primary physical activity outcome variable, the study's physical activity determinants, and the nonequivalent dependent variables to characterize the participants in the study at baseline. For intervention effects, SAS PROC ANOVA and PROC MIXED PROC were used. Intervention effects employed linear model regression methods to reflect the group randomization and the nesting of students within schools and intervention level.

CHAPTER FOUR:

RESULTS

The purpose of this study was to determine whether a theory-based physical activity curriculum addition to a school district's existing physical activity curriculum (in health and PE classes) targeting goal-setting, or the Social Cognitive Theory construct of self-regulation, increased students' physical activity levels. The study explored whether the theory-based curriculum addition was more effective when implemented with or without corresponding lessons. Focusing on goal-setting, this study sought to provide a better understanding of whether this strategy could be used to increase physical activity levels among adolescents and explore whether focusing on a single construct could successfully be targeted to increase physical activity levels. Process and outcome evaluation methods were used to examine the study's research questions. The primary physical activity outcome variable was the mean gain score in self-reported moderate-to-vigorous physical activity (MVPA) levels between intervention schools and the control school (physical activity behaviors) from baseline (pre-test) to follow-up (post-test). The primary physical activity outcome variable was measured using the **3-Day Physical Activity Recall (3DPAR)** that was previously used by Motl et al.[125] with middle school students. Physical activity determinants that have been positively associated with physical activity were also examined to determine whether goal-setting had an effect on them. The select determinants included goal orientation, social support (family influences and friend support), self-efficacy, outcome expectations, and PE enjoyment; and each was measured using previously validated instruments.

This chapter describes the study recruitment and characteristics of the study population, as well as presents descriptive statistics involving physical activity levels and determinants in the study population at pre-test. This is followed by the results of the analyses of the three study

research questions and hypotheses. The study research questions provide information regarding the implementation of the intervention, the impact of the intervention on physical activity levels, and physical activity determinants, respectively.

Recruited Study Population

School district administrators approved the use of the goal-setting curriculum supplement and study instruments as part of the district's regular health/PE curriculum during the fourth quarter of the 2013-2014 school year. The district's Health/PE Supervisor notified each middle school principal and health/PE teacher acknowledging the district's participation in the study and requested his/her participation and cooperation. The investigator sought to include all students in each grade enrolled in health and PE classes in the five district middle schools. The five middle schools comprise grades six through eight and enroll approximately 200 students per grade per school with a total middle school population of approximately 3,000 students. All students in the participating health and PE classes completed the goal-setting curriculum supplement and the survey instruments. However, only data for students with informed consent and assent were analyzed. Three schools had a greater than 60% consent/assent return rate while two schools had between 30-40% consent/assent return rate, which greatly reduced the number of available subjects and response data for analysis (see Table 4-1). Of those students who returned consent/assent forms, approximately 20% did not provide parental consent or minor assent; requesting their data to be excluded from the study.

Table 4-1: Study Possible Enrollment and Actual Enrollment

Study School	Class Type	Study Grades	Possible Enrollment	Actual Enrollment
Lessons and Goals (Full Intervention)	Health & PE	6,7,8	542	197 (36.3%)
Goals Only	PE	7,8	336	284 (84.5%)
Lessons Only	PE	6,8	421	140 (33.3%)
Control	Health & PE	6, 7, 8	599	334 (55.8%)

Study Population

Demographic information, including gender, grade, race/ethnicity, and socio-economic status (as measured by federal free/reduced lunch eligibility) for the study population and the overall middle school population for the district is provided in Table 4-2.

Table 4-2: Study Population and the Overall Middle School Population

Demographic Information	Study Population (n=945)	Overall Middle School Population (n=3,071)
Gender		
Female	53.2%	48.3%
Male	46.8%	51.7%
Grade		
6th	30.6%	32.0%
7th	32.0%	34.5%
8th	37.4%	33.6%
Race/Ethnicity		
White	40.9%	38.1%
African-American	8.4%	13.3%
Asian and Other	27.6%	24.1%
Hispanic	20.1%	24.6%
Don't Know	3.0%	
Socio-economic Status		
Free/Reduced Lunch	30.5%	40.7%

Demographic information for each of the four groups involved in the study is provided in Table 4-3. Sports and activity history and amount of time spent at home alone for each group is also provided. As previously stated, students self-reported their own gender, age, race/ethnicity, and socio-economic status so differences may exist between what the student self-reported and what the district's official records show for students. (The investigator was unable to access this district's official student records to confirm demographic information.) At baseline, students in the four groups involved in the study were similar in gender and amount of time spent home alone. There were differences between the groups for age, grade, race/ethnicity, socio-economic status, and sports and activity history at baseline. The Lessons and Goals group had slightly younger students by age and grade. The Control group had more White students while the Goals Only group had more Asian (and other) students and the Lessons and Goals group had

more Hispanic students. Both the Lessons Only and Lessons and Goals groups had more students who were eligible for free or reduced status, suggesting a lower socio-economic status. More students in the Control group had participated in school or community programs that were physical active (sports and activity history).

Table 4-3: Study Demographics

Demographic Information	Control (n=329)	Lessons Only (n=137)	Goals Only (n=284)	Lessons and Goals (n=195)	Differences Between Groups
Gender					$\chi^2 = 1.73$
Female	55.6%	53.3%	52.8%	49.7%	(3, N = 945)
Male	44.4%	46.7%	47.2%	50.3%	*P* value = 0.63
Age (Mean)	13.3	13.4	13.9	12.9	$F_3 = 53.25$ *P* value = <.0001
Grade					
6th	34.4%	47.5%	---	56.9%	Fisher's
7th	39.8%	---	48.9%	16.9%	(6, N = 945)
8th	25.8%	52.5%	51.1%	26.2%	P value = <.0001
Race/Ethnicity					
White	62.0%	34.3%	27.5%	29.2%	$\chi^2 = 210.41$
African-American	4.6%	7.3%	9.5%	13.8%	(12, N = 945)
Asian and Other	20.6%	21.9%	47.9%	13.8%	P value = <.0001
Hispanic	10.6%	29.2%	13.0%	40.5%	
Don't Know	2.1%	7.3%	2.1%	2.6%	
Socio-economic Status					$\chi^2 = 54.01$
Free/Reduced Lunch	17.0%	40.1%	31.3%	45.1%	(3, N = 945) *P* value = <.0001
Sports and Activity History					$\chi^2 = 18.64$
Yes	80.7%	69.3%	75.4%	64.2%	(3, N = 923)
No	19.3%	30.7%	24.6%	35.8%	*P* value = 0.0003
Time Spent Home Alone During the Week					
No time alone	45.9%	51.2%	41.1%	39.4%	$\chi^2 = 9.20$
1–2 hours a day and 1–2 days per week	6.4%	6.2%	3.9%	4.9%	(6, N = 908) *P* value = 0.16
>2 hours a day, and >2 days a week	47.8%	42.6%	55.0%	55.7%	

Attrition of Subjects During the Study

There was attrition of subjects at the follow-up data collection periods (post-test 1 and post-test 2). Approximately 7.6% of students who had completed the pre-test for Survey 1 (YRBS) did not complete any post-test for Survey 1; 25.5% of students who had completed the pre-test for Survey 2 (SPAQ) did not complete the post-test for Survey 2; and 33.2% of students who had

completed the pre-test for Survey 3 (3DPAR) did not complete the post-test for Survey 3. The amount of effort to complete the surveys likely affected the differences in attrition rates among the surveys. Survey 1 was the shortest and easiest to complete of the three surveys while Survey 3 took more effort to complete and was the longest. The four groups involved in the study had up to a 78.7% attrition rate (Lessons and Goals intervention group) over the course of this study. These he high subject attrition rate resulted in lower sample sizes in two of the four study groups: Goals Only, and Lessons and Goals). Students who did not complete the post-test measures were primarily either absent when the post-test surveys were administered in their health/PE class, or they were in one of the seven classes where the post-test measures were not administered due to time constraints at the end of the school year.

An analysis of this attrition showed that those subjects who completed pre-tests but not post-tests did not differ from those subjects who remained in the study (completed both the pre-tests and post-tests) on the primary outcome variable, mean difference in self-reported moderate-to-vigorous physical activity (MVPA) levels. Additionally, there were no differences found for age, gender, race/ethnicity or lunch status for Survey 1 (YRBS) or Survey 3 (3DPAR) between those who dropped out and those who were retained. There was a difference found for age and gender for Survey 2 (SPAQ). Table 4-4 provides the comparison of those subjects who completed pre-tests only and those subjects who completed both the pre-tests and post-tests.

Table 4-4: Comparison of Those Who Completed Pre-Tests Only and Those Who Completed Pre-Tests and Post-Tests				
	Demographic Information	Pre-Test Only	Pre-Test and Post-Test	Differences Between Groups
Survey 1 (YRBS)	Gender			$\chi^2 = 0.81$
	Female	48.0%	53.4%	(1, N = 917)
	Male	52.0%	46.6%	*P* value = 0.37
	Age (Mean)	13.4	13.4	F1 = 0.05
				P value = 0.82
	Grade			
	6th	37.0%	30.1%	χ^2 =6.79
	7th	19.2%	34.1%	(2, N = 917)
	8th	43.8%	35.8%	*P* value = 0.03
Survey 1 (YRBS)	Race/Ethnicity			
	White	37.0%	41.2%	Fisher's
	African-American	9.6%	8.2%	(4, N = 917)
	Asian and Other	24.7%	28.2%	*P* value = 0.52
	Hispanic	27.4%	19.4%	
	Don't Know	1.4%	3.0%	
	Socio-economic Status			$\chi^2 = 2.43$
	Free/Reduced Lunch	38.4%	29.6%	(1, N = 917)
				P value = 0.12
	Sports and Activity History			$\chi^2 = 0.07$
	Yes	75.7%	74.3%	(1, N = 895)
	No	24.3%	25.7%	*P* value = 0.80
	Time Spent Home Alone During the Week			
	No time alone	43.5%	43.4%	$\chi^2 = 1.61$
	1–2 hours a day and 1–2 days per week	8.7%	5.2%	(2, N = 881)
	>2 hours a day, and >2 days a week	47.8%	51.5%	*P* value = 0.45
Survey 2 (SPAQ)	Gender			$\chi^2 = 6.20$
	Female	60.7%	50.7%	(1, N = 920)
	Male	39.9%	49.3%	*P* value = 0.01
	Age (Mean)	13.3	13.5	$F_1 = 7.12$
				P value = 0.0078
	Grade			
	6th	29.8%	31.5%	$\chi^2 = 14.16$
	7th	24.8%	35.6%	(2, N = 920)
	8th	45.4%	32.8%	*P* value = 0.0008
	Race/Ethnicity			
	White	37.8%	42.2%	χ^2= 11.11
	African-American	8.8%	8.4%	(4, N = 920)
	Asian and Other	23.5%	28.9%	*P* value = 0.03
	Hispanic	27.3%	17.6%	
	Don't Know	2.5%	2.9%	
	Socio-economic Status			$\chi^2 = 3.42$
	Free/Reduced Lunch	35.3%	28.9%	(1, N = 920)
				P value = 0.06
	Sports and Activity History			$\chi^2 = 0.02$
	Yes	74.0%	74.5%	(1, N = 898)
	No	26.0%	25.5%	*P* value = 0.89

Table 4-4: Comparison of Those Who Completed Pre-Tests Only and Those Who Completed Pre-Tests and Post-Tests				
	Demographic Information	Pre-Test Only	Pre-Test and Post-Test	Differences Between Groups
	Time Spent Home Alone During the Week			
	No time alone	46.5%	42.4%	$\chi^2 = 1.37$
	1–2 hours a day and 1–2 days per week	5.7%	5.4%	(2, N = 884)
	>2 hours a day, and >2 days a week	47.8%	52.2%	*P* value = 0.50
Survey 3 (3DPAR)	Gender			$\chi^2 = 2.71$
	Female	56.8%	50.8%	(1, N = 851)
	Male	43.2%	49.2%	*P* value = 0.10
	Age (Mean)	13.5	13.4	$F_1 = 0.33$
				P value = 0.57
Survey 3 (3DPAR)	Grade			
	6th	31.4%	25.7%	χ^2 =11.19
	7th	26.8%	38.4%	(2, N = 851)
	8th	41.8%	35.9%	*P* value = 0.0037
	Race/Ethnicity			
	White	38.2%	42.0%	$\chi^2 = 9.12$
	African-American	10.4%	8.2%	(4, N = 851)
	Asian and Other	24.6%	30.1%	*P* value = 0.06
	Hispanic	24.3%	16.8%	
	Don't Know	2.5%	2.8%	
	Socio-economic Status			$\chi^2 = 1.66$
	Free/Reduced Lunch	32.9%	28.6%	(1, N = 851)
				P value = 0.20
	Sports and Activity History			$\chi^2 = 0.77$
	Yes	72.9%	75.7%	(1, N = 833)
	No	27.1%	24.3%	*P* value = 0.38
	Time Spent Home Alone During the Week			
	No time alone	46.3%	41.9%	$\chi^2 = 1.44$
	1–2 hours a day and 1–2 days per week	4.8%	5.2%	(2, N = 820)
	>2 hours a day, and >2 days a week	48.9%	52.9%	*P* value = 0.49
	MVPA Levels (Mean)	4.48	4.48	F_1 =0.01
				P value = 0.97

Research Question 1 Results and Process Evaluation

RQ-1 Are teachers able to successfully integrate the goal-setting lessons into the school district's health and physical education curriculum?

H-1 – Teachers who implement the goal-setting lessons will demonstrate integration and application of the lessons in their overall lesson plans.

The goal-setting lesson-related materials from the health and PE classes, as well as data from the System for Observing Fitness Instruction Time (SOFIT) served as the primary data for analysis for Research Question 1. The goal-setting curriculum supplement consisted of five lessons and goal-setting activities. Students learned (1) the differences between physical

activities that are light, moderate and vigorous in intensity; (2) how to enlist support and encourage others to be physically active; (3) how to use behavior substitutions to decrease sedentary behaviors and increase physical activity; (4) how to use assertive communication skills to appropriately reduce barriers to physical activity; and (5) how to use the FITT principles to help determine if their physical activity is adequate. The dose delivered was evaluated through reviewing the lesson-related materials submitted by the teachers and was evaluated to determine whether the teachers delivered the goal-setting lessons adequately. The lesson-related materials, including the goal-setting cards and student handouts, were reviewed to ensure that materials comprised the handouts from each of the five lessons and that each of the five goal-setting cards were completed. Based on this review of the lesson-related materials, each of the teachers participating in the delivery of the intervention at their school delivered all of lesson components as requested.

Using the System for Observing Fitness Instruction Time, known as SOFIT,[140] the investigator observed two PE classes per school for a total of 10 classes to determine whether the Institute of Medicine's current recommendation of having students spend at least 50% of PE class time in moderate-to-vigorous physical activity (MVPA) is met at the study school district.[79,142] A total SOFIT score for each PE class observed was tabulated for each coding category as described previously. The main outcome variable was the proportion of activities that were coded as "4" (walking) or "5" (very active) for each class, which served as the percentage of time spent in MVPA for each class, and the unit of analysis was PE class observed. PE students at the five study middle schools spent between 37% and 73% of PE class time in MVPA with an overall average of 53%. Five of the 10 PE classes observed had students spend greater than 50% of PE class time in MVPA, meeting the Institute of Medicine's recommendation. Two of the five schools had an average of greater than 50% of PE class time in MVPA for the two PE classes

observed for its school. For one school, the two PE classes observed had students spend less than 50% of PE class time in MVPA. Table 4-5 provides the SOFIT data for each PE class observed.

Table 4-5: Proportion of PE Class Spent in MVPA for Each PE Class Observed

Study School	% of Class Time Spent in MVPA	School Average
Control School		
Class 1	66.25%	
Class 2	73.27%	70.17%
Lessons Only School		
Class 1	48.28%	
Class 2	72.89%	60.29%
Goals Only School		
Class 1	46.15%	
Class 2	55.17%	49.66%
Lessons and Goals School 1		
Class 1	37.20%	
Class 2	45.31%	41.57%
Lessons and Goals School 2		
Class 1	39.44%	
Class 2	51.70%	45.51%
Overall Average	53.57%	53.44%

The process evaluation model described by Windsor et al[138] was used to determine the Program Implementation Index (PII), a numeric value that provides an implementation index for the completion of each intervention component. This model documented the delivery and teacher implementation of and student participation in the informed consent/assent process for the physical activity intervention as well as participant completion of the pre-test and post-test study instruments at the middle schools. PII is a numeric index which was calculated based on participants' completion of study components compared with the expected participation of each.[139]

Performance standards were established for study components. Based on previous projects implemented by the investigator, the performance standard for the completion of the informed consent was set at 85% (taking students forgetting to return signed informed consent documents into account) and the performance standard for the completion of study

instruments was set at 90% (taking student absences and mobility into account). The performance standard for delivery of the five lessons by the study teachers was set at 100%. PII was calculated for each of the study components and for the overall study. Table 4-6 provides the PII for the study components.

Table 4-6: PII for Study Components

Study Component	Unit of Analysis	A - Eligible Clients	B - Clients Exposed	C - Exposure Rate (B/A)	D- Acceptable Standard	Component Implementation Index (C/D)
Informed Consent	Students	1,898	1164	61.3%	85%	72.2
Survey 1	Students	945	850	89.9%	90%	99.9
Survey 2	Students	920	685	75.5%	90%	82.7
Survey 3	Students	852	504	59.2%	90%	65.7
Lesson 1	Teachers	17	17	100%	100%	100
Lesson 2	Teachers	17	17	100%	100%	100
Lesson 3	Teachers	17	17	100%	100%	100
Lesson 4	Teachers	17	17	100%	100%	100
Lesson 5	Teachers	17	17	100%	100%	100
					OVERALL PII	91.2

The study PII for the completion of informed consents ranged from approximately 37.9% to 99.4% with overall rate of 61.3%. During the implementation of the study, the investigator coordinated a second distribution of informed consents to students in the two intervention groups with the lowest return rates (Lessons Only group and Lessons and Goals groups); a third distribution was also completed for one of the schools in the Lessons and Goals intervention group at the beginning of the subsequent school year.

The study PII for the completion of study instruments was higher for pre-tests than post-tests. The PII for the pre-tests of the three survey instruments given before and after the intervention averaged 94.8% compared to the PII for the post-tests which averaged 77.9%. In most cases, the lower grade levels within a study group had a higher completion rate for the study instruments. Additionally, Survey 1, the shortest of the three survey instruments, had a higher PII and Survey 3, which took the most time to complete, had the lowest PII. The Goals Only intervention group which had the highest PII for informed consents also had the highest

PIIs for the majority of the study instruments. The overall study PII for the delivery and implementation of the study was 91.2.

The hypothesis for Research Question 1 was "Teachers who implement the goal-setting lessons will demonstrate integration and application of the lessons in their overall lesson plans." Based on the data available, this investigator concludes teachers did demonstrate integration and application of the goal-setting curriculum supplement (not taking the survey administration into consideration)

Research Question 2 Results

RQ-2 Does integrating the goal-setting lessons into school health and physical education curriculum result in increased physical activity among middle school students?

H-2 – Goal-setting lessons integrated into health and physical education classes will produce significant gains in levels of physical activity, as measured by the 3-Day Physical Activity Recall, among students receiving the lessons when compared to students receiving partial or none of the lessons.

Descriptive statistics (minimum, maximum, means, standard deviations) at baseline (pre-test) for the primary physical activity outcome variable, self-reported moderate-to-vigorous physical activity (MVPA), as measured by the 3-Day Physical Activity Recall (3DPAR), are provided in Table 4-7. Students in the four groups involved in the study were similar in their reported MVPA levels at baseline ($F_3 = 1.04$, *P* value = 0.37).

Table 4-7: Mean (SD) Levels of Physical Activity at Baseline as Measured by 3DPAR (Average Number of 30-minute Blocks Greater than 3.0 METS)

Study School	Minimum	Maximum	Mean	Standard Deviation
Control (n=286)	0	13.67	4.26	2.98
Lessons Only (n=131)	0	13.67	4.55	3.25
Goals Only (n=280)	0	14.33	4.51	2.95
Lessons and Goals (n=155) (Full Intervention)	0	15.0	4.80	3.60

Analysis of Variance (ANOVA) was first conducted to determine the differences between groups for the primary outcome variable of self-reported MVPA levels using mean gain scores

from baseline (see Table 4-8). As shown in Table 4-8, there was no statistical significance observed in mean gain scores of MVPA levels between groups ($F_3 = 0.71$, *P* value = 0.55).

Table 4-8: Mean Gain Scores (SD) in Physical Activity at Follow-Up as Measured by 3DPAR (Average Number of 30-minute Blocks Greater than 3.0 METS)

Study School	Minimum	Maximum	Mean	Standard Deviation
Control (n=205)	-9.33	8.00	-0.20	2.93
Lessons Only (n=37)	-6.00	6.33	0.56	2.48
Goals Only (n=229)	-10.00	12.67	0.06	2.96
Lessons and Goals (n=100) (Full Intervention)	-11.67	14.33	0.01	3.80

The individual level physical activity measure of self-reported MVPA levels as measured by the 3DPAR was analyzed using linear modeling with the mean gain score of MVPA as the dependent variable and the baseline MVPA value and the independent variables (gender, age, grade, race/ethnicity, socio-economic status, sports and activity history, and amount of time spent at home alone) as covariates (see Table 4-9). Comparison between health and PE classes is also provided in Table 4-9.

The intervention did not produce a statistical significant difference in MVPA (using mean gain score of MVPA) between the four groups involved in the study. Baseline MVPA and sports and activity history are the only two independent variables that appeared to have an effect on the study groups' mean gains score of MVPA.

Table 4-9: Linear Model Statistics with Mean Gain Score of MVPA for Study Groups and Baseline MVPA and Independent Variables					
Effect	Estimate	Standard Error	DF	t Value	*P* value
Study Group					
Lessons and Goals (Full Intervention)	0.3415	0.4030	541	0.85	0.3972
Goals Only	0.3433	0.3348	541	1.03	0.3057
Lessons Only	0.5560	0.5269	541	1.06	0.2917
Control	0				
Baseline MVPA	-0.4823	0.03997	541	-12.07	<.0001
Class					
PE Class	0.2506	0.4176	541	0.60	0.5486
Health Class	0				
Age	-0.3610	0.2324	541	-1.55	0.1209
Grade					
6th	-0.5125	0.5966	541	-0.86	0.3907
7th	-0.3712	0.3864	541	-0.96	0.3372
8th	0				
Gender					
Male	0.06918	0.2356	541	0.29	0.7692
Female					
Race/Ethnicity					
African-American	-0.09214	0.4656	541	-0.20	0.8432
Asian and Other	0.3731	0.2933	541	1.27	0.2039
Hispanic	0.5638	0.3729	541	1.51	0.1312
Don't Know	1.5338	0.8570	541	1.79	0.0740
White	0				
Socio-economic Status					
Free/Reduced Lunch	-0.1405	0.2751	541	-0.51	0.6096
Not Free/Reduced Lunch	0				
Sports and Activity History					
Yes	0.9089	0.2838	541	3.20	0.0014
No	0				
Time Spent Home Alone During the Week					
1–2 hours a day and 1–2 days a week	0.1005	0.5227	541	0.19	0.8476
>2 hours a day, and >2 days a week	0.4018	0.2484	541	1.62	0.1064
No time alone	0				

To compare the study population's physical activity levels with national and state data, the physical activity items from the CDC's **Middle School Youth Risk Behavior Survey** (YRBS) were used. Study data as well as national and state data for high school students from the 2013 YRBS are shown in Tables 4-10 and 4-11 as a comparison; only current national and state data are available for high school students. In the study, an average of 2.18% of students reported they had not participated in at least 60 minutes of any kind of physical activity on at least one (1) day

during the seven (7) days prior to the survey (i.e., did not participate in at least 60 minutes of physical activity on at least one day) as compared to 15.2% of students nationwide.[9] In addition, approximately 67.4% of students in the study reported being physically active for at least 60 minutes per day on five (5) or more days during the seven (7) days prior to the survey. Nationwide, 47.3% of students have reported physical activity levels of at least 60 minutes per day on five or more days.[9] Based on the two above parameters, students participating in this study reported being more active than their high school counterparts in New Jersey and across the nation, which is not unexpected as physical activity levels decline through adolescence.

Table 4-10: Percentage of students who did not participate in at least 60 minutes of physical activity on at least 1 day* and who were physically active at least 60 minutes/day on 5 or more days* at Baseline for the Study Population and Comparison to National and State Level Data

	Did not participate in at least 60 minutes of physical activity on at least 1 day		Physically active at least 60 minutes/day on 5 or more days	
	%	CI	%	CI
Control	1.3	(0.35-3.23)	68.1	(62.75-73.09)
Lessons Only	3.8	(1.23-8.57)	68.6	(60.13-76.27)
Goals Only	1.4	(0.39-3.66)	66.2	(60.37-71.68)
Lessons and Goals (Full Intervention)	3.2	(1.18-6.82)	67.2	(60.11-73.72)
2013 High School National YRBS[9]	15.2	(13.9-16.6)	47.3	(45.3-49.2)
2013 High School New Jersey YRBS[9]	11.6	(9.7-13.8)	48.7	(44.8-52.6)

*Doing any kind of physical activity that increased their heart rate and made them breathe hard some of the time during the 7 days prior to the survey.

Table 4-11 provides a comparison of students in the study, in New Jersey and across the nation who met the recommended levels of physical activity (i.e., 60 minutes or more of physical activity daily). Only 27.1% adolescents in the United States and 27.6% of New Jersey adolescents are presently meeting the recommended levels.[9] In comparison, 25.3% of students in this study reported meeting the recommended levels of physical activity.

Table 4-11: Percentage of students who were physically active at least 60 minutes/day on all 7 days* at Baseline for the Study Population and Comparison to National and State Level Data		
	Physically active at least 60 minutes/day on all 7 days	
	%	CI
Control	22.8	(22.6-23.1)
Lessons Only	32.1	(31.98-32.5)
Goals Only	20.4	(20.3-20.78)
Lessons and Goals(Full Intervention)	31.8	(31.5-32.2)
2013 High School National YRBS[9]	27.6	(24.0-31.4)
2013 High School New Jersey YRBS[9]	27.1	(25.5-28.8)

* Doing any kind of physical activity that increased their heart rate and made them breathe hard some of the time during the 7 days prior to the survey.

The hypothesis for Research Question 2 was the "goal-setting lessons integrated into health and physical education classes will produce significant gains in levels of physical activity, as measured by the 3-Day Physical Activity Recall, among students receiving the lessons when compared to students receiving partial or none of the lessons." Based on the data available and the lack of a significant difference in line with the thee implementation levels of the goal-setting curriculum supplement received, leads the investigator to conclude that students who participated in the goal-setting curriculum supplement, regardless of implementation level, showed no difference in the levels of physical activity as measured by the 3DPAR.

Research Question 3 Results

RQ-3 Will targeting goal-setting, a physical activity determinant, produce greater positive effects for those students?

H-3 – Students who are exposed to part of the goal-setting lessons will show significant gains in measures of select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.
H-4 – Students who are exposed to the full goal-setting lessons will show significant gains in measures of the select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.
H-5 – Students of teachers who have higher levels of fidelity of the goal-setting lessons will show significant gains in measures of the select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.

Descriptive statistics (minimum, maximum, means, standard deviations) at baseline (pre-test) for the selected physical activity determinants for the intervention (goal orientation, self-efficacy, family support, friend support, outcome expectations, and PE enjoyment) are provided

in Table 4-12. At baseline, students in the four groups involved in the study were similar on three of the selected physical activity determinants: goal orientation, self-efficacy, and family support. There were differences between the groups for friend support, outcome expectations, and PE enjoyment at baseline. Students in the Lessons and Goals reported having more perceived friend support, perceived more benefits of being active (outcome expectations), and enjoyed PE class more.

Table 4-12: Mean (SD) Levels of Selected Physical Activity Determinants at Baseline

	Study School	Min.	Max.	Mean	Standard Deviation	Difference Between Groups
Goal Orientation (range=1-5)	Control (n=313)	1.00	5.00	3.46	1.36	$F_3 = 0.84$ *P* value = 0.48
	Lessons Only (n=137)	1.00	5.00	3.46	1.36	
	Goals Only (n=279)	1.00	5.00	3.58	1.21	
	Lessons and Goals (n=189) (Full Intervention)	1.00	5.00	3.61	1.29	
Self-Efficacy (range=1-40)	Control (n=315)	4.00	40.00	27.95	6.68	$F_3 = 2.08$ *P* value = 0.11
	Lessons Only (n=131)	3.00	40.00	27.41	7.16	
	Goals Only (n=280)	8.00	40.00	28.58	5.99	
	Lessons and Goals (n=190) (Full Intervention)	10.00	40.00	29.05	6.86	
Family Social Support (range=1-25)	Control (n=310)	4.00	25.00	18.17	4.74	$F_3 = 1.13$ *P* value = 0.33
	Lessons Only (n=129)	5.00	25.00	17.53	5.14	
	Goals Only (n=279)	5.00	25.00	17.59	4.61	
	Lessons and Goals (n=174) (Full Intervention)	6.00	25.00	18.18	5.10	
Friend Social Support (range=1-15)	Control (n=311)	3.00	15.00	9.42	3.26	$F_3 = 3.75$ *P* value = 0.0107
	Lessons Only (n=130)	3.00	15.00	9.76	3.30	
	Goals Only (n=279)	3.00	15.00	10.03	2.72	
	Lessons and Goals (n=185) (Full Intervention)	3.00	15.00	10.33	3.35	
Outcome Expectations (range=1-45)	Control (n=312)	9.00	45.00	36.35	6.86	$F_3 = 5.32$ *P* value = 0.0012
	Lessons Only (n=130)	24.00	45.00	37.98	5.41	
	Goals Only (n=275)	14.00	45.00	36.75	6.14	
	Lessons and Goals (n=187) (Full Intervention)	9.00	45.00	38.38	5.75	
PE Enjoyment (range=1-5)	Control (n=314)	1.00	5.00	4.14	1.07	$F_3 = 8.16$ *P* value = <.0001
	Lessons Only (n=128)	1.00	5.00	4.41	0.85	
	Goals Only (n=274)	1.00	5.00	4.12	1.04	
	Lessons and Goals (n=187) (Full Intervention)	1.00	5.00	4.51	0.89	

ANOVA was first conducted to determine the differences between groups for the selected physical activity determinants using students' mean gain scores from baseline (see Table 4-13).

There were no statistical significance differences observed in mean gain scores for each of the selected physical activity determinants between groups.

Table 4-13: Mean (SD) Gain Scores of Selected Physical Activity Determinants at Follow-Up

	Study School	Min.	Max.	Mean	Standard Deviation	Difference Between Groups
Goal Orientation	Control (n=249)	-4.00	4.00	0.07	1.39	$F_3 = 1.82$ *P* value = 0.14
	Lessons Only (n=56)	-3.00	2.00	-0.34	1.07	
	Goals Only (n=235)	-4.00	4.00	-0.06	1.31	
	Lessons and Goals (n=122) (Full Intervention)	-3.00	2.00	-0.34	1.07	
Self-Efficacy	Control (n=251)	-25.00	22.00	-0.14	5.85	$F_3 = 0.30$ *P* value = 0.83
	Lessons Only (n=57)	-16.00	12.00	0.05	4.84	
	Goals Only (n=236)	-15.00	17.00	-0.25	1.21	
	Lessons and Goals (n=124) (Full Intervention)	-22.00	25.00	-0.66	6.78	
Family Social Support	Control (n=242)	-19.00	13.00	-0.56	3.96	$F_3 = 2.29$ *P* value = 0.08
	Lessons Only (n=56)	-8.00	12.00	-0.63	3.82	
	Goals Only (n=231)	-13.00	13.00	-0.24	3.85	
	Lessons and Goals (n=117) (Full Intervention)	-18.00	16.00	-0.99	4.59	
Friend Social Support	Control (n=245)	-10.00	9.00	0.01	3.01	$F_3 = 1.88$ *P* value = 0.13
	Lessons Only (n=56)	-8.00	12.00	0.63	3.82	
	Goals Only (n=231)	-13.00	13.00	-0.24	3.85	
	Lessons and Goals (n=112) (Full Intervention)	-12.00	7.00	-0.52	3.20	
Outcome Expectations	Control (n=241)	-29.00	24.00	-0.52	6.54	$F_3 = 1.93$ *P* value = 0.12
	Lessons Only (n=57)	-16.00	12.00	0.05	4.84	
	Goals Only (n=230)	-17.00	27.00	0.07	5.87	
	Lessons and Goals (n=119) (Full Intervention)	-27.00	13.00	-1.63	6.80	
PE Enjoyment	Control (n=240)	-4.00	3.00	-0.25	0.96	$F_3 = 0.55$ *P* value = 0.65
	Lessons Only (n=55)	-2.00	2.00	-0.13	0.72	
	Goals Only (n=226)	-3.00	2.00	-0.17	0.87	
	Lessons and Goals (n=115) (Full Intervention)	-4.00	3.00	-0.17	0.84	

The individual level measures of the self-reported, select physical activity determinants were analyzed using linear modeling with the students' mean gain scores (from baseline to follow-up) on the physical activity determinants (goal orientation, self-efficacy, family support, friend support, outcome expectations, and PE enjoyment) as dependent variables (see Table 4-14). No statistical significant differences were observed on the select physical activity determinants (using mean gain score on the Student Physical Activity Questionnaire) with α =

0.0167 level of significance, using Bonferroni's correction to account for the three treatment groups involved in the study.

Table 4-14: Linear Model Statistics with Mean Gain Scores of Select Physical Activity Determinants

	Study School	Estimate	Standard Error	DF	t Value	*P* value
Goal Orientation	Lessons and Goals (Full Intervention)	0.2417	0.1224	657	1.97	0.0487
	Goals Only	0.0462	0.1004	657	-0.46	0.6457
	Lessons Only	-0.3174	0.1631	657	-1.95	0.0521
	Control	0				
Self-Efficacy	Lessons and Goals (Full Intervention)	0.1275	0.5897	663	0.22	0.8289
	Goals Only	0.1321	0.4848	663	0.27	0.7854
	Lessons Only	0.1683	0.7836	663	0.21	0.8300
	Control	0				
Family Social Support	Lessons and Goals (Full Intervention)	-0.3019	0.4254	641	-0.71	0.4781
	Goals Only	0.1315	0.3479	641	0.38	0.7057
	Lessons Only	0.9989	0.5603	641	1.78	0.0751
	Control	0				
Friend Social Support	Lessons and Goals (Full Intervention)	-0.0681	0.2915	639	-0.23	0.8153
	Goals Only	0.4374	0.2331	639	1.88	0.0611
	Lessons Only	0.2592	0.3759	639	0.69	0.4908
	Control	0				
Outcome Expectations	Lessons and Goals (Full Intervention)	0.0928	0.6462	641	0.14	0.8858
	Goals Only	0.8749	0.5258	641	1.66	0.0966
	Lessons Only	1.1536	0.8486	641	1.36	0.1745
	Control	0				
PE Enjoyment	Lessons and Goals (Full Intervention)	0.1990	0.0988	631	2.01	0.0445
	Goals Only	0.0724	0.0796	631	0.91	0.3630
	Lessons Only	0.1631	0.1284	631	1.27	0.2043
	Control	0				

The hypotheses for Research Question 3 were

H-3 – Students who are exposed to part of the goal-setting lessons will show significant gains in measures of select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.
H-4 – Students who are exposed to the full goal-setting lessons will show significant gains in measures of the select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.
H-5 – Students of teachers who have higher levels of fidelity of the goal-setting lessons will show significant gains in measures of the select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.

It was hypothesized that with increased implementation level of the goal-setting curriculum supplement (Lessons Only being the lowest level and Lessons and Goals being the highest level) that the students' perceptions related to the select physical activity determinants would be

impacted by the intervention with regards to the implementation level (Hypothesis-3 and Hypothesis-4). The lack of a significant difference in line with the implementation level leads the investigator to conclude that students who participated in the goal-setting curriculum supplement, regardless of level, showed no difference on the select physical activity determinants than the control students. With teacher delivery of the lessons at 100%, Hypothesis-5 cannot be assessed.

Additional Findings

Descriptive statistics (minimum, maximum, means, standard deviations) at baseline (pre-test) for students who reported walking/biking to/from school, another variable of interest, are shown in Table 4-15. Students in the four groups involved in this study reported different levels of walking/biking to/from school at baseline ($F_3 = 12.20$, *P* value < .0001). More students in the Lessons and Goals intervention group reported walking/biking more often to and from school.

Table 4-15: Mean (SD) Levels of How Often Students Walk/Bike to and From School at Baseline

	Study School	Minimum	Maximum	Mean	Standard Deviation
Number Times Walk/ Bike To/From School (range=0-10)	Control (n=306)	0	10.00	2.16	2.95
	Lessons Only (n=137)	0	10.00	1.97	3.46
	Goals Only (n=284)	0	10.00	3.19	3.72
	Lessons and Goals (n=181) (Full Intervention)	0	10.00	3.80	3.82

Whether walking/biking to/from school had an impact on individual level physical activity measure of self-reported MVPA was analyzed using linear modeling with the mean gain score on the 3DPAR as the dependent variable and walking/biking to/from school as a covariate (see Table 4-16). Walking/biking to/from school did not impact students' reported levels of MVPA.

Table 4-16: Linear Model Statistics with Mean Gain Score of MVPA for Intervention Groups and Baseline MVPA and Independent Variables

Effect	Estimate	Standard Error	DF	t Value	*P* value
Walk/Bike To/From School	-0.0216	0.0347	541	-0.62	.5343

Results for Nonequivalent Dependent Variables

Descriptive statistics (minimum, maximum, means, standard deviations) at pre-test for the nonequivalent dependent variables (student perception of available environmental and recreational facilities for being active and student safety practices) are provided in Table 4-17. Students in the four groups involved in the study were similar in their safety practices at baseline. There were differences between the groups for student perception of available environmental and recreational facilities for being active which was not unexpected as the district covers 27 square miles comprising a wide variety of opportunities.

Table 4-17: Mean (SD) Levels of Nonequivalent Variables at Baseline

	Study School	Min.	Max.	Mean	Standard Deviation	Difference Between Groups
Perception of Available Environmental and Recreational Opps (range=0-11)	Control (n=308)	0	11.00	5.12	2.74	F_3 =11.57 *P* value < .0001
	Lessons Only (n=130)	0	11.00	4.69	2.52	
	Goals Only (n=278)	0	11.00	6.19	2.80	
	Lessons and Goals (n=185) (Full Intervention)	0	11.00	5.36	2.82	
Safety Practices (range=0-17)	Control (n=314)	3.00	17.00	9.16	2.75	F_3 = 0.20 *P* value = 0.90
	Lessons Only (n=135)	2.00	17.00	9.30	2.87	
	Goals Only (n=280)	2.00	17.00	9.18	3.10	
	Lessons and Goals (n=186) (Full Intervention)	3.00	17.00	9.33	3.09	

ANOVA was applied to determine the differences between groups for the two nonequivalent dependent variables using mean gain scores from baseline (see Table 4-18). There was no statistical significance difference noted in mean gain scores of student perception of available environmental and recreational facilities for being active (F_3 = 0.41, *P* value = 0.75). There was a statistical significance difference in mean gain scores for student safety practices (F_3 = 3.98, *P* value = 0.0079).

Table 4-18: Mean (SD) Gain Scores of Nonequivalent Variables at Follow-Up						
	Study School	Min.	Max.	Mean	Standard Deviation	Difference Between Groups
Perception of Available Environmental and Recreational Opps	Control (n=243)	-7.00	7.00	0.46	2.36	F_3 =0.41 *P* value = 0.75
	Lessons Only (n=55)	-5.00	11.00	0.71	2.95	
	Goals Only (n=233)	-10.00	9.00	0.38	2.62	
	Lessons and Goals (n=114) (Full Intervention)	-8.00	11.00	0.64	2.95	
Safety Practices	Control (n=296)	-7.00	6.00	-0.37	1.73	F_3 = 3.98 *P* value = 0.0079
	Lessons Only (n=123)	-8.00	9.00	-0.33	2.45	
	Goals Only (n=272)	-9.00	10.00	0.15	2.32	
	Lessons and Goals (n=160) (Full Intervention)	-9.00	6.00	-0.45	2.28	

The individual level nonequivalent dependent measure of safety practices was analyzed using linear modeling with the mean gain score of safety practices at follow-up as the dependent variable (see Table 4-19). A significant difference was observed for the Goal Only intervention group in safety practices during the study period; however, none of the other three groups in the study changed. (Since mean gain scores of student perception of available environmental and recreational facilities for being active was not statistically significant different among groups at the post-test, no further analysis was completed.)

Table 4-19: Linear Model Statistics with Mean Gain Score of Safety Programs for Intervention Groups					
Effect Safety Practices (mean gain score)	Estimate	Standard Error	DF	t Value	*P* value
Study Group					
Lessons and Goals (Full Intervention)	-0.0784	0.2077	846	-0.38	0.7060
Goals Only	0.5187	0.1778	846	2.92	0.0036
Lessons Only	0.0383	0.2271	846	0.17	0.8661
Control	0				

CHAPTER FIVE:

DISCUSSION AND CONCLUSIONS

Regular physical activity can decrease one's risk for many chronic diseases and disabilities, such as cardiovascular disease and non-insulin dependent diabetes, as well as reduce one's risk for all-cause mortality.[59] The many health benefits of regular physical activity, including helping to maintain a healthy body and enhancing psychological well-being, have been demonstrated through numerous rigorously designed studies.[1-7] The importance of physical activity as a public health prevention issue is reflected in the Healthy People 2020 Objectives developed by the U.S. Department of Health and Human Services.[8] These objectives feature increasing the proportion of both adults and adolescents who engage in physical activity as a national objective for improving the Nation's health.

The purpose of this study was to determine whether a theory-based physical activity curriculum addition to a school district's existing physical activity curriculum (in health and PE classes) targeting goal-setting, or the Social Cognitive Theory construct of self-regulation, increased students' physical activity levels. The study explored whether the theory-based curriculum addition was more effective when implemented with or without corresponding lessons. This study focused on goal-setting to provide a better understanding of whether this strategy can be used to increase physical activity levels among adolescents and explore whether focusing on a single construct from Social Cognitive Theory can successfully be targeted to increase physical activity levels. Physical activity determinants that have been positively associated with physical activity, such as self-efficacy and social support, were also examined to determine whether goal-setting had an effect on them. The select determinants included students' goal orientation, students' perceptions of their self-efficacy related to being active, students' perception of social support (family support and friend support) for being active,

students' perceived benefits of being active (outcome expectations), and the degree to which students enjoy PE class (PE Enjoyment).

Chapter five, presented in eight sections, provides a discussion of the study findings relevant to the Research Questions and the implementation of the study. First, the study design is discussed. Sections two and three provide a discussion of the results for the Research Questions. The fourth section provides a discussion of the physical activity levels for the study population compared to general population and the fifth sections compares the study results to other physical activity interventions. Strengths and limitations are discussed in section six. The final two sections provide a discussion of the implications for practice and considerations for future research.

Study Design

The current study used a mixed-methods, repeated measures, randomized experimental design with nonequivalent dependent variables.[38] The study was conducted with one large school district in central New Jersey with middle school students that attended health or PE class during the 2013-2014 school year. The school district volunteered to participate in the study and allowed randomization of schools into treatment groups, with the school as the unit of randomization, which is common in school-based research.[96,120] The school district delivered the intervention during its fourth quarter in its five middle schools. One middle school was randomized to serve as the control group and four middle schools were randomized to one of the three intervention groups (i.e., lessons only, goals only, or lessons and goals). The experimental research design and the operational procedures used (i.e., randomization schools, four treatment groups, nonequivalent dependent variables) increased the strength of the study design.

While analysis revealed students in the four groups involved in the study were similar in gender and amount of time spent home alone at baseline, there were differences between the groups for age, grade, race/ethnicity, and socio-economic status. The four schools implementing one of the three intervention levels selected two grades for the study. The investigator had planned for all grades in the five middle schools to participate. However, to maximize cooperation and collaboration from the schools and more importantly, from teachers within the schools, each of the intervention schools selected two grades for the study. The control school implemented the study in all three grades. These schools selected the two grade levels in their school environment that teachers felt would be most cooperative in completing the goal-setting lessons and study instruments. Therefore, different grade levels participated in the lessons only and goals only intervention groups, which may explain the differences between the groups for age and gender. However, there was no difference between the groups on the primary outcome variable, self-reported moderate-to-vigorous physical activity (MVPA) levels, at baseline. This lack of pre-test differences on MVPA provides evidence that none of the groups were extreme on this measure in comparison to other schools.

Two nonequivalent dependent variables (student perception of available environmental and recreational facilities for being active and student safety practices) were measured to strengthen the experimental design. Students in the four groups involved in the study were similar in their safety practices at baseline. There were differences at baseline between the groups for student perception of available environmental and recreational facilities for being active which was not unexpected as the district covers 27 square miles comprising a wide variety of opportunities. There was no statistical significance difference observed in mean gain scores (from baseline to follow-up) of student perception of available environmental and recreational facilities for being active ($F_3 = 0.41$, *P* value = 0.75); however, there was a statistical

significance difference in mean gain scores for student safety practices (F_3 = 3.98, *P* value = 0.0079). While seasonal differences were not expected to have influenced the outcomes of the study (pre-test data were collected in April 2014 and post-test were collected in June 2014), it is unknown whether more students rode a bike, rollerbladed, or skateboarded more often towards the end of the school year. Many students reported not riding a bicycle, rollerblading, or skateboarding on the pre-test but then reported these activities and how often they wore a helmet on the post-test which would have impacted their score on the safety practices index. The lack of a significant difference between the groups on the primary outcome variable, self-reported MVPA levels, makes the significant change in the safety practices nonequivalent dependent variable less of a concern.

The overall attrition rate for each of the study instruments was 7.6% For Survey 1 (YRBS), 25.5% for Survey 2 (SPAQ), 33.2% for Survey 3 (3DPAR). The four groups involved in the study had up to a 78.7% attrition rate (Lessons and Goals intervention group) over the course of this study. The high subject attrition rate resulted in lower sample sizes in two of the four study groups: Goals Only, and Lessons and Goals. An analysis of this attrition suggested that those subjects who completed pre-tests but not post-tests did not differ from those subjects who remained in the study (completed both the pre-tests and post-tests) on the primary outcome variable, mean difference in self-reported moderate-to-vigorous physical activity (MVPA) levels. Additionally, there were no differences found for age, gender, race/ethnicity or lunch status for Survey 1 (YRBS) or Survey 3 (3DPAR) between those who completed the pre-tests only and those who completed pre-tests and post-tests. There was a difference found for age and gender for Survey 2 (SPAQ).

Research Question 1 Discussion

RQ-1 Are teachers able to successfully integrate the goal-setting lessons into the school district's health and physical education curriculum?

H-1 – Teachers who implement the goal-setting lessons will demonstrate integration and application of the lessons in their overall lesson plans.

In this study, the health and PE teachers delivered the goal-setting curriculum supplement with the lessons and/or goals in their school as randomly assigned. As described in Chapter Four, a review of the lesson-related materials demonstrated that the participating teachers did deliver all of the lessons as planned in their respective classrooms. With only five lessons and school administrative support, it was not unexpected that the lesson delivery was high among the participating teachers.

Based on the data from using SOFIT[140] (System for Observing Fitness Instruction Time), only five of the 10 PE classes observed and two of the five middle schools had students spend greater than 50% of PE class time in MVPA, meeting the Institute of Medicine's recommendation. Based on these observations, PE instruction appears to be delivered with some variability across the school district. While the study was not expected to change student activity levels during PE class, documenting how much time students spend in MVPA in PE class provides the school district with descriptive information regarding the quantity of physical activity performed during PE classes across their middle schools.

Using the process evaluation model, described by Windsor et al,[138] an overall PII of 91.2% was revealed for the delivery and implementation of the study, slightly higher than the recommended 90% which is considered an excellent indication of program delivery in all settings.[138] While the overall PII did meet the recommended 90%, the overall PII was impacted by a lower than expected PII for the informed consent forms and the post-tests. The study PII for the completion of informed consents averaged 61.3% across the five middle schools. During the implementation of the study, the investigator coordinated a second distribution of informed consents to students in the two intervention groups with the lowest return rates (Lessons Only group and Lessons and Goals group); a third distribution was also completed for one of the

schools in the Lessons and Goals intervention group at the beginning of the subsequent school year. These extra distribution efforts resulted in additional consent forms being returned but the rates remained less than expected. The two schools in the Lessons and Goals intervention group noted that the low response rate was not unexpected, as parents do not always return requested school forms. The Goals Only intervention group had the highest PII with a rate of 98.5%. Teachers in this group achieved this high rate by making the informed consent forms a homework assignment. Students who returned their forms (regardless of whether they provided consent or not) received homework points toward their grade for the class. The investigator was not able to make this a requirement of all of the participating schools as it could have negatively impacted teachers' participation and collaboration in the study.

Not unexpectedly, the study PII for the completion of study instruments was higher for pre-tests than post-tests. Pre-tests were administered at the beginning of the fourth quarter in April. Post-tests were administered in June, at the end of the school year. Administering the post-tests at the end of school year did not allow time for teachers to administer the post-tests to students absent from class on the day the post-tests were originally administered. In addition, administering the post-tests at the end of the school year most likely increased survey fatigue as both teachers and students were anxious for the summer break to begin. For future studies, providing a small student incentive, such as homework points, would be advantageous to maximize student completion of study components, in particular the informed consent process. In addition, administering the post-tests at least a month before the end of the school year should allow time for students to make-up post-tests for those who were absent or for teachers to reschedule survey administration when class schedules are changed due to school assemblies or parties at the end of the school year.

Impact on Physical Activity Levels and Determinants (Research Questions 2 and 3)

Two Research Questions evaluated whether the goal-setting curriculum supplement produced changes in moderate-to-vigorous physical activity (MVPA), as well as select physical activity determinants, from pre-test (baseline) to post-test (follow-up). These Research Questions and related Hypotheses are outlined below.

RQ-2 Does integrating the goal-setting lessons into school health and physical education curriculum result in increased physical activity among middle school students?

H-2 – Goal-setting lessons integrated into health and physical education classes will produce significant gains in levels of physical activity, as measured by the 3-Day Physical Activity Recall, a valid and reliable measure of physical activity, among students receiving the lessons when compared to students receiving partial or none of the lessons.

RQ-3 Will targeting goal-setting, a physical activity determinant, produce greater positive effects for those students?

H-3 – Students who are exposed to part of the goal-setting lessons will show significant gains in measures of select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.

H-4 – Students who are exposed to the full goal-setting lessons will show significant gains in measures of the select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.

H-5 – Students of teachers who have higher levels of fidelity of the goal-setting lessons will show significant gains in measures of the select physical activity determinants, such as self-efficacy, social support, outcome expectations, and physical education enjoyment.

Physical activity behavior was measured through self-reported recall of physical activity using the 3-Day Physical Activity Recall (3DPAR). Using this instrument, students coded their daily activities in 30-minutes blocks of time and the intensity of each activity for each of three consecutive days (Sunday, Monday, and Tuesday). Data from the 3DPAR were converted to Metabolic Equivalents (METs) which was used to estimate physical activity levels (the number of 30-minute blocks that were considered MVPA). Baseline findings revealed no significant differences between the groups in their reported MVPA levels. The three intervention groups averaged 4.80 (Lessons and Goals), 4.51 (Goals Only), and 4.55 (Lessons Only) 30-minute blocks in which the main activity was rated as MVPA at baseline (pre-test). The control group mean

was 4.26 30-minute blocks of MVPA at baseline. Means at follow-up (post-test) were 4.41 (Lessons and Goals), 4.34 (Goals Only), and 4.76 (Lessons Only) 30-minute blocks in which the main activity was rated as MVPA for the intervention groups and 4.11 30-minute blocks of MVPA for the control group. Baseline MVPA and sports and activity history were the only two independent variables that appeared to have an effect on the study groups' mean gains score of MVPA. Students who had participated in school or community programs that were physically active (sports and activity history) had higher levels of MVPA (mean gain score from pre-test to post-test). The lack of a significant difference for the goal-setting curriculum leads the investigator to conclude that students who participated in the goal-setting curriculum supplement, regardless of implementation level, showed no difference on the primary outcome variable, self-reported MVPA levels, than the control students.

Select physical activity determinants (goal orientation, self-efficacy, family support, friend support, outcome expectations, and PE enjoyment) were examined to determine whether goal-setting had an effect on them. The physical activity determinants were measured through the Student Physical Activity Questionnaire (SPAQ), adapted from the TAAG Student Questionnaire.[73,132] Items on the SPAQ used a 5-point Likert-type scale (e.g., "Disagree A Lot" to "Agree A Lot," or "Never" to "Very Often"). Baseline findings revealed students in the four groups involved in the study were similar on three of the select physical activity determinants: goal orientation, self-efficacy, and family support. There were differences between the groups for friend support, outcome expectations, and PE enjoyment at baseline. No statistical significant differences were observed on the select physical activity determinants (using mean gain score on the Student Physical Activity Questionnaire) with $\alpha = 0.0167$ level of significance, using Bonferroni's correction to account for the three treatment groups involved in the study.

It was hypothesized that with increased implementation level of the goal-setting curriculum supplement (Lessons Only being the least intensive and Lessons and Goals being the most intensive) that the students' perceptions related to the select physical activity determinants would be impacted by the intervention with regards to the level (Hypothesis-3 and Hypothesis-4). The lack of a significant difference in line with the implementation level leads the investigator to conclude that students who participated in the goal-setting curriculum supplement, regardless of level, showed no difference on the select physical activity determinants than the control students. With such high equivalent rates of delivery of the goal-setting curriculum supplement, no assessment can be made with regard to Hypothesis-5.

There are several contributing factors that may have impacted the lack of significant results for this physical activity intervention study. First, the collection of informed consent/assent forms was more challenging in some schools than in others that led to a less than optimal consent/assent rate. Second, high attrition rates for the post-tests resulted in a considerably high amount of missing data. Both of these factors resulted in much smaller sample sizes for data analysis, thus, impacting power and statistical significance. Further, the study population reported high levels of moderate-to-vigorous physical activity (MVPA) as measured by the 3DPAR (30-minute blocks) at baseline. The overall mean level of MVPA was 4.48 30-minute blocks (5.13 for boys and 3.90 for girls) for the study population, higher than the overall mean level of MVPA found in the TAAG study which was 1.74 30-minute blocks (for girls) as measured by the 3DPAR.[146] The high level of MVPA at baseline may have impacted the study's ability to detect a statistically significant change in MVPA levels.

Physical Activity Levels As Compared to General Population

National rates of physical activity for MVPA provide context for how the study population compares with state and national data in relation to levels of physical activity for adolescents.

Comparison data are for high school students, the population with the most recent data available. While students participating in the study reported being more active in general than their high school counterparts in New Jersey and across the nation (67.4% compared to 48.7% and 47.3%, respectively, who reported being physically active for at least five or more days during the seven days prior to the survey), less of the study population currently met the recommended levels of physical activity (i.e., 60 minutes or more of physical activity daily). Only 25.3% of students in the study reported meeting the recommended levels of physical activity which is slightly less than the 27.1% of adolescents in the United States and 27.6% of New Jersey adolescents who reported meeting the recommended levels.[9] Physical activity levels are known to decline through adolescence. Nader et al.[13] reported that 91.6% of children aged 11 years met physical activity guidelines, but by age 15 years, only an average of 23.7% of children met the physical activity guidelines. Therefore, it will be important to continue encouraging students in the Woodbridge Township School District to maintain and increase their physical activity levels as they move to high school and beyond.

Study Results As Compared to Other Physical Activity Interventions (Middle School)

The results of the current study are placed into context of the literature reviewed in Chapter Two. Eight intervention studies that were conducted with the middle school student population that targeted moderate-to-vigorous physical activity were reviewed. These studies include Planet Health,[19] EatFit,[98] Trial of Activity for Adolescent Girls (TAAG),[37,42,99-104] Active by Choice Today (ACT),[105-108] Latin Active,[109] Central Texas Coordinated Approach To Child Health (CATCH) Middle School Project,[110] Middle-School Physical Activity and Nutrition (M-SPAN),[112,113] and the Intervention Centered on Adolescents' Physical Activity and Sedentary Behaviour (ICAPS).[114,115]

The TAAG study was the only one of these studies to examine only females, the other seven studies sampled both males and females, as was done in the current study. Planet Health,

TAAG, ACT, CATCH, M-SPAN, and ICAPS studies each employed a randomized experimental design similar to the current study. EatFit and Latin Active interventions each employed a quasi-experimental design. Six of the studies reviewed used constructs from Social Cognitive Theory to design the intervention. The current study was delivered during one-quarter (approximately 10 weeks). Process evaluation methods were conducted and baseline and follow-up measures were taken immediately before and after the intervention was conducted, respectively. Duration of the exposure to the treatment in the eight reviewed studies varied from five weeks (Latin Active) to multi-years (Planet Health, TAAG, CATCH, M-SPAN, and ICAPS). Five studies reported using process evaluation methods (Planet Health, TAAG, ACT, M-SPAN, and ICAPS). All studies conducted baseline and follow-up measures. Two studies (EatFit and Latin Active) used only self-report measures for student physical activity levels, three studies used self-report measures and accelerometers with a subset of the study population (Planet Health, TAAG and ICAPS), one study used accelerometers only (ACT), and one study used observations of PE classes. (No information on physical activity measures was available for CATCH.)

Two of the studies, Planet Health and EatFit saw no change in physical activity behavior among study participants, similar to the current study. Five of the other studies showed modest results in increasing physical activity among study participants. The TAAG study[37,42,99-104] showed a statistically significant, although moderate in practical terms, increase in physical activity levels among girls who participated in the intervention. ACT study results demonstrated students assigned to the intervention group engaged in significantly more minutes of moderate-to-vigorous physical activity (MVPA) per day than students in the control group at mid-intervention; however, these results were not sustained at 2-weeks post-intervention. The Latin Active program significantly increased students' reported vigorous physical activity levels and increased self-efficacy among girls, and decreased perception of neighborhood barriers among

boys. M-SPAN study results showed the intervention was effective in increasing physical activity at school but the effect was statistically significant only for boys. ICAPS study results showed statistically significant increases in supervised leisure physical activity outside of PE classes among intervention students when compared with contract students. CATCH study results regarding students' changes in physical activity levels have not yet been published.

Strengths and Limitations

Strengths of the study include the use of valid and reliable instruments for data collection and the implementation of a goal-setting curriculum supplement, lessons and goals, that was easy to use and integrate into health/PE curriculum in schools. The study was also conducted in a large, diverse school district that allowed for randomization of middle schools to one of four study groups (one control and three experimental), represents another strength of the study.

There are, however, several methodological limitations associated with the study. A limitation of the study is the inherent problem of using self-reports to measure physical activity on the 3DPAR. Student responses may be biased as they may provide socially acceptable responses and/or erroneous or inaccurate responses to study questionnaires. Students may have also inaccurately recalled and/or misinterpreted their activity levels. Given that the post-tests were administered at the end of the school year, students may have been distracted, rushed, or failed to concentrate appropriately. Physiological measures of physical activity, such as accelometry, would be the most valid data for a study such as this one but such measures are cost-prohibitive without a major source of external funding. The use of self-report measures offered a feasible and affordable means for measuring physical activity in this school-based intervention. The instruments used in the study have been shown to be valid and reliable among adolescent middle school populations. McMurray et al[145] determined the test-retest reliability of the 3DPAR as r = 0.76. However, this group of investigators urged caution in using

the 3DPAR due to their data providing some evidence of overestimates of self-reported intensity of effort. In addition, the investigators recommended using the 2-Day Physical Activity Recall because this tool is less susceptible to errors in recall.

Another limitation of the study was having teachers implement the theory-based physical activity curriculum addition in health and PE classes, as well as administer the study instruments. Although teachers did receive brief training on both the goal-setting curriculum supplement (lessons and goals) and the administration of the study instruments, their ability and willingness to implement these study components and to what extent they supported the study's importance may have impacted the outcome of the program. While health and PE teachers are accustomed to delivering lessons in class, teachers are not trained in the research and measurement processes and approaches to facilitate the collection of robust data for research purposes. School teachers routinely collect classroom assessments which contribute to the health and PE grades for students; however, these assessments are not designed to evaluate the impact of a health or PE program as a whole limiting teachers' research experience. Teachers appeared to deliver the goal-setting lessons with adequate fidelity; however, the administration of study instruments appeared to lack adequate fidelity and data collection was compromised.

The small sample sizes for two of the four groups involved in the study represents another limitation. Approximately 39% of the students eligible to participate in the study did not return informed consents documents rendering their data unusable in the analysis. In addition, an average of 22% of the participants were lost at follow-up. These factors affected the sample sizes of the groups involved in the study. The desired sample sizes for the three experimental groups was 300 for each of the treatment groups and 300 for the Control group. Only two of the four groups (Control and Goals Only) involved in the study met these accrual goals.

A significant methodological limitation was the relatively short time frame of the study. The appropriate length for an intervention to be most effective in increasing physical activity has not been determined; however, a review by Waters, et al.[97] noted a minimum intervention time may be 12 weeks with longer-term interventions having more likelihood of showing an impact. The lack of statistical significance in MVPA between intervention and control groups may be related to all of the study's limitations.

Practice Implications

Health and PE teachers, as well as schools as a whole, are well positioned to positively influence physical activity levels of American children and adolescents. Schools have daily access that is continuous and intensive to large numbers of children and adolescents with over 90% of U.S. children enrolled in school.[47,74] Further, schools' access to students occurs during their formative years,[75] which provides the opportunity to instill healthy behaviors which may persist into adulthood.[48,49] Schools can promote physical activity and a positive self-image among students as they deliver health and PE instruction, offer opportunities for physical activity, and provide after-school programs.

Schools cannot solve the nation's health problems related to physical inactivity. It is questionable whether behavior change should be the focus of any school-based program. However, schools can play an especially important role providing instruction on physical activity and healthy diet as a means of preparing students for life. Schools need to revisit and expand their role in providing instruction in physical activity.[147] Many states have limited health and PE requirements. Healthy People 2020[8] includes two objectives regarding the provision of physical education in schools: (1) increase by 10% the proportion of the Nation's public and private schools that require daily physical education for all students, and (2) increase by 10% the proportion of adolescents who participate in daily school physical education. Further, the

Community Preventive Services Task Force[148] recommends "enhanced school-based PE to increase physical activity based on strong evidence of effectiveness in increasing the amount of time students spend in MVPA during PE classes." The Taskforce advocates instructional strategies and lessons that increase physical activity and physical education lesson plans that incorporate fitness activities. The present study sought to integrate theory-driven goal-setting activities to increase physical activity and this study should be replicated with some revisions in an effort to retain students to have adequate statistical power to determine whether this is an instructional strategy that is effective in increasing physical activity.

Recommendations for Future Research

The limitations of the current physical activity intervention warrant further investigation to determine whether goal-setting strategies can increase students' physical activity levels. There are several recommendations that should be considered to contribute to the science base.

(1) The issue of attrition should be addressed in subsequent research studies by administering study instruments during health classes or another classroom where students are used to completing writing and homework assignments. The goal-setting curriculum supplement should still be implemented in both health and PE classrooms. However, removing survey administration from PE class may help to reduce attrition rates.

(2) Providing a small student incentive, such as homework points, may help to maximize student completion of study components, in particular the informed consent process.

(3) Engaging the participating teachers in more rigorous training to deliver student curriculum and administer study instruments or utilizing trained research staff may be a better option for future studies. However, the downside of using trained

research staff is that they are only there for the duration of the study. Afterwards, school systems need to determine whether the program can be turned over to regular teachers and staff.

(4) Each participating school received $1,000 in health/PE equipment for participating in this study. A larger financial incentive may have resulted in greater buy-in from teachers for the program, resulting in teachers supporting and promoting the program more among students. Teachers should communicate to students throughout the study that the instructional and measuring components should be taken seriously and that it is not just some added activity they can ignore.

(5) Administering the post-tests earlier in the school year, or at least a month before the end of the school year, should allow time for students to make-up post-tests for those who were absent or for teachers to reschedule survey administration when class schedules are changed due to school assemblies or other activities at the end of the school year.

(6) Physical activity levels may be overestimated when using only self-reports to measure physical activity; therefore, self-reports should be supplemented with objective measures, such as accelerometry.[145]

Considering these recommendations when implementing and evaluation school-based interventions may help to determine the effectiveness of future interventions.

Conclusions

In light of the lack of statistically significant findings regarding the goal-setting curriculum, this physical activity intervention study should be replicated in an effort to retain students to have adequate statistical power (i.e., power = 0.80). In addition, the study should be replicated with other adolescent populations as the study population from Woodbridge Township reported

high levels of MVPA and objective measures of physical activity should be used to support self-report physical activity recall surveys. Only with replication, adequate sample sizes, low attrition rates, and use of objective measures of physical activity will the efficacy of goal-setting as an instructional strategy to increase physical activity among adolescents be understood.

The study's secondary findings regarding self-efficacy suggest that improved self-efficacy is associated with higher levels of physical activity which supports other physical activity research.[70,107,149] The implementation of the goal-setting curriculum supplement is promising as the use of the supplement in the classroom by teachers was feasible and inexpensive. However, adequate training and reinforcement will be necessary to maintain consistent implementation. These findings regarding physical activity levels are suggestive of the importance of continuing to encourage and support daily physical activity throughout adolescence. Furthermore, the results verify the necessity of teacher involvement and school support of physical activity.

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