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Feasibility of a combined physical activity and sleep education intervention for girls living in a low socioeconomic status urban community

Cory J. Greever
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FEASIBILITY OF A COMBINED PHYSICAL ACTIVITY AND SLEEP EDUCATION INTERVENTION FOR ELEMENTARY AGE GIRLS LIVING IN A LOW SOCIOECONOMIC STATUS URBAN COMMUNITY

A Dissertation Presented
by
Cory J. Greever

Submitted to the Graduate School of the University of Massachusetts, Amherst in partial fulfillment of the requirements for the degree of

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FEASIBILITY OF A COMBINED PHYSICAL ACTIVITY AND SLEEP EDUCATION INTERVENTION FOR ELEMENTARY AGE GIRLS LIVING IN A LOW SOCIOECONOMIC STATUS URBAN COMMUNITY

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Declining sleep duration and poor sleep quality is a public health epidemic disproportionately effecting elementary age girls living in low socioeconomic status urban communities. The Girls Dancing and Sleeping for Health (Girls DASH) program was designed to test the feasibility, acceptability, and efficacy of a combined physical activity and sleep education program in this population. In combination with baseline data from a previously conducted intervention in elementary age urban girls living in a low SES community in Springfield, MA, results from a cross-sectional analysis indicated that greater screen time was positively associated with parental reports of child’s sleep quality. Additionally, children who got more physical activity had fewer and shorter accelerometer-derived nighttime awakenings and minutes spent in bed. Subsequently, the process evaluation data from the Girls DASH program indicated several roadblocks in
recruitment, retention, implementation, and attaining outcome measurements. However, there were aspects of the intervention, such as screen time education from the sleep education program, homework tutoring, after-school care and health education which participants deemed highly acceptable. Due to a high occurrence of missing data, it is difficult to draw conclusions regarding the efficacy of the intervention in improving sleep and physical activity. Judging from the available data, the intervention improved total moderate-to-vigorous physical activity significantly in the intervention groups vs. control. Additionally, there were improvements in after-school physical activity, parent-reported sleep duration and accelerometer-derived minutes spent in bed in all participants over time, with no differences between groups. The results from this study can be used to improve the feasibility, acceptability and potential efficacy of future interventions seeking to improve sleep and physical activity in elementary age girls living in low socioeconomic status urban communities.
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Pediatric obesity is a major public health epidemic in the US (118). Currently, approximately 17.5% of children age 6-11 years are considered obese (BMI ≥ 95th percentile for gender and age) (90). The increased prevalence of pediatric obesity has been linked to reductions in sleep duration (SD) and quality (SQ), physical activity (PA) level and increases sedentary behavior (SB) and screen time (2, 14, 38, 40, 129). Recently, Laurson et al. (69) examined the influence of meeting PA, SD and screen time recommendations (≥ 60 min/day of moderate-to-vigorous physical activity (MVPA) per day, 10-11 hours/night of sleep, ≤ 2 hr/day of screen time) on elementary age weight status. The results showed that only 9% of girls who met all three recommendations were obese compared to 42.5% of those who met none. Additionally, the authors noted 30% of girls who met none of the recommendations were obese compared to 22% of boys. These data suggest that the associations among PA, screen time, sleep and obesity are stronger in boys than in girls in this age group, highlighting the need to study these behaviors in elementary age girls.

Sufficient nightly SD and high SQ help regulate hormones related to appetite (leptin and ghrelin), insulin, growth hormones, and learning (65, 101). The National Sleep Foundation recommendations are that children age 5-12 years should sleep about 10-11 hours per night (41). Data from the most recent Sleep In America Poll show that 90% of US children do not meet these recommendations (18). Furthermore, recent literature comparing children living in low socioeconomic (SES) urban communities to children living in more affluent communities reported that urban children living in low
SES urban communities are more likely to suffer from insufficient SD and poor SQ (115, 117). A study examining sleep duration in a sample of elementary age children living in a low SES urban community [age = 9 - 12 years; n = 333 Latinos and 150 African Americans] suggests that elementary age girls slept less than all other age and gender categories in this population (137). These findings suggest that urban girls in low SES communities are at an elevated risk for compromised sleep, which is particularly concerning given that poor sleep has been associated with elevated obesity and cardiovascular disease risk in children (119). This highlights the need to identify modifiable risk factors that can improve sleep in high-risk populations such as elementary age girls from low SES urban communities.

Currently, there is evidence to suggest that SD, SQ and PA are behaviorally linked in children (69, 135). Patel and Hu (98) suggest that children who get less PA are less fatigued at night and get less sleep. Additionally, it has been proposed that children who get less PA also engage in more sedentary behaviors (SB), such as increased screen time, which disrupts the release of the hormone melatonin and delays nighttime fatigue (22, 28). Recently, Wong et al. (137) reported an inverse relationship between the amount of SB that low SES urban children accumulated and SD (137). It is also possible that PA is related to aspects of SQ, rather than SD. For example, higher daily levels of moderate-to-vigorous physical activity (MVPA) have been reported to promote sleep efficiency (proportion of bedtime spent actually asleep) on the following evening in Swedish children (38). While the relationship between sleep and PA has been proposed, the nature and directionality of these relationships in children at high risk for compromised SD and SQ, such as elementary age girls living in low SES urban
communities, remains unclear. Studies focusing on the associations among these behaviors would further inform prevention strategies aimed at improving sleep in this population. Therefore, the purpose of our first study was to examine the associations among PA, SB, SD and SQ in a sample of elementary age girls from two health behavior interventions conducted in a low SES urban community.

Problematic sleep is often characterized by the individual’s persistent failed efforts to fall asleep (24, 59, 67, 128). The individual will then try harder to fall asleep often making it more difficult (24, 59, 67, 128). In adults, sleep education programs that seek to improve sleep knowledge have been shown to improve individuals sleep self-efficacy (belief that they can sleep normally) and ultimately improve SD and SQ (121). According to a recent review of the literature, 12 studies have examined the effect sleep education strategies on improving either SD or SQ in children (12). Unfortunately, methodological issues/challenges (i.e., inconsistent measures of sleep duration/quality and very small sample sizes) make it difficult to determine the effectiveness of past sleep education interventions in children (12). None of the current sleep education interventions in children have focused on increasing PA; despite its potential to improve sleep in children. Additionally, none of these studies have focused on elementary age girls living in low SES urban communities, who are at high-risk for poor sleep (115, 117, 137). Recently, Bates et al. reported improvements in PA, earlier bed times and earlier wake times in elementary age girls living in a low SES urban community following a 4-week summer program which included daily PA, but not sleep education (9). However, children tend to be more active due to increased opportunities to play outside, and sleep less due to later bedtimes during the summer compared with the academic months (3, 51,
88). No studies have examined the feasibility of intervening on both sleep and PA during the academic months in elementary age girls living in a low SES urban community. Studies examining SD, SQ, SB and PA in this at-risk population would add significantly to our understanding of the relationship between these behaviors. It is currently unknown whether PA and SB are associated with SD and SQ in girls living in low SES urban communities. Therefore, the purpose of our first study was to examine if PA and SB are predictive of SD and SQ in a group of girls participating in two health behavior change interventions in a low SES urban community.

Given the apparent links between sleep and PA in children, health behavior interventionists should consider designing interventions that contain both PA and sleep education strategies. As increased rates of obesity, insufficient sleep and inactivity continue to plague girls living in low SES urban communities, it is imperative to design interventions which target sleep and PA behaviors and that promote participation from this population. There are no existing studies that have examined the effects of a sleep education and PA program during the school year in girls living in low SES urban communities(12). Therefore, the purpose of our second study was to examine the feasibility of a SE and PA program in elementary age girls living in a low SES urban community and secondarily, to examine potential changes in sleep and PA from participating in such a program.
Research Aims and Hypotheses

Study 1 – Associations among physical activity, sedentary behavior and sleep in elementary age girls living in a low socioeconomic status community

Aim1: The primary aim of this study was to examine whether PA and SB are associated with SD and SQ in elementary age girls participating in two health behavior interventions conducted in a low SES urban community.

H1: We hypothesized that higher PA and lower SB would be associated with longer SD and higher SQ in this population.

Study 2 – Feasibility of combined physical activity and sleep education intervention in elementary age girls in a low socioeconomic status urban community

Aim1: The primary aim of this study was to test the feasibility, acceptability and efficacy of an 8-week combined PA and sleep education intervention for elementary age girls living in a low SES urban community.

H1a: Feasibility: We hypothesized that we would meet recruitment and retention goals; and collect valuable process measures related to fidelity of intervention delivery and attaining outcome assessments.

H1b: Acceptability: children will demonstrate high attendance rates at intervention sessions, as well as high degrees of enjoyment and satisfaction with the overall program.

Aim2: Secondarily, this study aimed to examine whether participating in a sleep education plus PA program had the potential to improve SD, SQ and PA in elementary age girls living in a low SES urban environment.
H2: We hypothesized that participation in this program would improve SD, SQ and improve the PA levels of girls. While we measured overweight or obesity status over the course of the program, it is unlikely that the 8-week program would impact body weight or body fat, therefore these outcomes were not targeted.

Summary

Elementary age girls living in low SES urban communities are at high risk of suffering from compromised SD and SQ. Therefore, it is critical to identify modifiable risk factors that can improve sleep and test the feasibility, acceptability and efficacy of programs aimed at improving sleep in this population. The program was designed using combined PA and sleep education strategies in an attempt to improve sleep and PA in this at-risk population. The results could provide insightful strategies and considerations regarding the feasibility, acceptability and potential efficacy of addressing both of these health behaviors in girls living in low SES urban communities.
CHAPTER II
REVIEW OF LITERATURE

Overview

Pediatric obesity is a major public health epidemic in the United States. Recent data from the National Health and Nutrition Examination Survey (NHANES) suggests that 17.5% of children between the ages of 6-11 years are above the 95th percentile for Body Mass Index (BMI) (90). This is particularly concerning, given that obesity in youth has been associated with a number of cardiometabolic morbidities in children such as type 2 diabetes mellitus (T2DM), hyperlipidemia and hypertension (43, 57, 132). The prevalence of pediatric obesity has been associated with a lack of sufficient sleep (23, 62, 72). It has been demonstrated that obese children are more likely to experience short sleep duration (SD) and poor sleep quality (SQ) (23, 26, 44). The National Sleep Foundation recommendations are that children age 5-12 years should sleep about 10-11 hours per night (41). The most recent *Sleep In America Poll* conducted by the National Sleep Foundation suggests that 90% of all elementary age children do not meet these recommendations (18). Furthermore, girls living in low SES urban communities have been shown to be at an increased risk for compromised SD and SQ compared with children from more affluent communities (115, 117, 137). The prevalence of pediatric obesity has also been associated with a lack of physical activity (PA) (33, 80). Current recommendations suggest that children should accumulate at least 60 minutes of PA per day with the majority being moderate-to-vigorous PA (MVPA) (78). Despite these recommendations, NHANES data shows that only one third of all elementary age girls meet these PA guidelines (129). This is especially concerning given that children’s PA
levels continue to decline as they progress into adolescence and adulthood (85). Given this information, it appears that elementary age girls living in low SES urban environments could benefit the most from interventions seeking to improve SD, SQ and PA.

Sufficient sleep and PA not only are associated with reduced risk of obesity in youth, they can are also associated with the risk of cardiovascular disease (15, 17, 37, 80, 119). Many studies have reported an inverse association between both sleep and PA level with metabolic risk factors in children (15, 17, 37, 80, 119). Recently, Spruyt et al. examined the effects of SD and regularity of sleep schedules on BMI and metabolic homeostasis in children 4-10 years of age (119). The results suggest that children with short SD and irregular sleep schedules were at the highest risk for exhibiting impaired fasting insulin, low density lipoprotein and C-reactive protein levels (119). A longitudinal analysis of the association between PA guidelines and cardiometabolic risk factors revealed an inverse relationship between higher PA and lower composite cardiometabolic risk score (insulin resistance, triglycerides, cholesterol ratio and blood pressure) (80).

Despite this knowledge, there are no existing health behavior change interventions that have tested the feasibility, acceptability and efficacy of combined PA and sleep improvement strategies in children. More specifically, there have been no intervention strategies aimed at improving both PA and sleep in elementary age girls living in low SES urban communities, despite the fact that they are at high-risk for compromised low SD and poor SQ (115, 117, 137).

This review of literature is divided into three main sections. The first section discusses the physiological and behavioral links among sleep, PA and obesity in children.
The second section provides a review of sleep education interventions aimed at improving sleep in both adults and children. The third section will summarize the findings of successful PA interventions in children.

Physiological and Behavioral Links Among Sleep, Physical Activity and Obesity

It is well documented that obesity is predominantly caused by a chronic energy imbalance, in which individuals engage in excessive intake and insufficient expenditure of energy (63). A systematic review of longitudinal studies suggests that an inverse relationship between sleep and weight gain has been consistently observed in children (74). For example, a prospective analysis of 785 children found that longer parent-reported SD in third grade was associated with a 40% decreased risk of being overweight in sixth grade (72). Additionally, there is evidence to suggest that SD in childhood is negatively associated with adulthood obesity risk. Landhuis et al. examined data from prospective cohort of 1,037 individuals containing follow-up data from age 5 to 32 years old and found that increased parent-reported childhood SD was associated with a 35% decreased risk of being obese at age 32 (68). The findings from this body of literature has led researchers to suggest that SD is an independent risk factor for obesity, especially in children (46, 74).

In a 2008 meta-analysis, Patel and Hu (98) introduced a model pathway which suggested that short SD may impact both sides of the equation in a way that favors obesity by increasing caloric intake and reducing caloric expenditure. The researchers propose that insufficient sleep modulates appetite regulation by decreasing leptin and increasing ghrelin levels, ultimately increasing caloric intake (25, 98, 113, 116, 124).
These findings have been supported in children. Recently, Hart et al. (47) examined the effects of manipulating the sleep schedules on caloric intake and appetite regulatory hormones in 37 children age 8-11 years old. In a randomized crossover design, children spent one week on their normal sleep schedule, one week spending 1.5 hours less per night in bed than normal and one week spending 1.5 hours per night more in bed than normal. In the decreased sleep condition children consumed 134 calories per day more and had lower fasting leptin values compared with the increased sleep condition (47). Tatone-Tokuda et al. (126) prospectively analyzed the effects of sleep duration on dietary intake and eating behaviors in Canadian children (n=1,106) at ages 6 and 7. Children with shorter SD exhibited less frequent consumption of fruits and vegetables and more frequent consumption of soft drinks compared to children with longer SD. Additionally, parents of children who did not meet sleep recommendations were more likely to report that their children ate both too much and too quickly compared with reports from parents of children who met the recommendations (126).

In terms of energy expenditure, Patel and Hu (98) suggest that insufficient sleep increases daytime fatigue and in turn, decreases PA. While there is evidence to suggest decreased SD increases daytime sleepiness (13, 34, 76, 89, 110), the association between sleep and PA is inconsistent in children. For example, in a group of Swedish and Estonian children age 9-10 years (n=2,241), researchers observed no association between SD and PA (93). In contrast, Stone et al. (122) found that children who slept less than 9 hours per night on the weekdays were less active overall than those children who achieved the recommended 10 hours of sleep in a cohort of Canadian children (age = 11.1 years; n=865). It is also possible that PA is related to other aspects of SQ, rather than SD.
For example, a cross-sectional analysis of 1,231 Swedish children (6-10 years) found that higher daily levels of MVPA promoted sleep efficiency (proportion of bedtime spent actually asleep) on the following evening (38). Additionally, it has been proposed that children who are less active engage in more sedentary behaviors (SB) including increased use of light emitting screens, which delay the release of the hormone melatonin and delay the onset of sleep (22, 28, 31, 42). The findings from this body of literature are difficult to interpret due to differences in sleep assessment methods and outcome definitions. More work is needed using consistent measurement techniques to examine the relationship between SD, SQ, SB and PA in children.

There have been few studies examining the relationship between PA, SB, SD and SQ in elementary age girls living in urban communities. A recent examination of the influence of meeting PA, SD and screen time recommendations on childhood weight status revealed that only 9% of girls (7 – 12 years) who met all three recommendations were overweight or obese compared to 42.5% of girls who met none. Additionally, the authors noted that 30% of girls who met none of the recommendations were obese compared 22% of boys (69). These data suggest that perhaps the protective effect of meeting PA, sleep and screen time guidelines on weight status is greater in girls than boys in this age group. Recently, Wong et al. (137) examined relationships between PA, SB, and SD in a group of urban children in a low SES urban community (n = 483) and found an inverse relationship between SB and SD. However, the authors did not include measures of SQ in their analyses, despite the high prevalence of parent-reported SQ problems in children in low SES urban communities (115). Understanding if increasing PA and decreasing SB can improve SD and SQ in elementary age girls living in urban
communities is imperative in informing future prevention and treatment strategies in this population.

**Sleep Education Interventions**

**Adult Interventions**

Traditional sleep intervention approaches in adults have used combinations of cognitive behavioral therapy techniques such as delivering sleep education, normalization of bedtime routines, sleep restriction, and stimulus control to treat sleep problems (66, 76, 108, 121). Sleep education strategies typically involve delivering pertinent information about sleep guidelines, proper sleep habits and the benefits of meeting sleep recommendations (121). Normalization of sleep involves maintaining consistent bed times and wake times with the goal of developing a healthy sleep routine (76). Sleep restriction techniques require the individual to only attempt going to bed when they are sleepy and to remove themselves from bed when they are not tired, returning only when tired (35). Stimulus control is the practice of using the bedroom only as a place for sleep and removing items from the bedroom such as media devices that could negatively impact the integrity of the sleep environment (35). Sleep education interventions in adults have demonstrated improved effectiveness when compared to standard pharmacological treatments for insomnia, suggesting that they should be used in the prevention of sleep related problems (55, 83). These techniques have been proven most effective when used in combination with each other and when customized to the needs of the individual (35).

Several individualized sleep intervention programs have observed improvement in sleep related variables. For example, Suzuki et al. (123) found that significant
improvements in subjectively measured SQ were possible with just two weeks of internet based cognitive behavioral therapy including sleep education, daily sleep monitoring and individual feedback in 43 Japanese adult workers. Similar results have been reported using an intervention containing the same components delivered over a six week period by mail in older adults reporting insomnia symptoms (82). To expand on these findings, Kaku et al. (60) examined the impact of 20 days of 30-minute individualized cognitive behavioral therapy on the SQ of 151 Japanese electrical workers. The results indicated that the mean SQ score decreased (indicating improved sleep) in the intervention group and increased in the control group, who received no treatment (indicating worsened sleep) (60). Pech et al. (100) examined the effects of one week of group sleep education followed by five individual sessions of either cognitive behavioral therapy or problem solving training in 47 Australian adults between the ages of 18-60 years. The results suggest that both cognitive behavioral therapy and problem solving training were effective in improving SQ, but that there was no difference between the two interventions (100). The overall findings of these studies suggest that individualized CBT programs are an effective means to improve SQ in adults.

Recently, several comparative effectiveness trials have been conducted comparing the efficacy of individualized and group cognitive behavioral therapy approaches to treat sleep problems in adults. Nishinoe et al. (87) randomly assigned Japanese adults to either a group based sleep hygiene education intervention (n=62) or a combination of group based sleep education with individualized cognitive behavioral therapy (n=62). The group cognitive behavioral therapy intervention included five 40-minute sleep education sessions. The individual cognitive behavioral therapy included one 30-minute session that
began with the assessment sleep habits. Once sleep habits were assessed the individuals were asked to pick one of the following strategies that would be tailored specifically to their sleep needs: relaxation training, stimulus control or sleep restriction. The individuals were then given instructions on how to perform the given technique on a daily basis. The authors reported that the participants in the individualized cognitive behavioral therapy group significantly improved their SQ scores compared to the group cognitive behavioral therapy intervention (87). Yamadera et al. (138) randomized Japanese insomnia patients to either an individually treated (n=20) or a group treated (n=25) cognitive behavioral therapy program both consisting of stimulus control, sleep restriction, and sleep education. The conditions only differed in terms of one-on-one therapy vs. therapy in groups of three to five individuals at a time. The results indicated that individualized cognitive behavioral therapy improved objectively measured (actigraphy) and subjectively measured (Pittsburgh Sleep Quality Index) sleep onset latency, overall SQ and SD compared with group cognitive behavioral therapy in a group of Japanese insomnia patients (138). The findings from these studies suggest that individualized cognitive behavioral therapy is preferable to group therapy in adults.

**Child Interventions**

While individualized sleep intervention techniques have demonstrated consistent effectiveness in adults, pediatric sleep interventions are a relatively new area of research. The majority of studies have focused on sleep education as the primary intervention component in a school-based or group format (12). Blunden et al. (10, 11) tested the effects of the Australian Center for Education in Sleep education program on sleep
knowledge in both Australian primary school (n=55; mean age = 9.5 years) and high school (n = 22; mean age = 15.5 years) children. The program consisted of three presentations covering sleep facts, underlying causes and consequences of inadequate or poor sleep, sleep problems and solutions, as well as a student interactive workbook. The combined results from these studies suggest that sleep knowledge improved an average of 93% from pre-intervention scores following the three-week program (10, 11). Bakotic et al. (4) reported similar improvements in sleep knowledge in Croatian high school students (n = 1209; age range= 15-18 years, no mean reported) using a three week delivery of sleep education leaflets covering similar topics. There are many limitations to these studies, most notably the lack of comparison groups and no assessment of sleep behavior change. The findings from these studies also illustrate the fact that improving knowledge does not always reflect a change in the behavior.

Two preliminary studies tested the potential of the “sleep-smart” middle school sleep education program to change sleep behaviors over a 5-7 week period (70, 109). This program used a social learning classroom strategy focused on changing sleep behaviors and preventing irregular sleep and wake behaviors in adolescence. One of these studies used a subjective measure of sleep variables and found no notable improvements compared to a non-treated control (109). The other study objectively assessed sleep for 1-week via actigraphy in half of the experimental group (n=10) and subjectively in the other half (n=10). No significant differences were observed for objectively or subjectively measured sleep variables (70). In a similar study, Moseley and Gradisar (84) examined the effects of four 50-minute sleep education classes focused on promoting and maintaining healthy sleep habits in Australian high school students. One classroom was
randomly assigned to the intervention (n = 41 children in the classroom) and one classroom served as a control (n = 40 children in the classroom). Following the four-week intervention the researchers noted improvements in sleep knowledge with no improvements in sleep variables (84). The findings from these interventions are challenging to interpret due to the use of differing measures of sleep.

To date two studies have attempted to implement individualized sleep education interventions in pediatric populations (20, 133). Cain and Gradisar used a motivational interviewing technique to address sleep related problems in high school students (n=103; mean age = 16 years) (20). The program included five weekly sessions, which covered awareness of sleep health, role-playing scenarios, and behavioral experiments to engage students in behavior change and discussions on maintaining healthy sleep behaviors. Sleep habits were assessed via self-report. Daytime sleepiness was measured using the Pediatric Daytime Sleepiness Scale. Sleep knowledge was assessed using a 16-item quiz. Intentions to change sleep behaviors were assessed via a five-item questionnaire. Following the intervention, there were no changes in self-reported sleep habits or daytime sleepiness compared with the non-treated control group. Sleep knowledge and motivations to normalize sleep schedules improved in the intervention group compared to the control group. Given that this study was conducted in high-school age students, these findings may not be generalizable to younger children.

When addressing sleep behavior change in elementary age children, it is important to note that a child may have limited control over their bedtime routines. This could mean that including the parent in sleep intervention strategies is imperative. Recently, Willgerodt et al. (133) examined the feasibility of a series of three
individualized sleep education sessions to improve child sleep in nine parent-child dyads (8-11 years old) in an uncontrolled trial. Participants were asked to complete the Children’s Sleep Habits Questionnaire (CSHQ), complete a sleep diary and wear an accelerometer on their wrist for one week following the initial assessment. They repeated these measures following the motivational interviews and again one month following the program. At the second meeting, the CSHQ, sleep diary, and objective sleep data were reviewed with the participants. Open-ended questions allowed parents and children to explore their feelings and desires surrounding the child’s sleep. The interventionist then reviewed the facts regarding sleep and identified any discrepancies between desired outcomes and the measured behaviors. Parents and children then identified one targeted behavior to change. Using an individualized goal-setting tool, parents and children identified supports and barriers to this behavior and came up with an individualized plan. Dyads returned a week later to once again review the data and discuss discrepancies between the goals and behavior to determine if the intervention plan needed to change. Complete data was collected for only six dyads, therefore there were no statistical analyses performed. The authors noted that objective SD improved by more than 30 minutes on at least one night in all six children (133). While this was an extremely small pilot, all of the parents and children were able to agree upon a target behavior to change. This suggests that individualized interviewing techniques that include a parent are a potentially feasible and acceptable strategy for improving sleep in 8-11 year old children. Further research is needed testing the feasibility, acceptability and efficacy of this approach in at-risk populations, such as girls living in low SES urban environments.
Despite the knowledge that elementary age girls living in low SES urban communities are at a higher risk for compromised SD and SQ, there have been no interventions aimed at improving sleep specifically in this population. Additionally, no interventions in children have attempted to combine both sleep education and PA intervention strategies, even though there is a growing body of evidence that the two behaviors are linked. This project was the first to examine the effects of a sleep education intervention in combination with a PA intervention aimed at improving sleep and PA in elementary age girls living in an urban community.

**Physical Activity Interventions in Children**

Systematic reviews of PA interventions in children indicate that these strategies have produced small increases in objectively measured PA with no concomitant change in BMI (16, 61, 79). These interventions have mostly been implemented in the school, after-school, home and community settings, or some combination (61). While increases in PA have been small, a recent review and meta-analysis by Metcalf et al. shows that most interventions reporting success in improving PA in children have incorporated multicomponent models and modifications to the school, community and/or home environment (79). Examples and brief descriptions of some of these programs are outlined in Table 1. One of these studies examined the impact of participating in a physically active summer camp on PA on SD and quality in girls living in a low SES urban community. Bates *et al.* (9) reported improvements in MVPA, earlier bed times, and earlier wake times in urban girls following the 4-week summer program. While the authors were able to obtain pre-post PA and sleep data following the program, the camp
was not intended as a behavioral health intervention. Therefore, there were no reported process evaluation measures regarding feasibility and acceptability. Additionally, children tend to be more active due to increased opportunities to play outside, and sleep less due to later bedtimes during the summer compared with the academic months (3, 51, 88). No studies have examined the feasibility, acceptability and efficacy of intervening on both PA and sleep during the academic months in girls living in a low SES urban community. This program was the first to examine the effect of a combined PA and sleep education intervention in elementary age girls living in a low SES urban community and provides further insight into the relationship between these two behaviors in this population.
<table>
<thead>
<tr>
<th>Author and Year</th>
<th>Intervention Description</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barbeau, 2007(8)</td>
<td>Ten-month randomized controlled trial. The treatment consisted of an after-school program involving 80 min for PA, with focus on skill development, sustained MVPA and toning and stretching.</td>
<td>Girls in the treatment group increased their objectively measured MVPA by about 30 minutes per day.</td>
</tr>
<tr>
<td>Bates, 2015 (9)</td>
<td>The program lasted 4 weeks and included 6hr of daily structured activities each day including three 50-min morning PA sessions, 60 min of pool time, and 45 min of team PA. Each session provided instruction and PA through a variety of sports and fitness activities.</td>
<td>MVPA increased significantly during programming, with 28 additional minutes of MVPA at post-intervention.</td>
</tr>
<tr>
<td>Caballero, 2003 (19)</td>
<td>Three-year randomized, controlled, school-based trial in schools serving American Indian communities. The treatment consisted of four components: 1) change in dietary intake, 2) increase in PA, 3) a classroom curriculum focused on healthy eating and lifestyle, and 4) a family-involvement program.</td>
<td>There were no differences in objectively measured PA between treatment and control schools following the intervention. Self-reported PA was higher among intervention schools than control schools following the intervention.</td>
</tr>
<tr>
<td>Grydeland, 2013 (45)</td>
<td>Two-year school-based multicomponent cluster randomized intervention study to improve healthy weight development, increase physical activity, reduce sedentary time and a improve diet.</td>
<td>There was a significant intervention effect on overall PA a net effect of 50 cpm increase from baseline to post intervention in favor of the intervention group.</td>
</tr>
<tr>
<td>Hughes, 2008 (54)</td>
<td>One year randomized, controlled trial involving family-centered counseling and behavioral strategies to modify diet, physical activity, and sedentary behavior. The program consisted of 8 appointments (7 outpatient visits and 1 home visit) during 26 weeks with a total patient contact time of 5 hours.</td>
<td>There were significant between-group differences in favor of the intervention for changes in total PA, percentage of time spent in sedentary behavior, and light-intensity PA.</td>
</tr>
<tr>
<td>Jago 2012 (56)</td>
<td>Three-arm, cluster RCT. Three secondary schools were assigned to intervention arms. Intervention participants received a 9-week dance program with 2, 90-minute dance classes per week.</td>
<td>Results suggest between 5 and 12 minutes more weekday MVPA in the intervention group compared with the control incentives only group post-intervention.</td>
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<tr>
<td>Jones, 2008 (58)</td>
<td>1.5 year randomized controlled trial in adolescent girls. Treatment consisted of high-impact activities during the regular PE classes. Classroom lessons in PE and science classes designed to promote increased consumption of calcium-rich foods and increasing PA.</td>
<td>Following the intervention girls in the intervention schools engage in an average of six minutes more vigorous PA, nine minutes more after school PA and 19 minutes more PA on weekends than girls in the control group.</td>
</tr>
<tr>
<td>Kriemler, 2010 (64)</td>
<td>Multi-component physical activity program that included structuring the three existing physical education lessons each week and adding two additional lessons a week, daily short activity breaks, and physical activity homework.</td>
<td>Z-scores for MVPA in school, all day moderate-vigorous physical activity and total physical activity in school improved in the intervention vs. control groups.</td>
</tr>
<tr>
<td>Malone, 2008 (75)</td>
<td>Participants were given access to dance-dance revolution (DDR) in the home for 10 weeks. Effects on PA and sedentary screen time were compared in the intervention and the wait-list control at 10 weeks, and at 28-weeks, after the control had been given the system and game.</td>
<td>The DDR group showed increased vigorous PA and a reduction in light PA; the control group showed no increase in MVPA although they also had a reduction in light PA.</td>
</tr>
<tr>
<td>Pate, 2005 (96)</td>
<td>Two-year group-randomized controlled field trial for adolescent girls was conducted at 24 high schools. Treatment consisted of a physical activity intervention designed to change the curriculum and the school environment to increase PA support.</td>
<td>Following the intervention 45% of girls in the intervention schools reported vigorous physical activity during an average of 1 or more 30-minute time blocks per day over a 3-day period compared to 36% of girls in control schools.</td>
</tr>
<tr>
<td>Patrick, 2006 (99)</td>
<td>One-year randomized controlled trial for adolescent boys and girls age 11 to 15 years. Treatment consisted of a primary care, office-based, computer-assisted diet and PA assessment and goal setting.</td>
<td>Boys reported an increase in number of active days per week (intervention vs. control change: 4.1 to 4.4 d/wk. vs. 3.8 to 3.8 d/wk., respectively) following the intervention.</td>
</tr>
<tr>
<td>Author</td>
<td>Year</td>
<td>Study Design</td>
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<tr>
<td>------------</td>
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<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Rosenkranz</td>
<td>2010</td>
<td>One-year randomized controlled trial in girl scouts age 9-13. Seven Girl Scout</td>
</tr>
<tr>
<td>Sallis</td>
<td>1997</td>
<td>Two-year quasi-experimental study in elementary school children. Seven schools</td>
</tr>
<tr>
<td>Schneider</td>
<td>2007</td>
<td>One-year quasi-experimental study in high school students. Treatment consisted</td>
</tr>
<tr>
<td>Trost</td>
<td>2014</td>
<td>Participants in the program and active gaming group received hardware consisting</td>
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CHAPTER III
METHODS AND PROCEDURES

Study 1 – Associations among physical activity, sedentary behavior and sleep in elementary age girls living in a low socioeconomic status urban community

Overview
Currently, no studies have examined associations among PA, SB, SD and SQ in elementary age girls living in low SES urban communities. Therefore, the purpose of this study was to examine if PA and SB are associated with SD and SQ using the baseline data from a group of elementary age girls in a low SES urban community participating in two health behavior change interventions.

Participants
This study was a secondary analysis of baseline data collected for the Mothers and Daughters Dancing Together Trial (MAGNET) and the Girls Dancing and Sleeping for Health (Girls DASH; described in study 2) programs. The MAGNET program was a 12-week after school PA intervention aimed at improving PA levels in elementary age African-American girls living in a low SES urban community. The Girls DASH program was an 8-week after school PA and sleep education intervention aimed at improving PA and sleep levels in all elementary age girls from the same community. Both studies took place in the McKnight district in the city of Springfield, MA. This community is considered a low SES urban community based on a median family income of $27,009 per
year, with 32% of resident families falling beneath the poverty line. Girls were eligible for the MAGNET program if their primary maternal figure identified them as African-American, were between the ages of 7-10 years old and able to participate in physical education at school. Girls were eligible for the Girls DASH program if they were between the ages of 7-12 years old and able to participate in physical education at school. Girls were excluded from both studies if they had any conditions limiting their ability to participate in the PA program or unable to read or understand the assent document in English. Parents and girls provided informed consent and assent, respectively, to participate in this study. The University of Massachusetts institutional review board approved these studies.

**Outcome Assessments**

All baseline PA, SB, SD and SQ data were collected via the same methods, described for both the MAGNET and Girls DASH program. The only difference was that the MAGNET participants did not undergo accelerometer assessment of SD and SQ.

**Parent-Reported Sleep Duration and Quality Assessment**

All girls’ average SD and SQ were assessed via parental report using the CSHQ at baseline, 4-weeks and 8-weeks (95). This questionnaire has demonstrated high sensitivity ($r=0.80$), specificity ($r=0.72$) and test-retest reliability ($r=0.79$) in identifying sleep problems in children (95). Briefly, this questionnaire is a 45-item questionnaire that asks parents to report the frequency of various sleep behaviors within several domains within a typical week as well as average nightly bed times, morning wake times and SD. The
questionnaire items were then aggregated to obtain category scores for eight SQ domains and a composite SQ score, with higher scores indicating more frequently reported problems and worsened sleep.

**Accelerometer-Derived Sleep Duration and Sleep**

Girls wore a triaxial Actigraph accelerometer (Actigraph GT3x/GT3x+/ActisleepBT; Actigraph, LLC, Pensacola, FL) on their non-dominant wrist for seven consecutive days including during nighttime sleep to obtain accelerometer-derived measures of SD and SQ at baseline, 4-weeks and 8-weeks. Girls were instructed to only remove these monitors during times when they would be completely submerged in water (i.e., swimming). Non-wear time was identified and removed from analysis using the Choi et al. (30) algorithm. In order to be included in the analysis, participants had to wear the monitor for at least eight hours per day and at least three days per week. Raw acceleration data were collected at 30 Hz and reduced to 60-second epochs for the assessment of nocturnal sleep using the Sadeh et al. algorithm (111). This algorithm provided us with accelerometer-derived measures of bedtimes, wake times, number of minutes in bed, number of minutes spent asleep, sleep efficiency (percentage of time in bed spent asleep), awakenings after sleep onset and sleep fragmentation index scores.

**Physical Activity Assessment**

Girls’ PA was objectively measured using Actigraph GT3X accelerometers (Actigraph, LLC, Pensacola, FL) at baseline, 4-weeks and 8-weeks. Monitors were set to record data in 15-second epochs, given that the cut-point equation used was developed
using this sampling rate (39). Girls were instructed to wear the monitor on a small elastic belt over their right hip for seven consecutive days excluding times when the monitor would get wet and during nighttime sleep. The same wear time criteria described in the previous section were applied. The Evenson et al. (39) cut points for children were used to reduce accelerometer counts into periods of sedentary time, light PA (LPA), and MVPA. Counts per minute average (CPM) from the vertical axis of the accelerometer were assessed as a measure of average movement intensity.

**Child-Reported Sedentary Behavior**

Child-reported SB was assessed using a previously validated questionnaire, which has demonstrated high reliability ($r=0.94$) in elementary age girls living in a low SES urban community (104). Children were asked to report the number of minutes they spent in various types of SB in the morning (AM), afternoon and night (PM) on the most recent weekday and weekend day. Minutes from all SB questions were added together to determine weekday AM and PM SB, weekend day AM and PM SB, total weekday SB, and total weekend day SB. Minutes from all questions involving screen time were added together to determine weekday AM and PM screen time, weekend day AM and PM screen time, total weekday screen time, total weekend day screen time. Weekday values were multiplied by five and weekend day values were multiplied by two in order to estimate child-reported weekly SB, total weekly screen time, SB minutes per day, screen time minutes per day and PM screen time minutes per day.
**Statistical Analyses**

Only girls with baseline PA, child-reported SB, parent-reported SD, and parent-reported SQ data were included in the primary analysis. The PA data failed to meet the assumptions of normal distribution; therefore a log transformation was applied. Multiple linear regressions were used to determine if PA (percent of time spent in LPA, MVPA, and CPM) and child-reported SB (minutes per day of SB, screen time, and PM screen time) explained significant portions of the variance in parent-reported SD and parent-reported SQ. Given that there is a known effect of obesity on sleep in children, BMI percentile was included in all regression models (26). In cases where PA and child-reported SB explained significant portions of the variance in parent-reported SD and SQ, standardized regression coefficients were examined to determine which PA and/or child-reported SB variables were predictive of parent-reported SD and SQ. Given that the participants from the MAGNET program did not wear a wrist accelerometer for sleep assessment, only Girls DASH participants (n=24) had complete wrist and hip accelerometer data. Considering our limited power, partial correlations were used rather than regression to examine associations between PA and accelerometer-derived SD (minutes per night in bed, minutes of sleep per night, bed times and wake times) and SQ (sleep efficiency, awakenings after sleep onset and sleep fragmentation index) in girls who wore both monitors. Significance for all tests were determined using an $\alpha$ of $p < 0.05$. All analyses were performed in SPSS (version 23, Chicago, IL).
Overview

The purpose of the Girls DASH program was to examine the feasibility and acceptability of a PA and sleep education (sleep education) intervention in 7-12 year old girls living in a low SES urban community and secondarily, to examine the efficacy of the program on improving PA and sleep behaviors in this population. Primary outcomes were feasibility (recruitment and retention goals; process measures related to fidelity of intervention delivery and outcome measurement) and acceptability (attendance, degree of enjoyment of the lesson plans, and satisfaction with the overall program). Our secondary outcome variables were related to the efficacy of the program (changes in girls SD, SQ, total PA and SB).

After informed consent and baseline assessment, girls were randomly assigned to one of three groups: physical activity plus sleep education (PA+S), sleep education plus physical activity (S+PA) or control (CON). Over the course of the 8-week protocol, the PA+S participants (girls) were involved in an after-school dance classes for the entire 8-weeks (n=32 classes) and a series of three sleep education sessions with the child and primary caregiver aimed at improving sleep in girls over the final 4-weeks. The S+PA participants involved the same sleep education program, carried out over the 8-week protocol, with after-school dance classes (n=16 classes) added in the final 4-weeks. Participants in all groups received weekly after-school health education sessions, daily
homework tutoring and afterschool care. Process evaluation outcomes were assessed over the entire course of the study. Behavioral outcome variables were assessed again at 4 and 8-weeks following the start of the intervention. Changes over time and group comparisons of the behavioral outcome variables were assessed using linear mixed models with adjustment for potential confounders. A schematic of the study protocol is depicted in Figure 1.

Figure 1 – Girls DASH Protocol

**Participant Recruitment and Study Protocol**

**Initial Roadblocks**

At the onset of this project, our initial goal was to conduct a 12-week culturally tailored PA and sleep education intervention for elementary age Latina girls in Springfield, MA during the 2014-2015 school year. Latina girls are a population at high-risk of obesity, low PA and compromised sleep (17, 52, 71), therefore we wanted to design a program that served that community while addressing knowledge gaps in the sleep and PA literature. We experienced many difficulties making contacts in the Latina community, given that our lab has not specifically targeted this population previously.
Although the Springfield community is heavily Latino (38.6%), our recruitment strategies in the community were unsuccessful. We attempted to recruit heavily from within Rebecca M. Johnson Elementary School (intervention site), but were unsuccessful in recruiting and enrolling enough participants to begin a cohort of the intervention. After failing to launch cohorts in both the fall of 2014 and the spring of 2015, the decision was made to attempt the program in a different community.

We began to make contacts in the nearby Hampshire County Public School system during the spring of 2015 that we believed could assist us in reaching the local Latina community. These community members indicated that they would put us in direct contact with eligible participants and local Latina organizations. Although Hampshire County, MA has a very small Latina population (5.3%), we believed that our proximity to the community, the communities ties with the university, our contacts within the school system and the attractiveness of a free after-school health program would be enough to successfully launch a cohort in Summer 2015. We intended to hold the program on campus in order to take advantage of the proximity and public transportation aspects this location had to offer. However, the interest from our contacts within the Latina community began to quickly diminish for undisclosed reasons. We eventually completely lost contact with these individuals and were never put in contact with potential participants and pertinent organizations as promised. We attempted to advertise on public television, make additional contacts, generate recruiting opportunities and distribute flyers throughout the community however our efforts failed to generate enough interest to begin a cohort in this community. It became clear that we needed to adapt several aspects of our protocol in order to proceed with the project.
Protocol Changes

After failing to successfully launch a program in the Latina communities of Springfield and Hampshire County, the decision was made to return to the McKnight district in Springfield with several revisions to our protocols and recruitment strategies. First and foremost, further review of the pediatric sleep literature suggested that disparities in SD and SQ were more related living in a low SES urban environment than to racial differences (115, 137). Therefore, we felt it necessary to return to a low SES urban community where we had established contacts, remove the cultural tailoring components and open the program to elementary age girls of all races and ethnicities in this community. In addition to changing the population of interest, we decided to alter several aspects of the protocol that we believed could make the program more acceptable to our target population.

Initially, our plan was to design a program where the maternal figure participated in both the PA and sleep education components. However, we attempted to do this in the MAGNET trial and found higher attrition rates in the group where the maternal figure participated in the PA program. Therefore, we opted to remove the maternal PA component of the program. Additionally, we opted to shorten the program from 12-weeks to 8-weeks, in hopes that reducing the length of commitment would improve retention. Given that our previous recruitment materials and strategies had failed to reach enough participants previously in this community, it was necessary to seek alternate mediums of recruitment as well.

In addition to our previously described recruitment efforts, we began recruiting through Facebook. We developed a page that contained all pertinent program and contact
information and advertised that page to parents of elementary age girls within the local community. Recruitment numbers began to rise almost immediately and we were able to recruit 76% of our participants via Facebook. Between August-October of 2015, we were able to recruit enough participants to begin the intervention in the October of 2015.

Participants and Recruitment

The Girls DASH program was targeted at elementary age girls from the same low SES urban community. The program took place in the McKnight district of the city of Springfield, MA. The McKnight community is considered a low SES urban community based on a median family income of $27,009 per year, with 32% of resident families falling beneath the poverty line. The participant population consisted of 7-12 year old girls and their primary caregivers. In order to be included in the study, girls had to be 7-12 years old at baseline. Participants were excluded if they had conditions or injuries limiting their ability to participate in the primary assessments or the PA intervention.

Given that the primary outcomes of interest were related to study feasibility and acceptability, and the lack of pediatric sleep interventions using objective measurement techniques to assess changes in sleep (12), power calculations were generated to observe a significant change in parent-reported SD. In reviewing the literature, we found no interventions in elementary age children that observed significant improvements in parent-reported SD using the same measurement tool employed in this study. A small-moderate effect size (Cohen’s f=0.3) was calculated using the means and standard deviations from a similar length sleep education intervention that observed an increase in parent-reported SD in preschool children (136). We chose to use a study conducted in
preschoolers given that there were no available interventions of similar length that had reported changes in parental-reported or accelerometer-derived SD and SQ. To achieve a desired power of 0.8, it was determined that a total of 27 girls (PA+S, n=9; S+PA, n=9; CON, n=9) would need to complete the intervention to detect a significant group by time interaction for sleep duration at 0.05 level. Assuming a 30% attrition rate, the goal was to recruit 36 girls to participate in the program. Recruitment strategies included face-to-face recruiting at afterschool organizations, community events, distribution of flyers at local organizations and schools (Appendix 1) and social media targeted at parents of elementary age girls. All interested participants were asked to contact research staff for screening to insure they meet the study inclusion criteria (Appendix 2). We then assigned each participant a study ID to assure that all personal and contact information were de-identified. The baseline assessment visit (see below for description) was scheduled with all participants who met the inclusion criteria. All participants that completed baseline assessments were assigned a participant ID in order to de-identify their data, to assure that researchers were blinded during all randomization procedures.

**Enrollment and Randomization Protocol**

We continuously recruited participants and conducted baseline visits over the summer of 2015 until two weeks prior to the start of the intervention. Once all girls had completed baseline visits, they were randomized into the PA+S, S+PA, or CON groups. Randomization was stratified by girls’ BMI percentile. Stratification was done in an effort to obtain an even distribution of children above and below the 85th percentile for BMI across both groups, given its relationship with sleep and PA. Participants BMI
percentile was determined by entering girls’ baseline height, weight and date of birth into the Center for Disease Control (CDC) calculator for BMI percentile (https://nccd.cdc.gov/dnpabmi/calculator.aspx). Participants’ BMI percentiles were then separated into two groups (< 85th percentile or ≥ 85th percentile) and randomized separately into the PA+S, S+PA or CON groups. A trained member of the research staff who was not involved in the data analysis performed all randomization procedures.

**Intervention Development**

**Experimental Intervention Theoretical Framework**

Both the PA and sleep education interventions were based on the Social Cognitive Theory (6). This theory is largely based on the notion that behavior change is enhanced through improving self-efficacy (an individual’s confidence in their ability to perform a behavior). This is best achieved through positive experiences and environmental support (5). This intervention provided the opportunity for girls to interact in a physically active and educationally rich environment. The intervention was structured on the interplay of three types of factors: personal, behavioral, and environmental. The personal domain was addressed by having the girls participate in physical activity multiple times per week for one hour at a time. This gave girls ample opportunity to acquire skills regarding dancing and increase their PA. The behavioral domain was addressed by having girls engage in self-monitoring through completing sleep diaries and reviewing these diaries with the interventionist and their parents to form a behavior change plan and monitor progress. Girls were involved in selecting their own target sleep behavior, which entered them into a contract with themselves, their parents and the interventionist. The environmental
domain was addressed through manipulations to the sleep environment, which may improve SD and SQ. Together these factors may have improved the girls’ interest in the two treatment interventions and their self-efficacy to perform these behaviors, ultimately improving their sleep and/or PA.

**Sleep Education Intervention**

The sleep education process used was developed following a protocol adapted from Willgerodt et al (133). The results of the Willgerodt et al. study provided preliminary evidence that a small sample children 8-11 years old and their parents (n=9) were able to identify a target sleep behavior for change (133). The only difference in the protocol used in this study was that the PA+S group received three sleep education sessions over the course of the final 4-weeks, as where the S+PA group received three sessions over the course of the first 4-weeks. We chose to develop these two groups in order to compare the isolated effects of the PA and sleep education intervention on sleep behaviors at 4-weeks, and the combined effects at 8-weeks. We believed that both components had the potential to improve sleep, however that the combined effects would be more effective. Target behaviors for change and intervention strategies were selected based off a review of information from national sleep organizations and literature supporting their prevalence and associations with sleep in urban populations. These target behaviors, intervention strategies and supporting rationale are listed in Table 2.
<table>
<thead>
<tr>
<th>Target Behavior</th>
<th>Intervention Strategy</th>
<th>Rationale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watching TV, playing video games and/or using the computer within one hour of</td>
<td>In the initial intervention session, if dyads choose this target behavior, parents and children will be asked to identify the amount of time spent, the proximity to bedtime, and the location which the child watches TV, playing video games and/or using the computer. Dyads will then be given the following plan to change this behavior:</td>
<td>71% of children have a television in their bedroom, 50% have a game console in their bedroom, and 33% have internet access in their bedroom. (74). The light emitted from the screens of these devices has been shown to delay the release of melatonin, the primary hormone involved in falling asleep (28).</td>
</tr>
</tbody>
</table>
| bedtime                                                                         | 1. Reducing the total amount of screen time the child is exposed to per day  
2. Restricting the usage of televisions, game consoles and computers within an hour of bedtime                                                                 |                                                                                                                                                                                                                                                                                           |
| Intake of caffeinated beverages before bedtime                                   | In the initial intervention session, if dyads choose this target behavior parents and children will be asked to identify the amount of caffeinated beverages consumed by the child daily and how close to bedtime caffeinated beverages are consumed. Dyads will then be given the following plan to change this behavior: | A recent poll of 287 children revealed that 75% of children consume caffeine and that children between 8-12 years old consumed 109 mg of caffeine, the equivalent of 2.5 cans of cola (131). This study also revealed that consumption of caffeine is negatively correlated with total hours of sleep in children (131). Data from the National Sleep in America poll suggest that children who consume caffeine daily sleep an average of 15 minutes less per night than children who do not consume caffeine (22). |
The sleep environment:
noise and temperature

In the initial intervention session, if dyads choose this target behavior parents and children will be asked to identify the temperature and/or potential sources of noise both inside and outside the room in which the child sleeps. Dyads will be given the following plan to manipulate the sleep environment in a way that is more conducive to sleep:

1. Increasing or decreasing the temperature of the room so that it is closer to optimal temperature through changing the air conditioning/heat or using a fan/space heater. If the parents cannot afford to alter the temperature in the room they will be presented with the option to reduce the amount of clothing/blankets the child sleeps in.

2. Implementing the use of a “white noise” instrument such as a sound conditioner (free app for smart phones), fans, air purifiers, or light relaxing music/books on tape, depending on what is available in the home.

Research suggests that maximal sleep time is achieved at an average room temperature of 65 degrees when wearing pajamas or at least one sheet with noise levels below 50 decibels (the equivalent of a quiet conversation) (92). In situations where people are exposed to noisy environments the addition of “white noise” can help mask the sounds coming from inside and outside the room (120).
Physical Activity Intervention

Our lab recently conducted focus groups with mother-daughter dyads in the Greater Springfield/Holyoke, MA community in order to determine the types of PA and components of a PA program that would incite participation from elementary age girls in low SES urban communities. From these focus group meetings, it was determined that a dance program was the best approach. The top dance styles that participants indicated they would be interested in participating in were hip-hop and jazz.

The dance routines utilized were previously developed for the MAGNET intervention. Professional dancers were hired to create one ten-minute routine for each dance style. Each routine consisted of brief warm-up (1-2 minute), 7-8 minute MVPA dance routine and a brief cool-down (1-2 min). Each routine was videotaped onto DVD. A female dance instructor was hired to learn each routine and teach the daily intervention. Instructors had to demonstrate prior experience teaching both dance styles to 7-12 year old children. Dance instructors were required to complete a Criminal Offender Record Information check to ensure that they did not have any previous criminal charges that deemed her unfit to work with children. Prior to teaching each dance style, the dance instructor was required to perform the routine for the research staff to demonstrate fidelity of the dance movements.

Health Education Intervention

Girls in all three groups participated in the health education portion of the intervention. The health education intervention served as a standard care control and contains “active components” that differ from the other components of the intervention.
The health education intervention consisted of eight mini health lessons (15 minutes each, 1x week). These mini lesson topics were centered on health topics derived from the CDC and from the focus group data that were previously collected. These topics were chosen based on their relevance to the communities of greater Springfield, MA area. The following topics were covered in the mini health lessons:

1. Benefits of PA
2. PA recommendations
3. Ways to accumulate PA
5. Nutrient types, reading food labels and 30-minute healthy meals
6. Communication skills
7. Improving academic performance
8. Bullying

*Developing the mini lessons*

For each topic, detailed background information was gathered. This information was used to generate an outline of each lesson. Each lesson had the following sections:

1. Information dialogue: This section was formatted as a dialogue between the interventionist and the children. The interventionist asked leading questions to gauge children’s current level of understanding of the topic, followed by delivery of key points and information.
2. Kids activity zone: Each mini lesson had an accompanying activity that applied the knowledge items delivered in the lesson. These activities were
taken from various age appropriate health education outlets and selected by
the research staff.

**Study Procedures**

**Data Collector Training**

All data collectors underwent a training session led by the study PI in August
prior to collecting any baseline data. Data collectors had to demonstrate proficiency in
delivering all questionnaires in interview format to both daughters and mothers in mock
interviews observed by members of the leadership team. Data collectors had to
demonstrate the ability to correctly place both the Actigraph and Actisleep monitors on
participants. All data collectors were trained in measuring height, weight, and body fat
via handheld bioelectrical impedance. Once data collectors had been trained in all
physical measurement techniques, a member of the research staff performed height and
weight measurements on all members of the data collection team. Each data collector was
randomly assigned three members of the data collection team for whom they were
responsible for collecting height and weight data. Their numbers were compared for
agreement with those collected by the research staff on the same three individuals. If any
measurements fell outside the acceptable range of variability (0.3 kg for weight, 0.5 cm
for height), the data collector was assigned another three individuals to assess. Each data
collector also performed body fat measurements on those same three members of the data
collection team. Immediately prior to this the data collector was asked to leave the room
while a member of the leadership team performed these measurements on the same three
individuals. A member of the leadership team observed the measurement process and
compared their values for agreement with those obtained by the leadership team. If data
collectors displayed deficiency in executing the measurement procedure or any measurements fell outside the acceptable range of variability (4% for body fat), the data collector was assigned another three individuals to assess. Once data collectors demonstrated proficiency in all physical measurement and questionnaire techniques they obtained certification to collect data by a member of the leadership team.

**Intervention Descriptions**

**Sleep Education Interventions (PA+S and S+PA Groups)**

The sleep education intervention consisted of three sessions over the course of the final 4-weeks of the 8-week protocol in the PA+S group, and over the first 4-weeks of the 8 week protocol in the S+PA group. Girls and their primary caregivers in the PA+S and S+PA groups participated in three (initial intervention and two follow-up intervention) sessions. The format of these sessions was adapted from Willgerodt et al (133). Each session was scheduled to take approximately 45 minutes. The primary interventionist conducted all interviews.

The initial intervention was conducted in week 5 for the PA+S group and week 1 for the SE+PA group. Prior to the session, the interventionist reviewed and printed the child’s baseline sleep data for the session. The session began with an open-ended discussion between the interventionist, primary caregiver and daughter regarding the child’s sleep habits, challenges going to sleep and waking up and sleepiness during the day. The interventionist took detailed notes on the conversation to get an idea of potential problems surrounding the child’s sleep. The interventionist then summarized the notes taken verbally with the participants and clarified any points of confusion. The
interventionist then reviewed information on the purpose of sleep, how sleep works, the benefits of proper sleep, sleep tips and sleep traps sections of the National Sleep Foundation’s “Sleep For Kids” service. This service can be found at http://www.sleepforkids.org/index.html. The interventionist reviewed the child’s sleep diary and Actisleep data with the primary caregiver and daughter to initiate a conversation regarding the target behavior to change. The interventionist then highlighted any discrepancies from the sleep diary and the child’s baseline sleep data. The interventionist introduced the three target behaviors for improving sleep previously outlined in Table 2. Primary caregivers and children were then asked to consider the information reviewed from the sleep diary, sleep data and educational information and agree upon one of the three target behaviors to work on. Finally, once the dyad selected the target behavior, the interventionist outlined the strategy for changing the targeted behavior described in Table 2. The dyad was then asked to schedule the first follow-up intervention session following the initial intervention session.

The two follow-up intervention sessions served to monitor the success in implementing the target behavior change plan. The follow-up intervention sessions took place one week and two weeks following the initial intervention session. One week prior to each follow-up intervention session, participants received a copy of the National Sleep Foundation Sleep Diary (NSFSD, Appendix 3) to complete for seven consecutive days prior to the session. Success in implementing the intervention plan was determined from changes in the factors that disturbed sleep such as temperature or noise, consumption and timing of caffeinated beverages or activities performed within an hour of bedtime items on the NSFSD depending on the target behavior selected. If the target behavior was
moving in the desired direction, the dyad was encourage to maintain the current plan of action. If the target behavior was not changing or moving in the opposite direction, the interventionist and the dyad discussed why the changes are not being made and what changes can be made to the plan to improve its success at the end of the follow-up intervention sessions.

**Physical Activity Intervention (PA+S and S+PA Groups)**

Girls assigned to the PA+S group participated in an after school dance program in weeks 1-8 of the program. Girls assigned to the S+PA group participated in the dance classes in weeks 5-8 of the program. The dance classes were scheduled to take place from 5:30-6:30 p.m. Each dance style was scheduled to rotate on a bi-weekly basis and was instructed for a total four weeks. Dance classes were scheduled for one hour and offered four times per week (Monday-Thursday). The dance instructor was instructed to divide each 10-minute routine into segments to instruct during the dance class, culminating in a full routine by the end of each bi-weekly cycle. Each session included a 2-minute warm up, 2-minute cool down, and 56 minutes for MVPA dance instruction.

**Health Education Intervention (PA+S, S+PA and CON Groups)**

All participants in the PA+S, S+PA and the CON groups received the health education intervention. Girls were given the same mini health lessons each week with their assigned group on a randomly assigned day. Each lesson was 15 minutes in duration and culminated with a written activity that applied the knowledge gained during the lesson. Once participants in the CON group completed the entire 8-week intervention
protocol, they were offered the dance classes once per week for 8-weeks in the spring of 2016.

**Intervention Schedule**

The intervention was scheduled 4 days/week (Mondays, Tuesdays, Wednesdays and Thursdays from 3:30-6:30 p.m.) for 8 weeks at Rebecca Johnson Elementary School in the McKnight district of the city of Springfield, MA. Given the lack of resources required to provide transportation, participants needed to provide their own means of transportation. Upon arrival at the intervention, girls signed in on their designated group sign-in sheet and received a healthy snack until 4:00 p.m. Snacks were chosen based off of the following criteria: 1) Under 150 calories per serving 2) at least one serving of whole grains and 3) less than 15 g of sugar per serving. During the 8-week intervention, from 4:00-5:30 p.m. all participants received homework tutoring and after-school care provided by UMass undergraduate students. The CON group was in homework tutoring/daycare from 4:00-6:30 p.m. Daycare included structured activities, arts and crafts and leisure reading materials provided by the intervention staff. Girls who were scheduled to dance participated in the dance class from 5:30-6:30 p.m.

**Measurements**

**Feasibility**

We assessed the feasibility of our intervention by measuring our success in attaining our recruitment goals (% of target), limiting attrition (% of target), obtaining outcome assessments (% of randomized sample with outcome data at each time point),
and our fidelity in delivering both the PA and sleep education aspects of the intervention as intended. Information regarding the duration of the dance routine, style of dance being taught and music selected was recorded daily. A trained member of the research staff recorded whether more than half the class appeared to be enjoying and participating in the dance, as well as the proper implementation of the routine in the dance classes (Appendix 4). Intensity of the dance sessions was monitored on one randomly selected day per week using accelerometers. A trained member of the research staff monitored attendance at the sleep education sessions and the proper implementation of the session protocols (Appendix 5).

**Acceptability**

We measured the acceptability of our program by monitoring attendance, adherence and post-program satisfaction. Girls in all groups were required to sign-in during each intervention day to determine attendance. A head count was also taken during the dance sessions to determine how many girls participated each day in the dance classes. We also monitored the number of sleep education sessions and sleep diaries completed by both the primary caregivers and children in the PA+S and S+PA groups.

At the end of the program, primary caregivers and children were given post-program satisfaction surveys. For this survey, primary caregivers (Appendix 6) and children (Appendix 7) were asked to rate their level of satisfaction (on a scale of 1 – 5) with the different components of the program. Children were given a multiple choice questionnaire at the end of the program to assess the bedroom environment in terms of screen presence, screen usage, noise, light and temperature levels in the bedroom.
(Appendix 8). The decision to include the bedroom environment questionnaire came after the intervention had begun, therefore we do not have baseline data for these measures. Primary caregivers and children were also contacted by phone and asked open-ended questions regarding the specific aspects of each component they were the most and least satisfied with, as well as suggestions to improve the intervention (Appendix 9).

**Efficacy (Secondary Outcomes)**

**Data collection sessions**

All baseline measurements took place in the participant’s home during the early Fall of 2015. All visits took place at a time that was most convenient for the participants and was about 1.5 hours in duration. Primary caregivers and daughters were asked to first sign informed consent (Appendix 10) and assent (Appendix 11) forms. Each visit was carried out by at least two trained members of the research team. Once consent and assent were given, one member of the research staff began physical measurements on the primary caregiver and the other on the girl. After the completion of physical measurements, the questionnaires were delivered in an interview format to girls by a member of the research team and recorded on paper, while primary caregivers completed their own form. However, research staff was available to answer any questions that the primary caregiver might have. The midpoint and post intervention assessments were performed at the intervention site at 4-weeks and 8-weeks in addition to the dance sessions and followed the same data collection protocols as baseline.
Parent-Reported Sleep Duration and Quality Assessment

All girls’ average SD and SQ were assessed via parental report using the Children’s Sleep Habits Questionnaire CSHQ at baseline, 4-weeks and 8-weeks (95). This questionnaire has demonstrated high sensitivity ($r=0.80$), specificity ($r=0.72$) and test-retest reliability ($r=0.79$) in identifying sleep problems in elementary age children (95). Briefly, this questionnaire is a 45-item questionnaire that asks parents to report the frequency of various sleep behaviors within several domains within a typical week as well as average nightly bed times, morning wake times and SD. The questionnaire items were then aggregated to obtain category scores for eight SQ domains and a composite SQ score, with higher scores indicating more frequently reported problems and worse sleep. A modified version of this questionnaire used in this study can be found in Appendix 12.

Accelerometer-Derived Sleep Duration and Sleep Quality

Girls wore a triaxial Actigraph accelerometer (Actigraph GT3x/GT3x+/ActisleepBT; Actigraph, LLC, Pensacola, FL) on their non-dominant wrist for seven consecutive days including during nighttime sleep to obtain accelerometer-derived measures of SD and SQ at baseline, 4-weeks and 8-weeks. Recently, the manufacturer ceased producing the Actisleep models and provided firmware and software updates that allowed us to use all of our triaxial monitors to measure sleep. Girls were instructed to only remove these monitors during times when they would be completely submerged in water (i.e., swimming). All data were processed using Actilife 6 software (Actigraph, LLC, Pensacola, FL). Non-wear time was identified and removed from analysis using the Choi et al. (30) algorithm. In order to be included in the analysis,
participants had to wear the monitor for at least eight hours per day and at least three days per week. Raw acceleration data were collected at 30 Hz and reduced to 60-second epochs for the assessment of nocturnal sleep using the Sadeh et al. algorithm (111). This algorithm provided us with accelerometer-derived measures of bedtimes, wake times, number of minutes in bed, number of minutes spent asleep, sleep efficiency (percentage of time in bed spent asleep), awakenings after sleep onset and sleep fragmentation index scores.

**Physical Activity Assessment**

Girls’ PA was measured using Actigraph GT3X accelerometers (Actigraph, LLC, Pensacola, FL) at baseline, 4-weeks and 8-weeks. Monitors were set to record data in 15-second epochs, given that the cut-point equation used was developed using this sampling rate (39). Girls were instructed to wear the monitor on a small elastic belt over their right hip for seven consecutive days excluding times when the monitor would get wet and during nighttime sleep. The same wear time criteria described in the previous section were applied. All data were processed using Actilife 6 software (Actigraph, LLC, Pensacola, FL). The Evenson et al. (39) cut points for children were used to reduce accelerometer counts into periods of sedentary time, LPA, and MVPA. Counts per minute (CPM) from the vertical axis of the accelerometer were assessed as a measure of average movement intensity. Variables of interest were percent of wear time spent in all PA intensities and CPM during the entire period of observation, the intervention time (Monday-Thursday, 3:30 pm – 6:30 pm) and the dance class time (Monday-Thursday, 5:30 pm – 6:30 pm).
Child-Reported Sedentary Behavior

Child-reported SB was assessed using a previously validated questionnaire, which has demonstrated high reliability ($r=0.94$) in elementary age girls living in a low SES urban community (104). Children were asked to report the number of minutes they spent in various types of SB in the morning (AM), afternoon and night (PM) on the most recent weekday and weekend day. Minutes from all SB questions were added together to determine weekday AM and PM SB, weekend day AM and PM SB, total weekday SB, and total weekend day SB. Minutes from all questions involving screen time were added together to determine weekday AM and PM screen time, weekend day AM and PM screen time, total weekday screen time, total weekend day screen time. Weekday values were multiplied by five and weekend day values were multiplied by two in order to estimate child-reported weekly SB, total weekly screen time, SB minutes per day, screen time minutes per day and PM screen time minutes per day. A modified version of this questionnaire used in this study can be found in Appendix 13.

Mediators/moderators and Confounding Outcome Variables

Anthropometric Measures and Demographic

Trained members of the research staff assessed physical measurements of girls at baseline, 4-weeks and 8-weeks. Height was measured using a direct reading stadiometer, and taken twice to the nearest 0.1 cm (third time if difference between trials is $> 5$ mm). Weight was measured using a digital scale twice to the nearest 0.1 kg (third time if difference between trials is $> 0.2$ kg mm). BMI was calculated using mean/median of trials for height and weight (kg/m$^2$). For children, BMI percentiles were determined using
the CDC growth charts. Demographic information was obtained at baseline via structured questionnaire with questions completed by the primary caregiver about race, ethnicity, education, marital status, and family income.

**Sleep and Physical Activity Self-Efficacy**

Girls’ sleep and PA self-efficacy was assessed at baseline, 4-weeks and 8-weeks. Girls’ sleep self-efficacy was measured using the Sleep Self-Efficacy Scale (67). The modified version of this questionnaire that was be used in this study can be found in Appendix 15. This scale generated a numeric score for sleep self-efficacy, however these values have not been validated in any populations. This questionnaire is the only questionnaire of its kind and there are no validated questionnaires for assessing sleep self-efficacy in any population. Girls’ PA self-efficacy was assessed using the Children's Self-Perceptions of Adequacy in and Predilection for Physical Activity (CSAPPA), which has demonstrated high reliability (r=0.84) and moderate validity (r=0.50) in elementary age children (48). A modified version of this questionnaire that was used in this study can be found in Appendix 16.

**Statistical Analyses**

Intention-to-treat analysis was conducted using two different methods. First, linear mixed models with main effects for group and time, as well as group*time interactions were used to examine changes in outcome variables using only the available data for each variable at each time point. Second, multiple imputations were used to predict and replace missing values. A series of 5 linear imputations were conducted using
all anthropometric, accelerometer, child-reported and parent-reported variables at all time points to predict and replace all missing values. Given that imputing the missing values gave us a balanced data set, we used repeated-measures MANOVAs with main effects for group and time, as well as group*time interactions were used to examine changes in outcome variables using the imputed data set. Differences in baseline values across groups for all outcome variables were tested using one-way ANOVAs. Two sets of group comparisons were performed. In the first set of comparisons, all three groups were treated as separate (PA+S vs. S+PA vs. CON). In the second set of comparisons, the two intervention groups were combined and compared to the CON group (PA+S and S+PA vs. CON). These comparisons were done in order to test the efficacy of participating in either combined PA and sleep education group compared to CON. In cases where there were significant differences between groups at baseline, these variables were included as covariates in the linear mixed models and repeated measures MANOVAs. In all cases where there were significant main effects and/or interactions, Bonferroni corrections for multiple comparisons were applied to detect where the differences lie. Statistical significance for all tests was determined using a α of $p < 0.05$. All analyses were performed in SPSS (version 23, Chicago, IL).
CHAPTER IV
MANUSCRIPTS

Study 1 – Associations among physical activity, sedentary behavior and sleep in elementary age girls living in a low socioeconomic status urban community

ABSTRACT

Background: Insufficient sleep duration (SD) and sleep quality (SQ) in children is associated with higher risk of poor health outcomes in elementary age girls living in low socioeconomic status (SES) urban communities. Decreased physical activity (PA) and sedentary behavior (SB) may be associated with poor SD and SQ. This study examined if PA and SB are associated with SD and SQ in elementary age girls from a low SES urban community. Methods: Baseline PA, SB, SD and SQ data from 7-12 year old girls (n = 55) participating in two interventions conducted in a low SES urban community was used for analysis. PA was measured via accelerometry for 7 days. SB, SD and SQ were assessed via validated child/parental report instruments. SD and SQ were also assessed via accelerometry in a subsample of girls (n = 24) for 7 days. Results: There was an association between child-reported SB and parent-reported SQ ($p = 0.01$, $r^2 = 0.35$, $r^2$ adjusted = 0.23). More screen time per day was predictive of worsened parent-reported SQ ($\beta = 0.50$, $p = 0.02$). In terms of accelerometer measures, there were negative correlations between PA and the number of nighttime awakenings (LPA partial $r = -0.45$, $p = 0.04$; MPA partial $r = -0.44$, $p = 0.04$; VPA partial $r = -0.45$, $p = 0.04$) and between counts per minute average (CPM) and sleep fragmentation (partial $r = -0.65$, $p = 0.002$). Conclusions: In this population, increased child-reported SB was associated it with worse parent-reported SQ and decreased PA was correlated with more accelerometer-
derived awakenings per night and higher sleep fragmentation. These findings suggest that SB and PA may be modifiable risk factors for interventions seeking to improve sleep in this population. More work is needed using longitudinal designs, larger samples to confirm the nature and existence of these relationships.
Introduction

Children’s sleep duration (SD) and sleep quality (SQ) decline significantly as they progress from childhood into adolescence (41, 134). These trends present a major public health concern, given that insufficient SD and poor SQ have been associated with an increased risk of poor physical (i.e., obesity and diabetes mellitus) and mental (i.e., cognitive function and depression) health throughout the lifespan (23, 50, 89). In order to combat these trends, it is paramount to identify modifiable risk factors that are associated with SD and SQ, especially in populations at high-risk for compromised SD and SQ (12). While SD and SQ decline in all children as they age, children living in low socioeconomic status (SES) urban communities experience a greater reduction in both SD and SQ compared to children living in more affluent communities (32, 115, 137). Several studies have indicated that increased sedentary behavior, increased screen time and decreased physical activity (PA) are modifiable risk factors associated with poor sleep in children (22, 38, 69, 93). It has been suggested that children who are more physically active and less sedentary will be more fatigued at the end of the day, leading to improved sleep (97). With respect to screen time, research has shown that increased exposure to light emissions from media devices such as television, cell phones and tablets, especially in the evenings, delays the onset of sleep by attenuating the release of melatonin, a key hormone in initiating the sleep cycle (28).

There are studies that have examined the relationship between PA, SB, and SD in children, however the findings are inconsistent (50, 69, 93). Furthermore, it remains unclear if decreased PA and/or increased SB are predictive of compromised SD and SQ.
in elementary age children living in urban communities. Currently, only one study has examined the associations between times spent in different PA intensities and SD in a bi-ethnic sample of urban children and reported a negative association between SB and SD (137). The authors also noted that girls slept significantly less than boys, indicating that girls living in these types of communities may be at higher risk for compromised sleep (137). However, this study did not include measures of SQ, investigate components of SB that would most likely impact sleep (i.e. screen time), or stratify their results by gender. Currently, no studies have examined whether PA and SB are associated with SD and SQ in elementary age girls living in low SES urban communities. Therefore, the purpose of this study was to examine associations among PA, SB, SD and SQ in a group of elementary age girls participating in two health behavior change interventions conducted in a low SES urban community.

**Methods**

**Participants**

This study was a secondary analysis of baseline data collected for the Mothers and Daughters Dancing Together Trial (MAGNET) and the Girls Dancing and Sleeping for Health (Girls DASH) programs. The MAGNET program was a 12-week after school PA intervention aimed at improving PA levels in urban African-American girls. The Girls DASH program was an 8-week after school PA and sleep education intervention aimed at improving PA and sleep levels in urban girls. In both studies, girls were recruited from the greater Springfield, MA area. Girls were eligible for the MAGNET program if their primary maternal figure identified them as African-American, were
between the ages of 7-10 years old and able to participate in physical education at school. Girls were eligible for the Girls DASH program if they were between the ages of 7-12 years old and able to participate in physical education at school. Girls were excluded from both studies if they had any conditions limiting their ability to participate in the PA program or unable to read or understand the assent document in English. Parents and girls provided informed consent and assent, respectively, to participate in this study. The University of Massachusetts institutional review board approved the study.

**Physical Activity Assessment**

Trained research staff members collected all data either in the participant’s home or at the intervention site. Girls’ PA was objectively measured using Actigraph GT3X accelerometers (Actigraph, LLC, Pensacola, FL). Monitors were set to record data in 60-second epochs during the MAGNET study. However, for Girls DASH, we opted to collect data at 15-second epochs. Therefore, all Girls DASH files were converted to 60-second epochs, so that we could employ the same reduction techniques to all participants. Girls were instructed to wear the monitor on a small elastic belt over their right hip for seven consecutive days excluding times when the monitor would get wet and during nighttime sleep. All data were processed using Actilife 6 software (Actigraph, LLC, Pensacola, FL). Non-wear time was identified and removed from analysis using the Choi et al. (30) algorithm. In order to be included in the analysis, participants had to wear the monitor for at least eight hours per day and at least three days per week. The Evenson et al. (39) cut points for children were used to reduce accelerometer counts into periods of
light PA, moderate PA (MPA) and moderate-to-vigorous PA (MVPA). Vector magnitude counts per minute (CPM) were assessed as a measure of average movement intensity.

**Child-Reported Sedentary Behavior**

Child-reported SB was assessed using a previously validated questionnaire, which has demonstrated high reliability ($r=0.94$) in elementary age girls living in a low SES urban community (104). Children were asked to report the number of minutes they spent in various types of SB in the morning (AM), afternoon and night (PM) on the most recent weekday and weekend day. Minutes from all SB questions were added together to determine weekday AM and PM SB, weekend day AM and PM SB, total weekday SB, and total weekend day SB. Minutes from all questions involving screen time were added together to determine weekday AM and PM screen time, weekend day AM and PM screen time, total weekday screen time, total weekend day screen time. Weekday values were multiplied by five and weekend day values were multiplied by two to determine total weekly SB, total weekly screen time, SB minutes per day, screen time minutes per day and PM screen time minutes per day.

**Parent-Reported Sleep Duration and Quality Assessment**

All girls average SD and SQ were assessed via parental report using the Children’s Sleep Habits Questionnaire (95). This questionnaire has demonstrated high sensitivity ($r=0.80$), specificity ($r=0.72$) and test-retest reliability ($r=0.79$) in identifying sleep problems in elementary age children (95). Briefly, this questionnaire is a 45-item questionnaire that asks parents to report the frequency of various sleep behaviors within
several domains within a typical week as well as average nightly bed times, morning wake times and SD. The questionnaire items were then aggregated to obtain a composite SQ score, with a higher score indicating more frequently reported problems and worsened sleep.

**Accelerometer-Derived Sleep Duration and Quality**

Girls who participated in the Girls DASH program (n=24) also wore a triaxial Actigraph accelerometer (Actigraph GT3x/GT3x+/ActisleepBT; Actigraph, LLC, Pensacola, FL) on their non-dominant wrist for seven consecutive days including during nighttime sleep to obtain accelerometer-derived measures of SD and SQ. Recently, the manufacturer ceased producing the Actisleep models and provided firmware and software updates which allowed all of our triaxial monitors to measure sleep. Girls were instructed to only remove these monitors during times when they would be completely submerged in water (i.e., swimming). All data were processed using Actilife 6 software (Actigraph, LLC, Pensacola, FL). Non-wear time was identified and removed from analysis using the Choi et al. (30) algorithm. In order to be included in the analysis, participants had to wear the monitor for at least eight hours per day and at least three days per week. Raw acceleration data were collected at 30 Hz and reduced to 60-second epochs for the assessment of nocturnal sleep using the Sadeh et al. algorithm (111). This algorithm provided accelerometer-derived measures of bedtimes, wake times, number of minutes spent in bed, number of minutes spent asleep, sleep efficiency (percentage of time spent in bed spent sleeping), number and length of nighttime awakenings and sleep fragmentation index scores.
Physical Measures

Girls’ height was measured to the nearest 0.1 cm using a portable stadiometer. Girls’ weight was measured to the nearest 0.1 kg using a Scale-Tronix 5125 digital scale (Scale-Tronix, LLC, White Plains, NY). BMI was calculated as kg/m² and BMI percentile ranks for age and gender were determined using the Center for Disease Control growth charts (91).

Statistical Analyses

Only girls with baseline PA, child-reported SB, parent-reported SD, and parent-reported SQ data were included in the primary analysis. The PA data failed to meet the assumptions of normal distribution; therefore a log transformation was applied. Multiple linear regressions were used to determine if PA (percent of time spent in LPA, MVPA, and CPM) and child-reported SB (minutes per day of SB, screen time, and PM screen time) explained significant portions of the variance in parent-reported SD and parent-reported SQ. Given that there is a known effect of obesity on sleep in children, BMI percentile was included in all regression models (26). In cases where PA and child-reported SB explained significant portions of the variance in parent-reported SD and SQ, standardized regression coefficients were examined to determine which PA and/or child-reported SB variables were predictive of parent-reported SD and SQ. Given that we only had wrist and hip accelerometer data on the Girls DASH participants (n=24), partial correlations were chosen rather than multiple linear regression to examine associations...
between PA and accelerometer-derived bedtimes, wake times, number of minutes spent in bed, number of minutes spent asleep, sleep efficiency (percentage of time spent in bed spent sleeping), number and length of nighttime awakenings and sleep fragmentation index scores. Significance for all tests were determined using an $\alpha$ of $p < 0.05$. All analyses were performed in SPSS (version 23, Chicago, IL).

**Results**

A total of 55 (MAGNET n=31; Girls DASH n=24) girls with complete PA, child-reported SB, parent-reported SD and parent-reported SQ data were included in the analyses. It is worth noting that the majority of participants (n=42) in the current analysis met the criteria for compromised parent-reported SQ (mean total SQ score >41) indicating that this was indeed an at-risk population. Participants were mostly African American (n=46), low-income and relatively inactive. Baseline characteristics are displayed in Table 3.

The regression analyses indicated that child-reported SB explained a significant portion of the variance in parent-reported total SQ score ($F(7, 40) = 3.04, p = 0.01, r^2 = 0.35, r^2$ adjusted $= 0.23$). Specifically, more minutes of screen time per day was associated with worse SQ ($\beta = 0.50, t = 2.56, p = 0.02$). There were no other associations between any other child-reported SB, parent-reported SD or SQ variables.

The regression analyses did not suggest any relationships between PA and parent-reports of child’s SD or SQ. However, there were several significant correlations between PA and accelerometer-derived sleep variables in the Girls DASH subsample (n=24). There were negative correlations between percent of time spent in LPA, MPA and VPA
with the number of nighttime awakenings (LPA partial $r = -0.45, p = 0.04$; MPA partial $r = -0.44, p = 0.04$; VPA partial $r = -0.45, p = 0.04$). There was a negative correlation between CPM average and sleep fragmentation index score (partial $r = -0.65, p = 0.002$) and a positive correlation between CPM average and number of minutes spent asleep (partial $r = 0.52, p = 0.02$). There were no other correlations between any other PA and accelerometer-derived sleep variables.

**Discussion**

Declining SD and SQ in children have been linked to poor mental and physical health outcomes (23, 50, 89). In order to combat these trends, it is important to identify modifiable risk factors, such as decreased PA and increased SB that may be associated with poor sleep. In this sample of elementary age girls living a low SES urban community, accumulating more daily child-reported SB (specifically, screen time) was associated with worse parent-reported SQ. Others have investigated associations between accelerometer-derived SB and SD and noted an inverse relationship between these two behaviors in elementary age urban children, however this study did not examine measures of SQ (137). It is important to understand risk factors that are related to SQ as well as SD, given that 37% of parents report child problems in at least one SQ domain (18). Also, the use of a child-report measure of SB allowed us to measure screen time, which is not possible using an accelerometer measure of SB. It is imperative to measure screen time in these types of studies given that increased exposure to screens (i.e., TV, tablets, smart phones) could delay the release of melatonin and subsequently compromise SD and SQ (21, 28). Given that the presence of a television in the bedroom has been
associated with 31 fewer minutes of sleep per night in children living in low SES urban communities (27), this behavior should be a primary target for interventions seeking to improve sleep in this population.

In addition to parent reports of girls’ SD and SQ, we collected accelerometer-derived sleep measures using a wrist-mounted monitor in a subsample of girls. We found that accumulating more LPA, MVPA fewer nighttime awakenings and lower sleep fragmentation scores. Previous work has not examined the relationship among PA, number of nighttime awakenings and sleep fragmentation scores. Our findings regarding nighttime awakenings and sleep fragmentation highlight the importance of including accelerometer-derived sleep measures other than SD. These findings may elucidate other potential health benefits of increasing PA in this population. It is possible that increasing PA is associated with improving aspects of sleep beyond SD. In terms of accelerometer-derived SD, we found that higher CPM during the day was correlated with and more minutes spent asleep per night. In a similar population of urban children, Wong et al. (137) noted no association between MVPA and accelerometer-derived SD. This could be due to differences in sample size, however it may also be related to differences in the PA metrics utilized. Both our study and the Wong et al. (137) study did not observe a relationship between percent time spent in MVPA and accelerometer-derived SD. There is a high degree of covariance when looking at time spent on PA, SB and sleep measured via accelerometry, given that they represent three portions of the same 24-hour day. We chose to include accelerometer average CPM given that it is a measure of average movement intensity, and is not prone to these time related issues of covariance. These
findings may indicate that SD is related more to average movement intensity, rather than activity volume in this population.

Given that we did not collect physiological outcome data, we cannot make inferences regarding the physiological mechanisms underlying these associations. It is possible that girls in low SES urban environments who accumulate more PA have higher levels of evening melatonin, making them more fatigued at night, although there is no literature examining this relationship in elementary age girls living in low SES urban environments. However, Gerra et al. (42) previously noted an increase in the melatonin levels following a brief aerobic exercise test in adolescent boys. More work is needed to examine the relationship between PA and melatonin levels in children who are at high-risk for compromised sleep, such as elementary age girls living in low SES urban communities. Additionally, given that insufficient PA and compromised sleep patterns are both risk factors for childhood obesity (69), future prevention strategies should examine the potential interaction between these behaviors within the obesogenic pathway.

Our findings should be interpreted in the context of several limitations. First, the use of a correlational design does not allow us to infer causality between increasing child-reported SB, decreasing PA and worse parent-reported SQ. Second, the use of parent-reported SD/SQ and child-reported SB may bias our results via social desirability bias and non-differential misclassification. The use of longitudinal designs and objective assessments of PA, SB, SD and SQ in future studies would improve our understanding of the relationships between these variables in this population. Third, our sample size is small and may limit our ability to detect significant associations. Lastly, we did not assess
melatonin levels, which potentially play a key role in the relationship between light exposure and sleep. Therefore, we cannot speak to the physiological mechanisms by which increasing screen time deters SQ in this population. Despite these limitations, this study had several strengths. Most importantly, this is the first study to assess relationships among PA, SB, SD and SQ in a homogenous sample of girls living in a low SES urban environment. Additionally, we used an objective measurement tool and validated techniques to assess PA. We also examined these relationships using objective assessments of sleep behaviors in a subsample of our population. Finally, while the use of report tools is considered a limitation, the SB, SD and SQ questionnaire utilized have demonstrated high validity and reliability in the population of interest (95, 105).

In summary, this study provides initial evidence that increased child-reported SB, specifically screen time, and decreased PA may be predictive of compromised parent-reported SQ in urban girls. These findings provide potential target behaviors for interventions seeking to improve sleep in this at-risk population. Future studies should be conducted using objective assessment techniques to measure sleep, longitudinal designs, larger samples and the assessment of underlying physiological mechanisms to confirm the nature and existence of these relationships.
Table 3 – Descriptive Characteristics

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Age</td>
<td>8.4 ± 1.7</td>
</tr>
<tr>
<td>BMI Percentile</td>
<td>70.8 ± 31.3</td>
</tr>
<tr>
<td>LPA %</td>
<td>31.8 ± 8.3</td>
</tr>
<tr>
<td>MVPA %</td>
<td>3.3 ± 1.9</td>
</tr>
<tr>
<td>Wear Time (days)</td>
<td>4.9 ± 2.4</td>
</tr>
<tr>
<td>SB (min/day)</td>
<td>448.2 ± 312.6</td>
</tr>
<tr>
<td>Screen Time (min/day)</td>
<td>250.8 ± 182.6</td>
</tr>
<tr>
<td>SD (hrs/day)</td>
<td>9.4 ± 1.4</td>
</tr>
<tr>
<td>SQ</td>
<td>46.7 ± 7.9</td>
</tr>
<tr>
<td>Race</td>
<td></td>
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<tr>
<td>AA</td>
<td>83.6%</td>
</tr>
<tr>
<td>White Hispanic</td>
<td>12.7%</td>
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<tr>
<td>Non-White Hispanic</td>
<td>3.6%</td>
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<tr>
<td>Household Income</td>
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</tr>
<tr>
<td>&lt;$20,000/yr.</td>
<td>32.7%</td>
</tr>
<tr>
<td>$20,000-40,000/yr.</td>
<td>40.8%</td>
</tr>
<tr>
<td>&gt;$40,000/yr.</td>
<td>19.5%</td>
</tr>
</tbody>
</table>

All data are Means ± SD

LPA % = accelerometer, % of time spent in light physical activity
MVPA% = accelerometer, % of time spent in moderate-to-vigorous physical activity
SB = child report, minutes per day of sedentary behavior
SD = parental report, child’s daily sleep duration
SQ = parental report, child’s composite sleep quality score
AA = African American
Study 2 – Feasibility of a combined physical activity and sleep education intervention for elementary age girls living in a low socioeconomic status urban community

Abstract

BACKGROUND: Insufficient sleep is a major public health epidemic disproportionately effecting elementary age girls living in low socioeconomic status (SES) urban communities. It is possible that increasing physical activity (PA) may improve sleep in children, however interventions addressing both behaviors have not been examined in elementary age girls living in low SES urban environments. The purpose of this study was to examine the feasibility, acceptability, and efficacy of an 8-week concurrent PA and sleep education intervention for elementary age girls in a low SES urban environment. METHODS: The goal was to recruit 36 urban elementary age girls (age, 8.8 ± 1.6 yrs.) and randomize them into one of three 8-week interventions: PA+S (PA = weeks 1-8; sleep education = weeks 5-8), S+PA (sleep education = weeks 1-4, PA = weeks 5-8) or a traditional health education intervention (CON; weeks 1-8) with < 30% attrition. PA intervention (Hip Hop and Jazz dances) was implemented for 60 minutes/day for 4 days/week. The sleep education intervention was implemented over three sessions. Process evaluation data were collected throughout the intervention and objective and subjective assessments of sleep and PA were obtained at baseline, 4-weeks and 8-weeks via accelerometer and validated questionnaires. Linear mixed models were used to examine changes in outcome variables. RESULTS: Recruitment (n = 42) and randomization (PA+S, n = 13; S+PA, n = 10; CON, n = 11) goals were met. Five girls recruited lost interest in the study and three girls did not complete their scheduled
baseline visits. The overall attrition rate was 52%. Complete outcome and acceptability data were obtained on 33% of the sample. There were significant increases in total daily moderate-to-vigorous PA (MVPA) ($F(2, 12.0) = 4.0, p = 0.04$) in the intervention groups compared to the CON group. There were significant decreases ($F(2, 13.1) = 4.5, P = 0.03$) in parent-reported problems with sleep duration (SD) with no differences between all three groups. **CONCLUSIONS:** This was the first study to test the feasibility of a PA and sleep education intervention in girls. Results suggest that improvements must be made to the intervention and assessment components in order to improve the feasibility of such a strategy in this population. While MVPA increased and parent-reported problems with SD decreased, these findings are limited by a small sample size and large percentage of missing outcome data.
**Introduction**

Short sleep duration (SD) and poor sleep quality (SQ) have been associated with elevated obesity and cardiovascular disease risk in children (119). Sufficient SD and SQ help regulate hormones related to appetite (leptin and ghrelin), insulin, growth hormones, and learning (65, 101). The National Sleep Foundation recommends that elementary school children (ages 5-12 yrs.) should sleep about 10-11 hours per night (41). Results from the 2014 *Sleep In America* poll suggest that 90% of elementary school children are not meeting these recommendations (18). In addition to insufficient SD, 37% of children suffer from compromised SQ (94). Therefore, it is important to identify modifiable risk factors that may promote healthy SD and SQ in this population.

Currently, there is evidence to suggest that SD, SQ and physical activity (PA) are behaviorally linked (69, 135). Patel and Hu (98) suggest that insufficient SD increases daytime fatigue and in turn, decreases PA. Additionally, it has been proposed that children who get less PA also engage in more sedentary behaviors (SB), such as increased screen time, which disrupts the release of the hormone melatonin and delays nighttime fatigue (22, 28). It is also possible that PA is related to other aspects of sleep beyond SD. For example, higher daily levels of moderate-to-vigorous physical activity (MVPA) have been reported to promote sleep efficiency (proportion of bedtime spent actually asleep) on the following evening in children (38). While the relationship between sleep and PA has been proposed, the nature and directionality of these relationships in children at high risk for compromised SD and SQ remains unclear.

While insufficient sleep is problematic in all children, recent literature suggests that children living in low socioeconomic status (SES) urban environments suffer
disproportionately from poor SD and SQ compared to their more affluent counterparts (115, 117). Recently, Wong et al. (137) reported that low SES urban girls had significantly lower SD than boys. In addition, the researchers reported an inverse relationship between the amount of SB that children accumulated and SD (137). These findings suggest that girls living in low SES urban environments are an at-risk population that could benefit from intervention strategies aimed at improving both sleep and PA. Recently, Bates et al. (9) reported improvements in MVPA, earlier bed times, and earlier wake times in low SES urban girls following a 4-week summer program which included daily PA. However, children tend to be more active due to increased opportunities to play outside, and sleep less due to later bedtimes during the summer compared to the academic months (3, 51, 88). Additionally this program was a previous in tact summer program, therefore the others did not report on the feasibility and acceptability of the program. No studies have examined the feasibility, acceptability and efficacy of intervening on both sleep and PA during the academic months in elementary age girls in a low SES urban community. Therefore, the purpose of this study was to examine the feasibility and acceptability of an 8-week sleep education and PA program in elementary age girls living in a low SES urban community during the academic months. Secondarily, we examined the efficacy of the program on SD, SQ and PA in this population.

**Methods**

**Study Design**

The Girls Dancing and Sleeping for Health (Girls DASH) program was an 8-week randomized controlled pilot study aimed at examining the feasibility, acceptability, and
efficacy of combined sleep education and PA intervention in elementary age girls in a low SES urban community. The primary outcomes of interest related to feasibility were achievement of recruitment and retention goals, fidelity of intervention delivery and success in attaining outcome assessments. Acceptability outcomes of interest were participant attendance, participation, enjoyment and program satisfaction. Our secondary outcomes were related to efficacy and included accelerometer-derived measures of PA and sleep, parent reports of child’s SD and SQ, child-reported SB, PA self-efficacy and sleep self-efficacy.

Participants

Participants were recruited from afterschool organizations, flyer distribution, community events and a social media (Facebook) from the McKnight district in the city of Springfield, MA. This community is considered low SES based off its mean family income of $27,009 per year, with 32% of resident families falling beneath the poverty line (http://www.census.gov/quickfacts/map/PST045214/2567000). Participants were eligible if they were between 7-12 years old on the first day of the intervention. Participants were excluded if they did not met the age and gender requirements or had conditions or injuries that limited their ability to participate in the primary assessments or the PA intervention. Primary caregivers and daughters provided informed consent and assent, respectively, to participate in this study. The University of Massachusetts Amherst institutional review board approved the study.

After the completion of baseline measures, girls were randomly assigned into one of three programs: a dance plus sleep education intervention (PA+S; PA = weeks 1-8;
sleep education = weeks 5-8), a sleep education plus dance (S+PA; sleep education = weeks 1-4; PA = weeks 5-8) or a traditional health education intervention (CON). Randomization was stratified by girls’ BMI percentile (≥ 85th percentile or < 85th percentile) to ensure an equal proportion of overweight and normal weight girls across all three groups, given previously known relationships between obesity status with sleep and PA. Trained members of the research staff who were not involved in the data analysis portions of the study completed all randomization procedures.

Intervention

Theoretical Framework

Both the PA and sleep education interventions were based on the Social Cognitive Theory (6). The intervention’s framework was structured on the interplay between personal, behavioral, and environmental domains. The personal domain was addressed by having the girls participate in the intervention multiple times per week in a fun setting and acquire the necessary skills to improve sleep and PA. The behavioral domain was addressed by having girls engage in self-monitoring by completing sleep diaries and reviewing these diaries with the interventionist and their parents to form a behavior change plan and monitor progress. The environmental domain only targeted the sleep education intervention, which was addressed through the manipulation of the home sleep environment and bedtime routine.
**Intervention Development**

The sleep education intervention framework was adapted from a protocol by Willgerodt et al., which examined the feasibility of an individually tailored intervention focused on improving sleep behaviors in 8-11 year old children (n = 9) (133). For the current study, targeted behavior change strategies were selected based on a detailed review of information from national sleep organizations (i.e., the National Sleep Foundation) and literature supporting their prevalence and associations with sleep in low socioeconomic urban populations (18, 28, 41, 49). A list of the targeted behaviors and the intervention strategies can be found in Table 4. The PA intervention was developed using the results of a focus group study recently conducted by our laboratory in the Greater Springfield, MA area (1). From these focus group meetings, it was determined that hip-hop and jazz dance was the most preferable form of PA in pre-adolescent urban girls. Professional dancers were hired to create two 10-minute routines [warm up (5 minutes), high intensity dance (50 minutes), cool down (5 minutes)] for each dance style. Each routine was recorded onto DVDs for the instructors to learn the choreography. A female dance instructor was hired to teach the dance classes. The health education intervention served as a standard care control and was completed by participants in all three groups. Mini lessons were developed on health topics derived from the CDC and from the focus group data (1) that were previously collected.

**Intervention Implementation**

The Girls DASH intervention was held afterschool Monday - Thursday (3:30 – 6:30 pm), for eight weeks from October - December 2016 at a local elementary school in
each intervention session consisted of two hours of homework tutoring/healthy snack time (3:30 pm - 5:30 pm) and one hour of dance class (5:30 pm – 6:30 pm).

**Sleep Education Intervention Protocol**

The sleep education intervention consisted of three sessions. Girls and their primary caregivers in the PA+S and S+PA groups were encourage to participate in an initial intervention and two follow-up intervention sessions. All sleep education intervention sessions took place during the intervention time that was convenient for the primary caregiver and during a time frame when the child was not participating in the dance session. Each session was scheduled to take approximately 45 minutes and was conducted by a trained member of the research staff. The initial sleep education intervention was conducted in week one for S+PA and week five for PA+S group. The session began with an open-ended discussion with the primary caregiver and child regarding the child’s sleep habits and challenges. Next, researchers reviewed with the primary caregiver and the child basic sleep education information ([http://www.sleepforkids.org/index.html](http://www.sleepforkids.org/index.html)), followed by the child’s baseline National Sleep Foundation Sleep Diary, SD and SQ data. Following this review of information, the primary caregiver, the child, and the research reached an agreement on one target sleep behavior to be modified by the child and caregiver in the coming weeks. Once the target behavior was agreed upon, the researchers outlined the strategy for modifying the targeted behavior, and the parent-child dyad was give another sleep diary to fill out for the following week. The outlines of each behavior change strategy can be found in Table 4.
Two follow-up intervention sessions served to monitor participants (primary caregiver and child) ability to implement the sleep education target behavior change plan and was scheduled to take place one and two weeks following the initial intervention session. If the target behavior was changing in a favorable direction (based on information from the National Sleep Foundation Sleep Diary), they were encouraged to maintain the current plan of action. If the target behavior was not changing or moving in the opposite direction, there was a discussion as to what barriers were preventing the plan from being implemented and how participants could be overcome the barrier.

**PA and Health Education Intervention Protocol**

Each dance style was instructed for four weeks total and styles alternated on a bi-weekly basis. The dance classes were scheduled to be 60 minutes in duration including warm-up (5 minutes) and cool down (5 minutes). Participants were encouraged to attend as many dance classes as possible during the weeks that they were scheduled to participate. The dance instructor divided each 10-minute routine into segments to instruct during the dance class until the entire routine had been instructed. Participants assigned to the CON group and participants assigned to the treatment groups received the health education intervention. Girls were given the same mini health lessons each week with their assigned group on a randomly assigned day. Each lesson was 15 minutes in duration and culminated with a written activity that applied the knowledge gained during the lesson.

**Measurements**
Feasibility

We assessed the feasibility of our intervention by measuring our success in attaining our recruitment goals (% of target), limiting attrition (% of target), obtaining outcome assessments (% of randomized sample with outcome data at each time point), and our fidelity in delivering both the PA and sleep education aspects of the intervention as intended. Information regarding the duration of the dance routine, style of dance being taught and music selected was recorded daily. A trained member of the research staff monitored enjoyment, participation and proper implementation of the routine in the dance classes. Intensity of the dance sessions was monitored on one randomly selected day per week using accelerometers. A trained member of the research staff monitored the proper implementation of the session protocols.

Acceptability

We measured the acceptability of our program by monitoring attendance, adherence and post-program satisfaction. Girls in all groups were required to sign-in during each intervention day to determine attendance. A head count was also taken during the dance sessions to determine how many girls participated each day in the dance classes. We also monitored the number of sleep education sessions completed by both the primary caregivers and children in the PA+S and S+PA groups. The number of sleep diaries completed and returned was also recorded.

At the end of the program, primary caregivers and children were given post-program satisfaction surveys. For this survey, primary caregivers and children) were asked to rate their level of satisfaction (on a scale of 1 – 5) with the different components
of the program. Children were given a multiple choice questionnaire at the end of the program to assess the bedroom environment in terms of screen presence, screen usage, noise, light and temperature levels in the bedroom. Primary caregivers and children were also contacted by phone and asked open-ended questions regarding the specific aspects of each component they were the most and least satisfied with, as well as suggestions to improve the intervention.

**Efficacy**

All PA and sleep outcome assessments were collected at baseline, 4 weeks and 8 weeks following the start of the intervention. Baseline data was collected at the participant’s home to reduce participant burden. All 4-week and 8-week data were collected at the intervention site.

**Parent-Reported Sleep Duration and Quality Assessment**

Girls’ average SD and SQ were assessed via parental report using the Children’s Sleep Habits Questionnaire CSHQ (95). This questionnaire has demonstrated high sensitivity ($r=0.80$), specificity ($r=0.72$) and test-retest reliability ($r=0.79$) in identifying sleep problems in elementary age children. Briefly, this questionnaire is a 45-item questionnaire that asks parents to report the frequency of various sleep behaviors within several domains within a typical week as well as average nightly bed times, morning wake times and SD. The questionnaire items were then aggregated to obtain category scores for eight SQ domains and a composite SQ score, with higher scores indicating more frequently reported problems and worsened sleep.
Accelerometer-Derived Assessment of Sleep

Girls wore a triaxial Actigraph accelerometer (Actigraph GT3x/GT3x+/ActisleepBT; Actigraph, LLC, Pensacola, FL) on their non-dominant wrist for seven consecutive days including during nighttime sleep to obtain accelerometer-derived measures of SD and SQ. Recently, the manufacturer ceased producing the Actisleep models and provided firmware and software updates which allowed all of our triaxial monitors to measure sleep. Girls were instructed to only remove these monitors during times when they would be completely submerged in water (i.e., swimming). All data were processed using Actilife 6 software (Actigraph, LLC, Pensacola, FL). Non-wear time was identified and removed from analysis using the Choi et al. (30) algorithm.

In order to be included in the analysis, participants had to wear the monitor for at least eight hours per day and at least three days per week. Raw acceleration data were collected at 30 Hz and reduced to 60-second epochs for the assessment of nocturnal sleep using the Sadeh et al. algorithm (111). This algorithm provided accelerometer-derived assessments of bed time, wake time, total time in bed, total sleep time, sleep efficiency (percentage of time in bed spent asleep), nighttime awakenings and sleep fragmentation index scores.

Physical Activity Assessment

Girls’ PA was objectively measured using Actigraph GT3X accelerometers (Actigraph, LLC, Pensacola, FL). Monitors were set to record data in 15-second epochs, given that the cut-point equation selected for data reduction was developed using this...
sampling rate (39). Girls were instructed to wear the monitor on a small elastic belt over their right hip for seven consecutive days excluding times when the monitor would get wet and during nighttime sleep. All data were processed using Actilife 6 software (Actigraph, LLC, Pensacola, FL). The same wear time criteria described in the previous section were applied. The Evenson et al. (39) cut points for children were used to reduce accelerometer counts into periods of sedentary time, light PA (LPA), and MVPA. Counts per minute (CPM) from the vertical axis of the accelerometer were assessed as a measure of average movement intensity. Variables of interest were percent of wear time spent in all PA intensities and CPM during the entire period of observation, the intervention time (Monday-Thursday, 3:30 pm – 6:30 pm) and the dance class time (Monday-Thursday, 5:30 pm – 6:30 pm).

**Child-Reported Sedentary Behavior**

Child-reported SB was assessed using a previously validated questionnaire, which has demonstrated high reliability ($r=0.94$) in elementary age girls living in a low SES urban community (104). Children were asked to report the number of minutes they spent in various types of SB in the morning (AM), afternoon and night (PM) on the most recent weekday and weekend day. Minutes from all SB questions were added together to determine weekday AM and PM SB, weekend day AM and PM SB, total weekday SB, and total weekend day SB. Minutes from all questions involving screen time were added together to determine child-reported estimates of weekday AM and PM screen time, weekend day AM and PM screen time, total weekday screen time, total weekend day screen time. Weekday values were multiplied by five and weekend day values were
multiplied by two to estimate total weekly SB, total weekly screen time, SB minutes per day, screen time minutes per day and PM screen time minutes per day.

**Physical Measures**

Girls’ height was measured to the nearest 0.1 cm using a portable stadiometer. Girls’ weight was measured to the nearest 0.1 kg using a Scale-Tronix 5125 digital scale (Scale-Tronix, LLC, White Plains, NY). Height and weight measurements were taken twice and the mean of the two measurements were calculated and used to calculate BMI (kg/m²). BMI percentile ranks for age and gender were determined using the Center for Disease Control growth charts (91).

**Sleep and PA Self-Efficacy**

Girls’ sleep self-efficacy was measured using the Sleep Self-Efficacy Scale (67). This scale generated a numeric score for sleep self-efficacy, however these values have not been validated in any populations. This questionnaire is the only questionnaire of its kind and there are no validated questionnaires for assessing sleep self-efficacy in any population. Girls’ PA self-efficacy was be assessed using the Children's Self-Perceptions of Adequacy in and Predilection for Physical Activity (CSAPPA), which has demonstrated high reliability (r=0.84) and moderate validity (r=0.50) in elementary age children (48).
Sample Size Calculations

A small-moderate effect size (Cohen’s $f=0.3$) was calculated using the means and standard deviations for parent-reported SD from a similar length sleep education intervention in preschool children ($n=152$) (136). We chose to use the data from a preschool study because there were no similar length programs that saw significant improvements in SD or SQ using the CSHQ. To achieve a power of 0.8, it was determined that a total of 27 girls (PA+S, $n=9$; S+PA, $n=9$; CON, $n=9$) would need to complete the intervention to detect a significant group by time interaction for SD. Assuming a 30% attrition rate, the goal was to recruit and enroll 36 girls.

Statistical Analyses

Intention-to-treat analysis was conducted using two different methods. First, linear mixed models with main effects for group and time, as well as group*time interactions were used to examine changes in outcome variables using only the available data for each variable at each time point. Second, multiple imputations were used to predict and replace missing values. A series of five imputations were performed using a regression-based technique incorporating all available anthropometric, PA and sleep variables at all time points to predict and replace. Repeated measures MANOVAs with main effects for group and time, as well as group*time interactions were used to examine changes in outcome variables using the imputed data set. Differences in baseline values across groups for all outcome variables were tested using one-way ANOVAs. Two sets of group comparisons were performed. In the first set of comparisons, all three groups were treated as separate (PA+S vs. S+PA vs. CON). In the second set of comparisons, the two
intervention groups were combined and compared to the CON group (PA+S and S+PA vs. CON). In cases where there were significant differences between groups at baseline, these variables were included as covariates in the linear mixed models and repeated measures MANOVAs. In all cases where there were significant main effects and/or interactions, Bonferroni corrections for multiple comparisons were applied to detect where the differences lie. Statistical significance for all tests was determined using a $\alpha$ of $p < 0.05$. All analyses were performed in SPSS (version 23, Chicago, IL).

**Results**

**Feasibility**

**Recruitment**

A total of 42 urban girls from the greater Springfield, MA area were recruited and screened for eligibility. A total of 34 girls completed baseline data collection visits and were randomized into the three groups. A detailed representation of recruitment, randomization and attrition results can be found in Figure 2.

**Intervention Fidelity**

The intervention routine was not implemented as intended due to unforeseen conflicts with the dance instructor’s schedule. The instructor was unable to arrive until 6:00 pm and did not alert the program staff of this issue until the first day of the program. Therefore, in order to maximize opportunities for the children to be active during the PA intervention, the children participated in an aerobic hip-hop dance DVD on 89.7% of the intervention days between 5:30 pm – 6:00 pm (Shaun T’s Fit Kids Club, Beachbody
The dance classes took place on 94% of intervention days. The average class length was 50.6 ± 12.2 min. There were no differences in class length during the weeks that only the PA+S group were participating versus weeks where both danced. There was no correlation between the length of the class and the percentage of time children spent in MVPA. The average length of the video sessions and main dance routines were 26.3 ± 5.6 min and 24.3 ± 4.6 min, and were not significantly different. The weekly accelerometer check suggested that participants spent similar percentages of time spent in MVPA during the video (16.9 ± 18.1%) and the main dance routine (16.3 ± 18.9%) and LPA during the video (47.7 ± 19.8%) compared to the main dance routine (40.1 ± 24.3%). Detailed PA intervention fidelity results are presented in Table 5.

Girls and their primary caregivers completed and returned 2.0 ± 1.0 and 1.4 ± 1.3 of the three provided sleep diaries in the PA+S and S+PA groups, respectively with no significant differences between groups. Of the three target sleep behaviors plans, 85.0% chose reducing screen time and 15.0% chose manipulating noise and/or temperature in the bedroom. Parents and children in both groups were able to agree upon the target behavior 100.0% of the time. The sleep education information was delivered to both the parent and the child 100.0% of the time.

**Attainment of Outcome Assessments**

Complete questionnaire, accelerometer (hip and wrist), and physical measurement data were obtained in 33% of participants at all three time-points, 36% of participants at baseline and 4-weeks and 70% of participants at baseline. Missing data at baseline was due to insufficient accelerometer wear-time in subjects that we were not able to get to re-
wear the monitor. Complete questionnaire and physical measurement data were obtained in 48% of participants at all three time points, 100% of participants at baseline, and 60% of participants at both baseline and 4-weeks. Valid hip accelerometer data were obtained in 39% of participants at all three time points, 78% of participants at baseline, and 54% of participants at baseline and 4-weeks. Valid wrist accelerometer data were obtained in 33% of participants at all 3 time points, 72% of participants at baseline, and 48% of participants at baseline and 4-weeks.

Acceptability

Intervention Attendance and Adherence

The mean attendance rate (days/wk) was 2.4 ± 0.8, 3.0 ± 0.5, and 3.1 ± 0.8 for the PA+S, S+PA and CON groups, respectively, with no significant differences in attendance between groups. Average attendance at the dance classes (girls/class) was 5.9 ± 2.5 in the PA+S group and 4.8 ± 1.3 in the S+PA group, with no significant difference between groups. In the PA+S group, 40.0% of participants completed three sleep education sessions, 40% completed two sessions and 20.0% completed one session. In the S+PA group, 25.0% of participants completed three sleep education sessions, 50.0% completed two sessions and 25.0% completed one session. There were no significant differences between groups in sleep education intervention attendance.

Seventy-five percent of girls reported having a TV in their bedroom, with 25.0% reporting that it was turned off the entire night, 42.0% turned it on some of the night, and 33.3% turned it on most of the night. Fifty percent of girls reported having access to other types of screen (i.e., tablets and smart phones) in their bedroom, with 25.0% reporting
that they use them during the hours when they are supposed to be sleeping. The majority of girls (56.3%) shared a bedroom with at least one or more siblings and classified their bedroom as too hot (56.3%), too noisy (44.7%) and/or too bright (56.3%).

The most common barriers reported by participants during the sleep education sessions were related to screen time. Many of the primary caregivers made statements such as “My child watches TV in the hour before bed and goes straight to bed after watching TV”, “she sleeps with the TV on and when I turn it off she turns it back on”, and “she sleeps with her cell phone on and next to her bed”. Children confirmed these sentiments making statements such as “I wake up in the middle of the night and turn my TV back on if my parents turn it off” and “My parents have a TV in their room that they leave on, so I go in and watch it while they’re asleep”.

Program Satisfaction

Girls’ satisfaction scores (Likert scale, 1 = very dissatisfied, 5 = very satisfied) for the overall program, sleep education portion and PA portion are presented in Table 6. A breakdown of common themes regarding facilitators, barriers and suggestions for improving each portion of the program with exemplary quotes from primary caregivers are presented in Table 7.

Efficacy

Baseline characteristics for each group are presented in Table 8. At baseline, participants in the PA+S group engage in more child-reported weekly minutes of SB ($p = 0.01$) and weekly minutes of screen time ($p = 0.03$) compared with the CON group.
Therefore, these variables were included as covariates in all linear mixed models and repeated measures MANOVAs. The linear mixed model analyses showed changes in total PA, intervention time PA, dance intervention time PA, objectively measured sleep and parent-reported sleep outlined below. There were no significant changes in child-reported SB, physical measures, sleep self-efficacy or physical activity self-efficacy. When analyzing the imputed data set with missing values replaced, there were no significant changes in any variables.

**Total Physical Activity**

There was a significant group*time interaction effect on the percent of time spent in MVPA from baseline to 8-weeks in the intervention groups compared to the CON group \(F(2,12.0) = 4.0, p = 0.04\). These changes are depicted in Figure 3. There were no other significant changes observed in percent time spent in any other PA intensities or CPM. These changes were not wholly accounted for by the changes in intervention time PA outlined below.

**Total Intervention Time and Dance Class Time Physical Activity**

There was a significant reduction over time \((F(2,12.1) = 9.12, P = 0.004)\) in the percent of the total intervention time (Monday-Thursday, 3:30-6:30 p.m.) spent sedentary from baseline to 4-weeks \((MD = -10.8 \pm 3.6, P = 0.02)\) and from baseline to 8-weeks \((MD = -22.2 \pm 5.9, P = 0.01)\) with no differences between all three groups. There was a significant increase over time \((F(2,18.6) = 7.6, P = 0.004)\) in the percent of the total intervention time spent in LPA from baseline to 4-weeks \((MD = 10.3 \pm 3.1, P = 0.01)\) and
from baseline to 8-weeks ($MD = 9.5 \pm 3.0, \ P = 0.01$) with no differences between all three groups. There were no other significant changes were observed in total intervention time PA.

There was a significant group*time interaction ($F (4, 23.5) = 2.93, \ P = 0.04$) on the percent of the dance class time (Monday-Thursday, 5:30-6:30 p.m.) spent in LPA. The PA+S group increased their dance class time LPA from baseline to 8-weeks compared to the S+PA ($MD = 16.1 \pm 4.1, \ P = 0.001$) and the CON ($MD = 10.7 \pm 4.0, \ P = 0.04$) groups. There was a significant reduction over time ($F (2, 16.6) = 5.65, \ P = 0.01$) in the percent of the dance class time spent sedentary from baseline to 8-weeks ($MD = -22.6 \pm 6.8, \ P = 0.01$) with no differences between all three groups. There was a significant increase over time ($F (2, 10.8) = 5.62, \ P = 0.02$) in the percent of the dance class time spent in MVPA from baseline to 4-weeks ($MD = 20.0 \pm 6.0, \ P = 0.03$) and baseline to 8-weeks ($MD = 20.1 \pm 6.4, \ P = 0.03$) with no differences between all three groups. There were no other significant changes observed in dance class time PA.

**Parent-Reported Sleep Duration and Quality**

There were significant reductions over time ($F (2, 13.1) = 4.5, \ P = 0.03$) in the number of parent-reported problems with SD from baseline to 4-weeks ($MD = -1.2 \pm 0.2, \ P< 0.001$) and baseline to 8-weeks ($MD = -1.7 \pm 0.4, \ P = 0.001$) with no differences between all three groups. There were no other changes in any other parent-reported sleep variables.
Accelerometer-Derived Sleep Duration and Quality

There was a significant increase over time \((F(2, 12.5) = 5.4, P = 0.03)\) in the total accelerometer-derived number of minutes spent in bed from baseline to 8-weeks \((\text{MD} = 126.2 \pm 43.7, P = 0.04)\) with no differences between all three groups. There were no other changes in any other accelerometer-derived sleep variables.

Discussion

Declining SD and SQ in children are significant public health problems, which are associated with a variety of poor physical and mental health outcomes \((77, 86, 125)\). Elementary age girls living in low SES urban environments are a population that may be disproportionately at-risk for compromised SD and SQ \((115, 137)\). Recent literature has suggested that increasing PA, reducing SB and providing sleep education may be effective strategies for improving SD and SQ in children \((12, 38, 93, 137)\), however there have been no combined sleep education and PA interventions in elementary age girls from low SES communities during the academic year. Our program was the first to test the feasibility, acceptability, and efficacy of such an intervention strategy in this population.

Feasibility

Based on our sample size and power analysis, our goal was to recruit, enroll, and randomize at least 36 girls in a low SES urban community with limited attrition \((30\%)\) into this study. We were able to recruit 42 girls, however we did not meet our attrition goals \((52\%)\). A recent review of attrition rates in pediatric PA interventions which used
accelerometers to assess PA behaviors reported a mean attrition rate of 11.5% with a range of 0 - 30.9% (53). Of the individual studies reviewed, the Bristol Girls Dance Project was most similar to our intervention (9 week, 2x/week dance intervention in 11-12 year old urban girls) and reported an attrition rate of 6% (56). One potential explanation for the differences in attrition is that we did not provide transportation for participants due to financial and logistical limitations. While our program was in an after-school setting, girls did not all attend the school where the intervention was held, therefore many participants needed transportation to the intervention site. Other after-school dance programs such as the Bristol Girls Dance project and the GEMs multi-site trial have conducted the intervention at multiple schools and provided transportation likely resulting in lower rates of attrition (56, 106). Future efforts should consider either providing transportation or conducting the intervention at multiple after-school sites to limit attrition.

Recently in the US, Bates et al. reported a similar attrition rate to ours (49%) in a sample of urban girls participating in a 4-week summer camp that promoted PA in the greater Chicago, IL area (9). Given that this program was a summer camp in which researches collected pre-post data, rather than a targeted behavioral intervention, the authors did not report process evaluation measures related to feasibility and acceptability. The similarity in our findings, and the relatively large range of attrition rates observed in these types of interventions highlight the need to further understand the aspects of the program that led to participant dropout.

A proportion (n = 3) of the PA+S group was lost to issues beyond the scope of the program components. These participants were dismissed from the program by the school
administration for persistent behavioral issues. One participant in the S+PA group reported being very satisfied with the study, however stated dropping out as a result of family time conflicts. Still, there was a large proportion of the sample that was lost to follow-up (PA+S, n = 8; S+PA, n = 3; CON, n = 5). The majority of the dropouts from PA+S group came in the first four weeks (n = 6). It is possible that participants in these groups were initially dissatisfied with the adaptations made to the dance program. This could be due to the implementation of the video in place of formal dance instruction, although some of the qualitative data from the participants suggests that the video was simpler to follow and kept them moving for longer periods of time. However, participants reported getting bored with doing the same video throughout the program. This finding is similar to what was reported by the Bristol Girls Dance Project, which reported that participants wanted a large range of dance styles and that different types of dance styles were preferred by different girls (36). It is possible that future intervention efforts should focus more on simpler, continuous movements with varied routines, rather than learning full dance routines.

While the PA intervention was not implemented as intended, we were largely successful in implementing the sleep education intervention as planned. The intervention was delivered according to plan in 100% of the participants who attended their initial intervention sessions and all participants were able to agree upon a target behavior to change. The majority of participants chose to focus on reducing screen usage, which is logical in the context of our finding that more than half our sample had a TV in their bedroom. Given the known associations between increased screen time and compromised
sleep in children (22), it is important to continue to address this behavior in pediatric sleep interventions.

We also examined our success in attaining complete sleep and PA outcome measurements. We were largely unsuccessful (33%) in attaining complete assessments of PA and sleep via accelerometer. This could be explained by the fact that the participants reported that the monitors were cumbersome and hard to keep up with. For example, one parent stated that “making sure the child is wearing the monitors became my job instead of my child’s and I already have enough to keep up with”. These results are within the range (3.3 - 75.4%, mean = 37.4%) of missing accelerometer data reported in a recent review of pediatric PA interventions (53). Still, further efforts must be made to enhance participant compliance with monitor protocols in order to obtain more objective measures of sleep and PA in pediatric health interventions.

Acceptability

Previous research regarding after-school dance programs has highlighted the impact of intervention volume on participant satisfaction. Post-program focus groups from the Bristol Girls Dance project revealed that some participants viewed two sessions per week as too large a commitment (36). We chose to conduct the intervention four times per week in order to give girls as many opportunities per week to attend and maximize the volume of PA exposure. However, given that previous after-school dance programs have indicated that two sessions a week may be too much volume (11), it is likely that the decision to hold our program four times per week discourage parents from bringing their children to the program and led to dropout. Similarly, Robinson et al. (104)
reported that the majority of participants attended 1-2 of the 3 recommended weekly dance sessions in the Stanford GEMs program over a 2-year period. Parents in our program indicated that they would have liked the program to be longer, which may allow for fewer intervention days per week and better participation. This may suggest that four days per week for eight weeks is too short and intense a volume for a PA intervention in this population. Similar to intervention volume, qualitative analyses of previous after-school dance programs have suggested that parental participation in the dance intervention may be of interest (36). However, we chose not to involve parents in the dance program based on unpublished results from a recent mother-daughter dance program conducted by our group in which we observed lower attrition rates in participants who participated without their mothers.

In terms of the sleep education intervention, parents indicated that they enjoyed learning the negative effect of screen usage on children’s sleep. However, transcripts from the sleep education sessions suggest that some of the children were resistant to these changes. For example, one child indicated that she turns her TV on in bed because “I want to watch my TV in bed so that I can finish watching my shows and go to sleep when they are over”. While reducing screen time in children is an attractive option for improving sleep in children, it is possible that this behavior may be difficult to change in this population. The majority of girls in our study had screens in their bedrooms and used them during sleeping hours, which is consistent with national data and supports the idea that removing screens from the sleep environment is quite difficult (18). The lack of reduction in screen time observed in our study is consistent with previous findings from programs such as the Stanford GEMs feasibility study, which aimed to reduce screen
time in African-American girls and noted no significant reductions (104). Additionally, parents in our program specifically stated that restricting screen time was more difficult on the weekends compared with the weekdays. Parents also indicated that they wanted more instruction on proper nighttime eating habits that promote sleep and that the sleep diary was too difficult to keep up with on a daily basis. Future interventions in this population should address replacing weekend screen time usage with other activities, improving nighttime eating habits to promote sleep and using simpler and less burdensome sleep diaries.

**Efficacy**

Given the small number of participants who completed the program (PA+S, n = 5; S+PA, n = 6; CON, n = 5), we cannot draw conclusions regarding the potential impact of our intervention on SD and SQ in this population. There were significant improvements in the amount of parent-reported problems with sleep duration as well accelerometer-derived time spent in bed in the whole sample with no group differences. These findings are similar to recent findings from Bates et al. (9) in which a 4-week PA focused summer camp improved bed times and wake times over a 4-week period. However contrary to our findings, the study by Bates et al. reported reductions in minutes spent asleep recorded by the accelerometer. The discrepancy in these findings could be due to the fact that the previous study took place over the summer months, as where ours took place during the academic months. Previous work has suggested that children go to bed later during the summer and sleep less (88). Our baseline data were collected at the beginning of the school year, when children are transitioning out of their summer routines and into their
school year routines, which may explain why we observed an improvement in sleep related behaviors as the school year progressed.

It is difficult to interpret our findings regarding sleep behavior change in the context of the literature due to sleep education interventions that have assessed changes in sleep behaviors (12). It is possible that our observed change in parent-reported problems with SD with no between group differences are due to the decrease in intervention time accelerometer-derived sedentary time in the whole sample, which has been previously shown to have an inverse relationship with SD in urban children (137). This could suggest that simply attending the intervention limited children’s opportunities to engage in sedentary time after school, which is supported by the finding that intervention time sedentary time decreased and intervention time PA increased in the CON group as well as the intervention groups. This could be due to several factors such as limited access to screens while at the intervention and the fact that we did not force CON participants to stay sedentary the entire time. Attending the intervention also limited girls’ access to high sugar foods and caffeinated beverages, which are associated with impaired sleep in children (22, 29, 81). This limited access may have lowered the intake of these items during after-school hours. However, we did not collect dietary measures and cannot comment on whether reduction in consumption of these items occurred. Additionally, parents indicated that they were pleased that their child was completing their homework at the intervention, which may have allowed them to spend more time in bed at night.

In a similar fashion, it is difficult to assess the potential impact of our intervention on changes in PA levels. However, we did observe an increase in total
MVPA in the two intervention groups combined compared to the CON group (Figure 2). Recently, Bates et al. (9) observed similar increases in MVPA following a 4-week summer camp in elementary age girls from a low SES urban community. Their program provided participants with 2-3 hours of PA opportunities on a daily basis, which could explain why MVPA improved in a shorter period of time. There was an increase in total intervention time PA (3:30 - 6:30 pm) in all participants with no differences between groups. This finding is similar to the Baylor GEMs pilot study, in which there were non-significant changes in after-school PA in both groups at 12-weeks (7). Also, Jago et al. (56) reported that their dance intervention group actually had smaller improvements in after-school MVPA compared to the CON group. Other after-school programs, such as the Georgia FitKid program have noted significant increases in after-school PA compared to control groups (139). However, this program was far more intensive, longer (1 year) and had a much higher sample size (n=1,187) and more completers (n=515) compared to our program.

Limitations

Our findings must be interpreted within the context of several limitations. First, our study was meant to provide information about feasibility and acceptability, therefore the sample size is small. There was a high occurrence of missing data, which hinders our ability to draw conclusions regarding the outcome assessments. The intervention was brief and these findings cannot be extrapolated to draw conclusions regarding longer interventions. The PA intervention was not implemented as intended (use of the DVD instead of intended routines) and did not occur every day (94%) due to difficulties with
the dance instructor. It was outside the scope and resources of this study to collect measurements on other factors that are related to PA, SD and SQ, such as diet, therefore any observed changes in these behaviors could be due to other factors. Future work regarding relationships between PA, SD, SQ and behavior change strategies attempting to intervene on these factors should work to address these limitations.

**Strengths**

There were several strengths to our study. First, the use of a randomized controlled design is highly desirable in behavior change programs. The use of this design should ensure that potential confounders are distributed evenly across conditions and that observed effects are due to the intervention and not random error. This study is the first to comprehensively assess the feasibility and acceptability of intervening on these behaviors concurrently in a homogenous population of elementary age girls living in a low SES community. The feasibility results provide information on best practices and sample size calculations for PA and sleep education intervention strategies in this at-risk population. We collected both objective and subjective assessments of PA, SB, SD and SQ. The program was framed in the context of sound theoretical underpinnings. The use of previously collected formative information in formatting the intervention allowed us attempt to tailor the intervention to our population of interest.

**Conclusion**

In conclusion, this study is the first to report on the feasibility and acceptability of conducting a PA and sleep education intervention in elementary age girls living in a low...
SES urban community. Our results suggest that there are several considerations that should be addressed in order to improve the success of these strategies. Future interventions should aim to format a more acceptable PA component and reduce participant burden in terms of behavior monitoring. Additionally, the feasibility of these intervention strategies should be tested in more diverse populations with longer durations and the inclusion of other behaviors such as diet, which may be related in the causal pathway of changing PA, SB, SD and SQ.
<table>
<thead>
<tr>
<th>Target Behavior</th>
<th>Intervention Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watching TV, playing video games and/or using the</td>
<td>3. Reducing the total amount of screen time the child is exposed to per day</td>
</tr>
<tr>
<td>computer within one hour of bedtime</td>
<td>4. Restricting the usage of televisions, game consoles and computers within an hour of</td>
</tr>
<tr>
<td></td>
<td>bedtime</td>
</tr>
<tr>
<td>Intake of caffeinated beverages before bedtime</td>
<td>3. Reducing or eliminating the child’s daily consumption of caffeinated beverages</td>
</tr>
<tr>
<td></td>
<td>4. Limiting the consumption to only daytime hours or as far from the bedtime as possible</td>
</tr>
<tr>
<td>The sleep environment: noise and temperature</td>
<td>3. Increasing or decreasing the temperature of the room so that it is closer to optimal</td>
</tr>
<tr>
<td></td>
<td>temperature through changing the air conditioning/heat or using a fan/space heater</td>
</tr>
<tr>
<td></td>
<td>and/or adding/removing one layer of pajamas</td>
</tr>
<tr>
<td></td>
<td>4. Implementing the use of a “white noise” instrument such as a sound conditioner</td>
</tr>
<tr>
<td></td>
<td>(free app for smart phones), fans, air purifiers, or light relaxing music/books on tape,</td>
</tr>
<tr>
<td></td>
<td>depending on what is available in the home.</td>
</tr>
</tbody>
</table>
Figure 2 – Recruitment and Enrollment Flow Chart

- **Contacted** n=135
- **Screened and scheduled BV** n=42
  - Baseline visits completed n=34
    - Randomized n=34 Moved away n=1
      - **PA+SE** n=13
        - Midpoint n=7 Lost to behavior n=3 Lost to follow up n=3
          - Post n=5 Lost to follow-up n=2
      - **SE+PA** n=10
        - Midpoint n=8 Lost to follow-up n=2
          - Post n=6 Lost to follow-up n=1 Lost interest n=1
      - **CON** n=11
        - Midpoint n=6 Lost to follow up n=5
          - Post n=5 Lost to follow up n=1
  - Lost interest n=5 Lost contact n=3
  - Lost to behavior n=3
  - Lost to follow up n=3
  - Baseline visits completed n=34
  - Randomized n=34 Moved away n=1
    - **PA+SE** n=13
      - Midpoint n=7 Lost to behavior n=3 Lost to follow up n=3
        - Post n=5 Lost to follow-up n=2
    - **SE+PA** n=10
      - Midpoint n=8 Lost to follow-up n=2
        - Post n=6 Lost to follow-up n=1 Lost interest n=1
    - **CON** n=11
      - Midpoint n=6 Lost to follow up n=5
        - Post n=5 Lost to follow up n=1
<table>
<thead>
<tr>
<th>Fidelity Question (% responding “yes” for each question)</th>
<th>Wk. 1-4 PA+S only</th>
<th>Wk. 5-8 PA+S and S+PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>During the dance intervention, were at least 50% of the girls participating in the dance lessons?</td>
<td>93.7</td>
<td>100.0</td>
</tr>
<tr>
<td>During the dance intervention, did at least 50% of the girls seem to be having fun?</td>
<td>83.3</td>
<td>100.0</td>
</tr>
<tr>
<td>Did the dance instructor follow the dance routine developed?</td>
<td>91.7</td>
<td>93.8</td>
</tr>
<tr>
<td>Did the dance instructor use the required music?</td>
<td>91.7</td>
<td>93.8</td>
</tr>
<tr>
<td>Did the dance instructor encourage the participants to participate?</td>
<td>75.0</td>
<td>87.5</td>
</tr>
<tr>
<td>Of the entire dance class, did participants spend at least 50% of the time simply standing and watching the dance instructor versus dancing?</td>
<td>8.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Survey Question</td>
<td>PA+S</td>
<td>S+PA</td>
</tr>
<tr>
<td>-----------------------------------------------------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>How satisfied were you with the Girls DASH program?</td>
<td>4.0 ± 1.0</td>
<td>3.3 ± 1.2</td>
</tr>
<tr>
<td>How satisfied were you with the sleep education portion?</td>
<td>3.8 ± 1.5</td>
<td>2.6 ± 1.9</td>
</tr>
<tr>
<td>How satisfied were you with the dance portion?</td>
<td>4.4 ± 0.5</td>
<td>4.0 ± 1.1</td>
</tr>
<tr>
<td>How likely are you to participate in dance in the future?</td>
<td>4.0 ± 1.4</td>
<td>4.5 ± 0.5</td>
</tr>
<tr>
<td>How satisfied were you with the dance instructors teaching?</td>
<td>3.4 ± 1.7</td>
<td>3.3 ± 1.6</td>
</tr>
</tbody>
</table>

Likert scale = 1-5; 1 = very dissatisfied, 5 = very satisfied
Data are means ± SD
Table 7 – Common Themes and Exemplar Quotes from Post-Program Interviews

What was the hardest part about being in Girls DASH?

<table>
<thead>
<tr>
<th>Theme</th>
<th>Exemplar Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitors</td>
<td>“Wearing the activity and sleep monitors and keeping track of them.”</td>
</tr>
<tr>
<td>Teacher Coop.</td>
<td>“Teachers at school were not cooperative of the kids wearing the activity and sleep monitors during school.”</td>
</tr>
<tr>
<td>Sleep Diaries</td>
<td>“Keeping up with the sleep diaries and getting the child to be consistent filling them out.”</td>
</tr>
</tbody>
</table>

What were you and your child’s favorite parts about being in Girls DASH?

<table>
<thead>
<tr>
<th>Theme</th>
<th>Exemplar Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutoring</td>
<td>“Getting homework help.”</td>
</tr>
<tr>
<td>Making Friends</td>
<td>“Playing games with other girls and making friends.”</td>
</tr>
<tr>
<td>Fun Activities</td>
<td>“There was always something constructive to do and there was no downtime for them to get in trouble.”</td>
</tr>
<tr>
<td>Health Education</td>
<td>“Teaching about healthy eating in the health education lessons.”</td>
</tr>
</tbody>
</table>

What were you and your child’s least favorite parts about being in Girls DASH?

<table>
<thead>
<tr>
<th>Theme</th>
<th>Exemplar Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dance Video</td>
<td>“The video got boring after awhile since it was the same.”</td>
</tr>
<tr>
<td>Program Length</td>
<td>“I wish it was longer and that you all had more time with them.”</td>
</tr>
<tr>
<td>Snack Selection</td>
<td>“The snacks were kind of boring and not appeasing.”</td>
</tr>
</tbody>
</table>

Please tell us why you are satisfied/dissatisfied with the dance portion and with dance teacher’s instruction.

<table>
<thead>
<tr>
<th>Theme</th>
<th>Exemplar Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty</td>
<td>“The video was simpler and easier to do and kept me moving.”</td>
</tr>
<tr>
<td>Learning Steps</td>
<td>“I thought the teacher did a good job teaching the steps.”</td>
</tr>
</tbody>
</table>
Discipline  “I did not like the way the dance teacher talked to us sometimes.”

Which part of the sleep education portion was of the most interest?

<table>
<thead>
<tr>
<th>Theme</th>
<th>Exemplar Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen Time</td>
<td>“Learning about how screen time effects sleep was an eye opener.”</td>
</tr>
<tr>
<td>Behavior Change</td>
<td>“It was good to learn what activities we could do instead of using electronics before bed.”</td>
</tr>
<tr>
<td>Sleep Education</td>
<td>“I liked discussing the educational information. It usually takes my child over 45 minutes to lay down and these things were very helpful.”</td>
</tr>
</tbody>
</table>

Is there anything you would like to see changed or added to the sleep education portion?

<table>
<thead>
<tr>
<th>Theme</th>
<th>Exemplar Quotes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekends</td>
<td>“It’s hard to restrict kids during times when you want to give them some freedom like the weekend.”</td>
</tr>
<tr>
<td>Nutrition</td>
<td>“Focus more on what not to eat before bed and water intake as part of the program.”</td>
</tr>
<tr>
<td>Simpler Diaries</td>
<td>“The sleep diaries were too much and had too many questions. In our family there is only one parent and there is too much to do when I get home. I didn’t have time to help her with it.”</td>
</tr>
</tbody>
</table>
Table 8 – Baseline Characteristics

<table>
<thead>
<tr>
<th></th>
<th>PA+S (n = 13)</th>
<th>S+PA (n = 10)</th>
<th>CON (n = 11)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs.)</td>
<td>9.2 ± 1.9</td>
<td>8.6 ± 1.7</td>
<td>8.5 ± 1.2</td>
<td>0.48</td>
</tr>
<tr>
<td>BMI %</td>
<td>84.0 ± 17.9</td>
<td>70.5 ± 35.4</td>
<td>66.3 ± 37.1</td>
<td>0.35</td>
</tr>
<tr>
<td>%Sedentary</td>
<td>68.6 ± 7.1</td>
<td>67.4 ± 7.8</td>
<td>68.9 ± 8.2</td>
<td>0.93</td>
</tr>
<tr>
<td>%LPA</td>
<td>26.8 ± 6.0</td>
<td>27.7 ± 6.1</td>
<td>27.0 ± 6.8</td>
<td>0.95</td>
</tr>
<tr>
<td>%MVPA</td>
<td>4.7 ± 1.5</td>
<td>4.9 ± 1.9</td>
<td>4.1 ± 2.0</td>
<td>0.42</td>
</tr>
<tr>
<td>SB (min/wk.)</td>
<td>1940.8 ±807.3*</td>
<td>3013.0 ± 1531.8</td>
<td>4294.09 ± 2521.1</td>
<td>0.01</td>
</tr>
<tr>
<td>Screen Time (min/wk.)</td>
<td>936.9 ± 864.2 *</td>
<td>1813.0 ± 1264.9</td>
<td>2195.4 ± 1258.9</td>
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</tr>
<tr>
<td>Measured SD (min/night)</td>
<td>440.1 ± 62.7</td>
<td>409.5 ± 88.1</td>
<td>445.9 ± 56.2</td>
<td>0.59</td>
</tr>
<tr>
<td>WASO</td>
<td>72.6 ± 21.1</td>
<td>61.5 ± 29.4</td>
<td>84.3 ± 32.7</td>
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</tr>
<tr>
<td>Sleep Efficiency (%)</td>
<td>85.5 ± 4.2</td>
<td>84.9 ± 8.7</td>
<td>83.4 ± 7.1</td>
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<tr>
<td>Reported SD (hrs./night)</td>
<td>9.3 ± 1.7</td>
<td>9.4 ± 2.0</td>
<td>9.3 ± 1.3</td>
<td>0.99</td>
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<tr>
<td>Reported SQ</td>
<td>49.1 ± 5.4</td>
<td>49.9 ± 7.5</td>
<td>50.5 ± 9.4</td>
<td>0.91</td>
</tr>
<tr>
<td>Race</td>
<td></td>
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<td>0.30</td>
</tr>
<tr>
<td>AA</td>
<td>38.4%</td>
<td>70.0%</td>
<td>45.5%</td>
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<tr>
<td>Hispanic</td>
<td>46.2%</td>
<td>30.0%</td>
<td>54.5%</td>
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<tr>
<td>White</td>
<td>15.4%</td>
<td>0.0%</td>
<td>0.0%</td>
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</table>

*Significant difference
<table>
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<tr>
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<tbody>
<tr>
<td>&lt;$20k/yr.</td>
<td>50.0%</td>
<td>55.6%</td>
<td>41.7%</td>
</tr>
<tr>
<td>$20-40k/yr.</td>
<td>37.5%</td>
<td>33.3%</td>
<td>58.3%</td>
</tr>
<tr>
<td>&gt;40k/yr.</td>
<td>12.5%</td>
<td>11.1%</td>
<td>0.0%</td>
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<td>&lt; HSG</td>
<td>25.0%</td>
<td>44.4%</td>
<td>27.3%</td>
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<tr>
<td>HSG</td>
<td>25.0%</td>
<td>33.3%</td>
<td>54.6%</td>
</tr>
<tr>
<td>College Grad</td>
<td>50.0%</td>
<td>22.3%</td>
<td>18.1%</td>
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</table>

Data are means ± SD, * = Significant differences between groups. BMI% = Body mass index percentile rank for age and gender, % Sedentary = Percent of total time spent sedentary (accelerometer), % LPA = Percent of total time spent in light intensity physical activity (accelerometer), % MVPA = Percent of total time spent in moderate to vigorous physical activity (accelerometer), SB = Child-reported sedentary behavior WASO = Awakenings after sleep onset, SD = Parent-Reported Sleep duration, SQ = Parent-reported sleep quality, AA = African American, < HSG = Did not graduate high school, HSG = High school graduate.
Figure 3 – Total Moderate-to-Vigorous Physical Activity Over Time in Intervention vs. Control Groups

Data are estimated marginal means ± SEM, * = p < 0.05 difference between INT and CON over time. MVPA = Moderate-to-vigorous physical activity, INT = PA+S and S+PA intervention groups combined, CON = Control group
CHAPTER V
CONCLUSION

Summary of Study Results

The initial plan for this project was to test the feasibility, acceptability and efficacy of a culturally tailored PA and sleep education intervention for Latina elementary age girls and their primary maternal figures. Our recruitment efforts in the Latina communities of Springfield, MA and Hampshire County, MA continually fell short of our goals. After these unsuccessful attempts we made the decision to change several aspects of our recruiting efforts and study protocol, in order to attract more participants while filling knowledge gaps in the pediatric PA and sleep literature.

In terms of our recruiting efforts, our first adaptation to the program was to expand our intervention to all elementary age girls. Further review of the sleep literature suggested that compromised sleep quality was less related to race and more strongly related to living in a low SES urban community (9, 115, 117, 137). Therefore, we made the decision to return to the McKnight community in the city of Springfield, in order to engage elementary age girls living in a low SES urban community. We were able to recruit several girls through community events, and advertisement at community centers; however our most successful recruiting avenue was social media. Through social media, we were able to recruit and enroll 76% of our final sample. Our findings suggest that an intervention targeted specifically at the Latina community was not feasible. Given that elementary age children in low SES urban communities are an at-risk population for compromised sleep regardless of race, future prevention efforts in these communities should consider developing programs for all races and ethnicities. Social media
recruitment proved very successful, therefore future interventions should consider adopting this strategy to engage this population.

In addition to modifying our recruiting strategies, we made several adaptations to the study protocol in order to attract more participants. First, we shortened the program from 12 to 8-weeks. This was done in an effort to minimize the length of commitment for participants. Additionally, we opted to drop the maternal component of the PA intervention. This decision was made after finding that attrition rates from the MAGNET trial were higher in the maternal participation group compared to the group in which the mother did not participate. Given that we would need parental involvement in the sleep education program, we felt that it may be too overwhelming for parents to participate in the PA program 4x week. We also removed the Latina cultural tailoring aspects of the program since it was now open to all races and ethnicities. Following the changes in the scope and protocol of our program, we were able to recruit enough participants to launch the Girls DASH program.

The overall goals of this dissertation were 1) to further understand the relationship between PA, SB, SD and SQ in elementary age girls in a low SES urban community and 2) to test the feasibility, and acceptability of a combined PA and sleep education intervention in this population. Secondarily, we sought the efficacy of such a program in elementary age girls in a low SES urban community. In order to accomplish this task we designed a feasibility trial, which aimed to combine both PA and sleep education intervention strategies designed specifically for urban girls. In the first study, we measured PA via accelerometry; and measured SB, SD and SQ via child and parental-reports. We were able to combine our baseline data with that of a previously conducted
intervention in order to examine the associations between PA and SB on SD and SQ in this population. We also collected baseline accelerometer-derived measurements of SD and SQ in the subsample of girls from the Girls DASH program. We ran partial analyses comparing the accelerometer-derived PA and sleep data. There was relationship between child-reported SB and parent-reported SQ \( (p = 0.01, \ r^2 = 0.35, \ r^2 \text{ adjusted} = 0.23) \). Specifically, more screen time per day was predictive of worse sleep quality \( (\beta = 0.50, \ p = 0.02) \). In terms of accelerometer-derived sleep measures, there were negative correlations between PA and the number of nighttime awakenings (LPA partial \( r = -0.45, \ p = 0.04 \); MPA partial \( r = -0.44, \ p = 0.04 \); VPA partial \( r = -0.45, \ p = 0.04 \)) and between counts per minute average (CPM) and sleep fragmentation scores (partial \( r = -0.65, \ p = 0.002 \)). The results from this study indicate that increasing PA and limiting SB may be modifiable risk factors, which could serve as potential intervention targets to improve sleep in elementary age girls in low SES urban communities.

To assess the feasibility and acceptability of a combined PA and sleep education intervention in this population, we designed the Girls DASH program, an 8-week trial in which children were randomized into the PA+S, S+PA or CON groups. Our goals were to recruit 36 urban girls and limit attrition to > 30%. We collected detailed process evaluation data throughout the intervention in order to generate formative information to regarding the feasibility and acceptability of conducting such an intervention. Secondarily, Girls DASH aimed to examine the efficacy of the intervention on PA and sleep behaviors changes. The results from Girls DASH suggested that we were successful in reaching our recruitment targets (n =42), but that we were unsuccessful in meeting our attrition goals (52%) and obtaining complete PA and sleep outcome data on the sample
The process evaluation data indicated that there were several aspects of the intervention that could be improved upon including lengthening the intervention, reducing the weekly volume, and reducing participant burden in terms of PA and sleep assessment. In analyzing the limited data available, there was an increase in total daily MVPA in the intervention groups and significant decreases ($F (2, 13.1) = 4.5, P = 0.03$) in parent-reported problems with SD with no differences between all three groups. However, we cannot make any claims about the potential of this program to change PA and sleep, given that we did not achieve the necessary statistical power.

**Significance**

Declining SD and SQ in children is a major public health epidemic associated with poor mental and physical health outcomes (23, 44, 86, 102, 125). There is literature to suggest that this epidemic may disproportionately effect urban elementary age girls compared to their more affluent counterparts (115, 117, 137). This suggests that identifying modifiable risk factors that may improve sleep in this population is of paramount importance. A growing body of literature suggests that reductions in PA and increases in SB may be related to shorter SD and poor SQ in children (38, 51, 69, 73, 135, 137). However, less is known regarding the relationship between these behaviors in at-risk populations, such as elementary age girls in low SES urban communities.

The first study in this dissertation provides initial evidence that child-reported SB; specifically screen time may be associated with parental-reported SQ in girls in low SES urban communities. These associations between screen time, SD and SQ is not without physiological underpinnings. Exposure to light emissions from screens delays the release
of the hormone melatonin, a key hormone in initiating the sleep cycle (28), although we did not assess this in the current study. Additionally, the findings from the first study indicate that there were correlations between increasing PA and accelerometer-derived SD and SQ in this population. Recent PA intervention strategies have exhibited the ability to improve bed times and wake times in urban girls (9); and there has been laboratory data suggesting that PA may have beneficial effects on melatonin release in adolescence (42). Taken together, the findings from our work and previous studies provide rationale for the inclusion of PA and SB improvement strategies in sleep interventions for elementary age girls living in low SES urban communities.

The next step was to begin testing an intervention that sought to alter both activity and sleep behaviors in this at-risk population. In order to provide data on the feasibility, acceptability and efficacy of such a strategy, we designed the Girls DASH program. This study is the first to provide such information. However, the failure to retain the majority of participants (52% attrition) indicates that several improvements and modifications must be made in order to elicit optimal levels of adherence and participation from this population. In terms of the PA intervention, the dance program designed was not implemented as intended, due to difficulties with the hired instructor. Due to conflicts in the instructor’s schedule, we implemented a commercially available aerobic dance video during the first half of the scheduled dance period. Post-program evaluation indicated that some of the participants found this video to be repetitive and boring, which likely induced some participant dropout. However, participants also reported that the video was simpler and easier to follow than the developed dance routines. Future programs should consider developing interventions that use a wide variety of simple aerobic dance videos
to provide a variety of simple dances without the burden of hiring a dance instructor. Another potential explanation for our high attrition is that we did not provide transportation for participants due to financial and logistical limitations. While our program was in an after-school setting, girls did not all attend the school where the intervention was held, therefore many participants needed transportation to the intervention site. This may not only explain some of the attrition, but also the fact that on average, participants attended 2-3 of the intended four sessions per week. Previous after-school dance studies have noted that even two sessions per week may be too intense a volume for participants (36, 103). Parents from Girls DASH indicated that they would have liked the program to be longer, which would have allowed us to potentially deliver fewer weekly sessions. Collectively, our findings indicate that in order to attract and retain girls living in low SES urban communities in after-school dance programs, further efforts must be made to make the program more enjoyable, convenient and achievable.

While the PA intervention was not implemented as intended, we were largely successful in implementing the sleep education intervention as planned. The intervention was delivered according to plan in 100% of the participants who attended their initial intervention sessions and all participants were able to agree upon a target behavior to change. The majority of participants chose to focus on reducing screen usage, which is logical in the context of our finding that more than half our sample had a TV in their bedroom. Although the intervention was implemented as planned, we were not successful in reducing screen time in our sample of urban elementary age girls, indicating that further efforts and novel strategies must be tested to modify this behavior in future interventions. It is clear that children enjoy using screens, particularly in the evenings as
evidenced by representative quotes from girls who participated in the Girls DASH program. Parents in our program specifically stated that restricting screen time was more difficult on the weekends compared with the weekdays. Future efforts would benefit from researching more acceptable and enjoyable activities to replace screen time, as well as addressing the differences between weekday and weekend screen usage in urban elementary age girls.

While we sought to comprehensively and non-invasively assess PA and sleep using current best practices in accelerometry techniques, it was clear that participants found this process cumbersome. These conclusions were drawn from the limited amount of valid monitor data attained (33% of participants) and representative quotes attained from the participants. We also sought to couple our sleep assessments with self-monitoring techniques through the use of sleep diaries. Participants indicated that completing these diaries on a daily basis was frustrating, which led to a poor return and completion rate of the diaries. It would be beneficial for researchers to develop monitoring methods that only required the use of one monitor as opposed to two, and streamline the sleep diary so that participants would not have to keep up with them on a daily basis. Due to the limited amount of data available from our population, we cannot comment as to whether our intervention had the potential to improve sleep and PA in this population.

Limitations and Future Directions

Our findings from the first study should be interpreted in the context of several limitations. First, the use of a cross-sectional design does not allow us to infer causality
between increasing screen time, decreasing PA and worsened SQ. Second, the use of parental reports to measure SD and SQ may bias our results. Third, our sample size was very small which may limit our ability to detect these associations. Lastly, we did not assess melatonin levels, which potentially play a key role in the relationship between light exposure and sleep. Therefore, we cannot speak to the physiological mechanisms by which increasing screen time deters SQ in this population. Future studies should be conducted using objective assessment techniques to measure sleep, longitudinal designs, larger samples and the assessment of underlying physiological mechanisms to confirm the nature and existence of these relationships.

The findings from the Girls DASH intervention must also be interpreted within the context of several limitations. First, our study was meant to provide information about feasibility and acceptability, therefore the sample size is small. There was a high occurrence of missing data, which hinders our ability to draw conclusions regarding the outcome assessments. The intervention was brief and these findings cannot be extrapolated to draw conclusions regarding longer interventions. The PA intervention was not implemented as intended (use of the DVD instead of intended routines) and did not occur every day (94%) due to difficulties with the dance instructor. It was outside the scope and resources of this study to collect measurements on other factors that are related to PA, SD and SQ, such as diet, therefore any observed changes in these behaviors could be due to other factors. Future programs seeking to alter PA, SD, SQ and behavior change strategies attempting to intervene on these factors should work to address these limitations.
Conclusions

In summary, our first study provides initial evidence that increased screen time and decreased PA may be associated with compromised SQ in elementary age girls living in a low SES urban community. These findings provide potential target behaviors for interventions seeking to improve sleep in this at-risk population. Future studies should be conducted using objective assessment techniques to measure sleep, longitudinal designs, larger samples and the assessment of underlying physiological mechanisms to confirm the nature and existence of these relationships. Further understanding the behavioral and physiological nature of these relationships in at-risk populations is essential to reversing the epidemics of insufficient SD and poor SQ in children.

The Girls DASH program was the first to examine the feasibility and acceptability of conducting a PA and sleep education intervention in girls living in a low SES urban community. The results from our second study suggest that there are several considerations that should be addressed in order to improve the success of these strategies. Future interventions should aim to format a more acceptable PA component and reduce participant burden in terms of behavior monitoring. Additionally, the feasibility of these intervention strategies should be tested over longer durations and the inclusion of other behaviors such as diet, which may be related in the causal pathway of changing PA, SB, SD and SQ.
APPENDIX 1

FLYER

A FREE and FUN dance and health education after-school program for 7-12 year old girls

We are studying the use of dancing and sleep education on the health of girls (Ages 7-12).

The 8-week program will start at Rebecca Johnson Elementary School on Monday October 19th, 2015.

What is involved.....

1. Your daughter will be assigned randomly (like tossing a coin) to be part of ONE of the THREE following groups:
   a. Dance + Sleep Education Program
      i. 8 weeks. Monday-Thursday. Homework tutoring, healthy snack and weekly health education lessons from 4:30-5:30 p.m.
      ii. 8 weeks. Monday-Thursday. Dance classes from 5:30-6:30 p.m. during the entire 8-week program.
      iii. Weeks 5-8. A total of three sleep education sessions with you AND your daughter to be scheduled at your convenience.
   b. Sleep Education + Dance Program
      i. 8 weeks. Monday-Thursday. Homework tutoring, healthy snack and weekly health education lessons from 4:30-5:30 p.m.
      ii. Weeks 1-4. Monday-Thursday. Dance classes from 5:30-6:30 p.m. during the first four weeks of the program.
      iii. Weeks 5-8. A total of three 45-minute sleep education sessions with you AND your daughter to be scheduled at your convenience.
   c. Health Education Program
      i. 8 weeks. Monday-Thursday. Homework tutoring, healthy snack and weekly health education lessons from 4:30-5:30 p.m. AS A REMINDER, GIRLS IN THIS GROUP WILL NOT PARTICIPATE IN THE DANCE CLASSES OR SLEEP SESSIONS.

2. To help us understand how the program works, in the beginning, middle and end of the program you and your daughter:
   - Will be asked to complete surveys and have height and weight measures taken.
   - Your daughter will be asked to wear an activity monitor around her wrist to measure her physical activity level.
   - Your daughter be asked to wear a sleep monitor on her wrist to measure her sleep.

Parent/Guardian - If you and your daughter are interested or would like to learn more about the program, please contact Cory Greer by:

Phone: (757) 572-7110 or Email: greev2@comcast.net

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To be eligible for this study, we need to determine the following during the screener.

All questions for eligibility have a * before them.

- Age: Girl is 7 years or older, but has not had her 13th birthday.
- Child is able to participate in PE
- Child reads and speaks English
- Parent/Caregiver reads and speaks English

If NOT eligible (at any time during screening), read:

“I’m sorry, but based upon your answers to these questions, you and your daughter won’t be eligible to participate in this study. Unfortunately we are not allowed to include girls who do not meet all of the eligibility requirements. I appreciate your taking the time to answer these questions. Thank you very much.”
Opening Script

Hello, this is <<interviewer name>> calling from the UMass Girls DASH program. May I please speak with the mother of <girl’s name>?

If not home:  When would be a good time for me to reach him/her?

If home:  Hello, my name is <<interviewer name>> and I am calling from the UMass Girls DASH program. We are a health education study for girls in grades 2, 3, 4, and 5. I am calling because you have a daughter who may be eligible for our study. We are interested to learn the impact of a dance and sleep education program. Do you have 5 minutes to talk to me?

Our 8-week study involves completing surveys and taking measurements at the beginning, at 4 weeks, and then at 8 weeks. **During these 8 weeks, girls will be randomly selected (like a flip of a coin) to participate in one of three different programs to help them stay healthy.** One program includes a dance PLUS sleep education program where girls dance and then receive sleep education. One program includes a sleep education program PLUS dance program where girls receive sleep education and then dance classes. In the third program, girls participate in a health education program, where they will receive weekly health education lessons on site. The dance and sleep education classes will be held at a local community site. The health education program will consist of weekly mini-lessons that will be delivered at the intervention site. **AS A REMINDER, GIRLS IN THIS GROUP WILL NOT PARTICIPATE IN THE DANCE CLASSES OR SLEEP SESSIONS.** However, we will offer the dance classes twice per week, for four consecutive weeks at the conclusion of the program. As part of the program, we ask you and your daughter to complete some questionnaires. All girls will also be offered a healthy snack and homework tutoring from 4:30-5:30 pm every day of the program. The dance classes will take place from 5:30-6:30 pm each day.

Each family participating in this program will also be paid for their time, effort, and participation for a total of $30 if all measures are completed over the 8-week study.

If you think you might be interested, I have several questions that will help us determine if your daughter is eligible to participate in Girls DASH.

Do you think you might be interested?  □ yes  □ no

If NO:  Thank you very much for your time. If you change your mind, you can contact our program at (413) 545-6104.
If YES: Great (or some other encouragement.) Your responses to these screening questions are completely voluntary. However certain questions must be answered to determine your eligibility for the Girls DASH program. If you choose not to answer them, it will in no way affect your future associations with other programs at UMASS. Everything you tell me will be kept confidential and your answers will be seen only by our research staff. These questions take about 10-15 minutes.

PERSONAL INFORMATION

ID

Today’s Date: _____/_____/20__

*1. What is <<girl’s name>> birthdate? ____/____/19____
   Age?______ (7 to 12.9 years eligible)

2. To which of the following ethnic groups do you consider <<girl’s name>> to belong to? You may choose all that apply.
   - [ ] 1 Mexican, Mexican American or Chicano
   - [ ] 2 Puerto Rican
   - [ ] 3 Cuban
   - [ ] 4 Other Hispanic or Latino
   - [ ] 5 African
   - [ ] 6 West Indian or Caribbean
   - [ ] 7 Other (please specify):_________________________

3. In addition, to which of the following races do you consider <<girl’s name>> to belong to? You may choose all that apply.
   - [ ] 1 Black or African American
   - [ ] 2 White
3   American Indian or Alaska Native
4   Asian
5   Native Hawaiian or Other Pacific Islander
6   Other (Please specify):_________________________

CAREGIVER PARTICIPATION / INTEREST
1. How did you hear about the program? You may choose all that apply.
   - 1. My daughter
   - 2. Friend or other family member
   - 3. Child’s school (e.g. flier, word of mouth)
   - 4. Presentation at child’s school
   - 5. Church (e.g. flier, word of mouth)
   - 6. Presentation at church
   - 7. Child’s after school program (e.g. flier, word of mouth)
   - 8. Presentation at child’s after school program
   - 9. Other community program (e.g. flier, word of mouth)
   - 10. Presentation at other community program
   - 11. Newspaper ad or story
   - 12. Mail (e.g., letter, flier, postcard, brochure)
   - 13. Television
   - 14. Radio
   - 15. Health Fair
   - 16. Internet (e.g., e-mail, listserv, web site)
   - 17. Staff initiated phone call
   - 18. Other (please specify):__________________________

2. What interested you in participating in this program? You may choose all that apply.
   - 1. Interested in diet and physical activity
   - 2. Interested in health
   - 9. She wanted me to come
   - 10. Sounded interesting
3. Would be fun for me
4. Would be fun for her
5. Would help her
6. Wanted to learn more about the program
7. Wanted her to be with other kids
8. Wanted to be with other parents
9. Other (please specify):

11. It is an important health issue for African-Americans
12. Can get money or gifts
13. Interested in DANCE
14. Interested in reducing TV
15. Other (please specify):

ELIGIBILITY CRITERIA

* Is <<girl’s name>> able to participate in Physical Education (PE) at school?  
(If PE is not offered, ask: "Would <<girl’s name>> be able to participate in PE if it were offered?")

☐ yes  ☐ no

* Does <<girl’s name>> have any current or past cardiovascular, musculoskeletal, or developmental conditions that would limit her ability to participate in physical activity?

☐ yes  ☐ no

* Does <<girl’s name>> have any current or past cardiovascular, musculoskeletal, or developmental conditions that would limit her ability to wear a small physical activity monitor on her waist or a small sleep monitor on her wrist?

☐ yes  ☐ no

* Does <<girl’s name>> read and speak English?

☐ yes  ☐ no
* Does the parent read and speak English? (DO NOT READ QUESTION TO PARENT, ANSWER QUESTION BASE ON PARENT’S INTERACTION WITH DATA COLLECTOR)

☐ yes  ☐ no

**SUMMARY**

Considering only the screening eligibility criteria, does this girl satisfy the Girls DASH eligibility requirements?

- Age: Girl is 7 years or older, but has not had her 13th birthday.
- Child is able to participate in PE
- Child has no conditions limiting her ability to participate in physical activity or the assessments
- Child reads and speaks English
- Parent/Caregiver reads and speaks English

**If eligible, read to parent/caregiver:**

“Based on your answers to these questions, it looks like <<girl’s name>> will be eligible to participate.

The next step in this screening process is to schedule a visit that will take place in your home. The purpose of this visit is to get you and your daughter to sign the informed consent and assent documents and to complete the baseline surveys. The visit will take about 1 hour.

We want to make this as easy as possible for you, so we can schedule this next appointment at a time that is most convenient for you and your daughter.

Do you have questions?”

**INFORMED CONSENT & BASELINE ASSESMENT VISIT**
Did the girl and her parent/caregiver agree to schedule a visit?

☐ yes  ☐ no

a. If YES, scheduled date for Baseline Visit

   month □ day □ year 20

b. If YES, scheduled time for Baseline Visit

   AM □ PM  time □

b. Parent First and Last Name:

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c. Girls’ Name

<table>
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d. Relationship to girl(s): ______________________________

e. Mailing Address:

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f. Phone numbers:

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# APPENDIX 3

## NATIONAL SLEEP FOUNDATION SLEEP DIARY

National Sleep Foundation Sleep Diary

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<tr>
<th>Fill out days 1-4 below</th>
<th>Complete in morning</th>
<th>Complete at end of day</th>
</tr>
</thead>
<tbody>
<tr>
<td>I went to bed last night at:</td>
<td>I got out of bed this morning at:</td>
<td>Last night I fell asleep in:</td>
</tr>
<tr>
<td>I woke up during the night:</td>
<td>Last night I slept a total of:</td>
<td>My sleep was disturbed by: (e.g. stress, snoring, temperature)</td>
</tr>
<tr>
<td>When I woke up for the day, I felt:</td>
<td></td>
<td>I consumed caffeinated drinks in the:</td>
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<tr>
<td></td>
<td></td>
<td>I exercised at least 20 minutes in the:</td>
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<tr>
<td></td>
<td></td>
<td>About 2-3 hours before bed I consumed:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Medications I took during the day:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>About 1 hour before going to bed I did the following activities:</td>
</tr>
</tbody>
</table>

### Day 1

- **Date:** ______  
- **Time:** ______ PM/AM

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<thead>
<tr>
<th>PM/AM</th>
<th>PM/AM</th>
<th>_____ minutes</th>
<th>_____ times</th>
<th>_____ hours</th>
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</thead>
</table>
| ☐ Refreshed  
☐ Somewhat Refreshed  
☐ Fatigued |
| ☐ Morning  
☐ Afternoon  
☐ Within several hours of bed  
☐ Not Applicable |

### Day 2

- **Date:** ______  
- **Time:** ______ PM/AM

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<tr>
<th>PM/AM</th>
<th>PM/AM</th>
<th>_____ minutes</th>
<th>_____ times</th>
<th>_____ hours</th>
</tr>
</thead>
</table>
| ☐ Refreshed  
☐ Somewhat Refreshed  
☐ Fatigued |
| ☐ Morning  
☐ Afternoon  
☐ Within several hours of bed  
☐ Not Applicable |

125
<table>
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<th>Day 3</th>
<th>Date: _____  Time: _____</th>
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<td>____ minute(s) ___ times</td>
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<td>Refreshed □ Somewhat □ Fatigued</td>
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<td>□ Morning □ Afternoon □ Within several hours of bed □ Not Applicable</td>
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<tr>
<td></td>
<td>□ Alcohol □ A heavy meal □ Not Applicable</td>
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<table>
<thead>
<tr>
<th>Day 4</th>
<th>Date: _____  Time: _____</th>
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<td>Refreshed □ Somewhat □ Fatigued</td>
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<td>□ Alcohol □ A heavy meal □ Not Applicable</td>
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Fill out days 5-7 below

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<th>Day 5</th>
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<td>____ minute(s) ___ times</td>
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<tr>
<td></td>
<td>Refreshed □ Somewhat □ Fatigued</td>
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<td></td>
<td>□ Morning □ Afternoon □ Within several hours of bed □ Not Applicable</td>
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<td>□ Morning □ Afternoon □ Within several hours of bed □ Not Applicable</td>
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<td></td>
<td>□ Alcohol □ A heavy meal □ Not Applicable</td>
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</table>

Complete in morning

| I went to bed last night at: |
| I got out of bed this morning at: |
| Last night, I fell asleep in: |
| I woke up during the night: |
| When I woke up for the day, I felt: |
| Last night I slept a total of: |
| My sleep was disturbed by: (e.g. stress, snoring, temperature): |
| I consumed caffeinated drinks in the: |
| I exercised at least 20 minutes in the: |
| About 2-3 hours before bed I consumed: |
| Medications I took during the day: |
| About 1 hour before going to bed I did the following activities: |

Complete at end of day

<p>| □ Morning □ Afternoon □ Within several hours of bed □ Not Applicable |
| □ Morning □ Afternoon □ Within several hours of bed □ Not Applicable |
| □ Alcohol □ A heavy meal □ Not Applicable |</p>
<table>
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<tr>
<th>Day</th>
<th>Date: <em><strong><strong>/</strong></strong></em></th>
<th>Time: _____/AM/PM</th>
<th>_____ minute(s)</th>
<th>_____ times</th>
<th>_____ hours</th>
<th>Morning</th>
<th>Afternoon</th>
<th>Within several hours of bed</th>
<th>□ Not Applicable</th>
<th>Afternoon</th>
<th>Within several hours of bed</th>
<th>□ Not Applicable</th>
<th>Alcohol</th>
<th>□ A heavy meal</th>
<th>□ Not Applicable</th>
<th>Alcohol</th>
<th>□ A heavy meal</th>
<th>□ Not Applicable</th>
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</tbody>
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APPENDIX 4

DANCE FIDELITY SHEET

Date: ____________________      Style of Dance being taught: ________________

Name of dance instructor: __________________________________

1. Number of girls present during the dance intervention: ______________

2. During the dance intervention were at least 50% of the girls participating in the dance lessons? YES or NO

   If no, of the total number of girls present, what is the estimated number of girls that were participating? __________

3. During the dance intervention, did at least 50% of the girls seem to be having fun? YES or NO.

   If no, how many of the girls present were having fun? __________

4. How long was the dance class: ______________

5. Did the dance instructor follow the dance routine developed? YES or NO

6. Did the dance instructor use the required music? YES or NO

7. Did the dance instructor encourage the participants to participate? YES or NO

8. Of the entire dance class, did participants spend at least 50% of the time simply standing and watching the dance instructor versus dancing? YES or NO

9. Of the entire dance class, did participants spend at least 50% of the time engage in MVPA?
Please provide any comments on anything that was observed during the dance class:

_____________________________________________________________________________________________
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Data Collector Name: ______________________________
APPENDIX 5

SLEEP EDUCATION FIDELITY FORM

Date: ________________  Session: INITIAL or FOLLOW-UP

Name of interventionist: ________________________________

1. Did the child complete the session? : YES or NO

2. Did the child's primary caregiver complete the session? YES or NO

3. How did the primary caregiver complete the session?
   IN PERSON or PHONE or N/A

4. Did the child complete the sleep diary? YES or NO

5. Were the child, primary caregiver and interventionist able to identify and agree a target behavior for change? (initial session ONLY)
   YES or NO

6. Did the interventionist deliver the general sleep education material to the child (initial session ONLY)?
   YES or NO

7. Did the interventionist deliver the general sleep education material to the primary caregiver (initial session ONLY)?
   YES or NO

8. Did the interventionist suggest any modifications to the initial intervention plan? (follow-up session ONLY)
   YES or NO
Please provide any comments on anything that was observed during the intervention session:

_____________________________________________________________________________________________
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Data Collector Name: ________________________________
APPENDIX 6

PARENT POST-PROGRAM SATISFACTION SURVEY

1. On a scale of 1-5, with one being very dissatisfied and five being very satisfied, how satisfied are you with the Girls DASH Program?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5

2. On a scale of 1-5, with one being very dissatisfied and five being very satisfied, how satisfied are you with the sleep education portion of the Girls DASH program?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
   f. Not applicable (daughter did not participate in this portion)

3. On a scale of 1-5, with one being very dissatisfied and five being very satisfied, how satisfied are you with the dance portion of the Girls DASH program?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
   f. Not applicable (daughter did not participate in this portion)

4. On a scale of 1-5, with one being very unlikely and five being very likely, how likely are you to enroll your daughter in dancing for physical activity in the future?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
5. On a scale of 1-5, with one being very dissatisfied and five being very satisfied, how satisfied are you how satisfied the level of instruction provided by the dance instructor?

a. 1
b. 2
c. 3
d. 4
e. 5
f. Not applicable (daughter did not participate in this portion)
APPENDIX 7

DAUGHTER POST-PROGRAM SATISFACTION SURVEY

Girls DASH Daughter's End of the Program Survey

1. On a scale of 1-5, with one being very dissatisfied and five being very satisfied, how satisfied are you with the Girls DASH Program?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5

2. On a scale of 1-5, with one being very dissatisfied and five being very satisfied, how satisfied are you with the sleep education portion of the Girls DASH program?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
   f. Not applicable (I did not participate in this portion)

3. On a scale of 1-5, with one being very dissatisfied and five being very satisfied, how satisfied are you with the dance portion of the Girls DASH program?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
   f. Not applicable (I did not participate in this portion)

4. On a scale of 1-5, with one being very unlikely and five being very likely, how likely are you to participate in dancing for physical activity in the future?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
   f. Not applicable (I did not participate in this portion)
5. On a scale of 1-5, with one being very dissatisfied and five being very satisfied, how satisfied are you with the level of instruction provided by the dance instructor?
   a. 1
   b. 2
   c. 3
   d. 4
   e. 5
   f. Not applicable (I did not participate in this portion)
APPENDIX 8

BEDROOM ENVIRONMENT QUESTIONNAIRE

INSTRUCTIONS: Please ask the child to identify the option which best reflects the bedroom in which they normally sleep and circle:

1. Is there a television in the bedroom in which you sleep?
   a. Yes
   b. No

2. If the child answered, “Yes” to question 1, what is the status of that television during her nightly sleeping hours?
   a. Turned off the entire time
   b. Turned on some of the night
   c. Turned on most of the night
   d. N/A

3. Do you have access to any other screens (cell phone, tablet, iPod, computer, laptop, handheld video games etc.) during your nightly sleeping hours?
   a. Yes
   b. No

4. If you answered, “Yes” to question 3, do you ever use any of these devices during your nightly sleeping hours?
   a. Yes
   b. No
   c. N/A

5. How would you classify the current normal nighttime temperature in the bedroom in which you sleep?
   a. Too cold
   b. A little cold
   c. Just right
   d. A little hot
   e. Too hot

6. Which of the following statements describes the current normal nighttime noise level in the room in which you sleep?
   a. Completely silent (no “white noise” from fans, air conditioning, light music/neighboring conversation)
   b. Quiet with some “white noise”
   c. Slightly noisy (loud conversations/television/music from neighboring rooms or apartments or regular noise from outside ex. cars, sirens, street noise)
d. Noisy (loud conversations/television/music within the bedroom and regular noise from outside ex. cars, sirens, street noise)

7. Which of the following statements describes the current normal nighttime light level in the room in which you sleep?
   a. Complete darkness
   b. Dark with the use of a night-light
   c. Television on during some/most of the night
   d. Light from outside the room (street lights, closet lights, hallway lights)
   e. Television on during some/most of the night as well as lights from outside the room (street lights, closet lights, hallway lights)

8. Which of the following statements best describes your bedroom?
   a. I have my own bedroom
   b. I share a bedroom with 1 other sibling
   c. I share a bedroom with more than 1 other sibling
APPENDIX 9

POST-PROGRAM OPEN ENDED QUESTIONS

1. What was the hardest part about being in the Girls DASH program?

2. What were you and your child’s favorite part about being in the Girls DASH program?

3. What were you and your child’s least favorite part about being in the Girls DASH program?

4. Please tell us why you were either satisfied/dissatisfied with the Girls DASH program.

5. Please tell us why you were satisfied/dissatisfied with the facilitation provided by the Girls DASH program staff.

6. Please tell us why you are satisfied/dissatisfied with the level of instruction provided by the dance instructor.

7. Which dance style was of the most interest to your child and why?

8. Which part of the sleep education program was of the most interest to your child and why?

9. Is there anything that you would like to see changed or added to the sleep education portion of the program?

10. Do you have any additional comments or suggestions to improve the Girls DASH program?
APPENDIX 10

INFORMED CONSENT

FOR QUESTIONS ABOUT THIS STUDY, CONTACT:
Sofiya Alhassan, PhD
University of Massachusetts Amherst
Department of Kinesiology
Totman Building, Room 150
30 Eastman Lane
Amherst, MA 01003-9258
(413) 545-6104

WHAT IS THIS FORM

This Informed Consent form will give you the information you will need to understand why this study is being done and why your daughter is being invited to participate. It will also describe what you and your daughter will need to do to participate and any known risks, inconveniences or discomforts that you and your daughter may have while participating. We encourage you to take some time to think this over and ask questions now and at any other time. If you decide to participate, you will be asked to sign this form and you will be given a copy for your records.

PURPOSE OF RESEARCH PROJECT

Physical activity and sufficient sleep have been shown to be a way to lower obesity rates in elementary age girls. Unfortunately, low levels of activity and insufficient sleep are very common in elementary age girls. Therefore, it is important for us to find good programs that can improve their activity and sleep levels. An important factor in a health program is that the girls must enjoy performing the activities. Dancing has been shown to be fun and provide girls with moderate levels of activity.

ELIGIBILITY

Your daughter is invited to participate in this study of a health promotion program for 7-12 year girls. Girls in the second-, third- fourth-, fifth-grades from the greater Springfield, MA area are being asked to participate in this study.

PROCEDURES

If you and your daughter decide to participate, you will be asked to do the following things at convenient time for you and your daughter either at the intervention site or at your home, whichever is most convenient. Two individuals from the research staff will complete the following procedure:

1. We will measure your daughter’s height, weight, and percent body fat with a handheld device. We will repeat these measures at 4 weeks and 8 weeks after the start of the program (a total of 3 times during the 8-weeks).
2. We will ask you and your daughter questions about her health, physical activity habits and sleep habits. We will repeat these measures at 4 weeks and 8 weeks after the start of the program (a total of 3 times during the 8-weeks).

3. You and your daughter will then be assigned at random (liking flipping a coin) to one of the following groups:
   a. A dance PLUS sleep education program. Girls assigned to this group will participate in the dance program for 8 weeks PLUS 3 individual sleep education sessions with the child, primary caregiver and a person from the study (researcher) over the course of weeks 5 - 8 of the program.
      i. Some of the dance sessions will be videotaped for program assessment and the development of future programs. These videotapes will remain confidential and will not be viewed by anyone other than the research staff for any other reason.
   b. A sleep education PLUS dance program. Girls assigned to this group will participate in 3 individual sleep education sessions with the child, primary caregiver and a researcher over the course of weeks 1 - 4 of the program and then participate in the dance program during weeks 5 - 8 of the program.
      i. Some of the dance sessions will be videotaped for program assessment and the development of future programs. These videotapes will remain confidential and will not be viewed by anyone other than the research staff for any other reason.
   c. A health education program. Girls assigned to this group will participate in the health education program. This program consists of weekly face-to-face health mini-lessons designed to provide daughters information on leading a healthy lifestyle. **CHILDREN IN THIS GROUP WILL NOT PARTICIPATE IN THE DANCE PROGRAM OR SLEEP EDUCATION SESSIONS.**
      i. We will offer the dance classes for all of the girls in the health education program, twice per week, for four consecutive weeks at the conclusion of the study.
   d. All children in all 3 groups will be offered a healthy snack and homework tutoring at the intervention site from 4:30-5:30.
   e. On the following page there is a visual depiction of the different elements of the program and the timing in which those components will be delivered for each group.
4. The dance classes will be provided 4 days per week during the study and will take place at a local community site from 5:30-6:30 p.m. The dance classes will last about 1.0 hour each. The sleep education sessions will take place either at the same location or at your home 3 times over the course of the program and last about 45 minutes each. Girls will also be offered homework tutoring at the intervention site.

5. At the beginning, middle and end of the study your daughter will be asked wear a small beeper-sized motion sensor on a belt around her waist to measure her activity for 7 days in a row. In addition, your daughter will be asked to wear watch around her wrist during the same time she is wearing the activity monitor to measure her sleep level. The activity monitor will be worn during all waking hours and the sleep monitor will be worn 24 hours a day.
DURATION OF STUDY INVOLVEMENT

Your participation in this study will last for 8 weeks. Over the course of the 8-weeks, you and your daughter will meet with a researcher on three occasions during the study for approximately 1.0 hour per meeting. Girls in the dance PLUS sleep education program will also take part in the dance classes 4 days per week during weeks 1 - 8 of the program, while girls in the sleep education PLUS dance program will participate in the dance classes 4 days per week during weeks 5 - 8 of the program. Each dance class will last for 1 hour. Girls in these groups will also take part in 3 sleep education sessions with their primary caregiver during either the first or last 4-weeks of the intervention, with each session lasting 45 minutes each. The afterschool and health education activities will be offered to ALL girls in ALL 3 groups and will last for 1 hour including healthy snack time and homework tutoring.

WITHDRAWAL FROM STUDY

You and your daughter do not have to be in this study if you do not want to. If you agree to be in the study, but later change your mind, you and your daughter may drop out at any time. There are no penalties or consequences of any kind if you decide that you do not want to participate. You will be notified of all significant new findings during the course of the study that may affect your willingness to continue.

The research staff may also withdraw you and your daughter from the study without your permission for one or more of the following reasons:

- Failure to follow the instructions of the research staff
- The research staff decides that continuing your participation could be harmful to you and/or your daughter
- The study is cancelled, other administrative reasons, or unanticipated circumstances

POSSIBLE RISKS, DISCOMFORTS, AND INCONVENIENCES

Your daughter may be at increased risk of injury during physical activity (from dance classes or from increased exercise because of the health education program). For girls in the dance program, instructors will be trained in basic First Aid and to use proper warm-up and cool-down routines. The elastic belts and watches used to secure the motion sensors in place may rub your daughter’s skin and become uncomfortable. No skin damage should result from this and the discomfort level is minimal. Since we will be videotaping and/or photographing some of the dance classes, you and your daughters’ participation in this study may not be confidential.

MEDICAL TREATMENT

The University of Massachusetts Amherst does not have a program for compensating subjects for injury or complications related to human subject research but in the unlikely event of injury resulting directly from being part of this study, researchers will assist you
and your daughter in every way to ensure that you and your daughter get proper medical attention.

**POTENTIAL BENEFITS**

Potential benefits of participating in this study include the possibility of better health for your daughter, and increasing physical activity levels and sleep levels. Participating in this study may also improve how your daughter feels about herself. Finally, what we learn from this study may increase our knowledge about the best ways to help other girls improve their physical activity and sleep levels. We cannot guarantee that you will receive any benefits from this study, however you and your daughter might feel better with the increase in physical activity and sleep.

**ALTERNATIVES**

The only alternative to being apart of this study is not to participate.

**CONFIDENTIALITY**

The information obtained from this study will be treated as privileged and confidential. It will not be released except upon your written consent. You and your daughter’s right to privacy will be maintained at all times. You and your daughter will be assigned a numerical ID number at the beginning of the study and all your data will be identified by ID number only. You and your daughter’s name and ID number will be recorded at the beginning of the study and this information will be placed in a file cabinet that will be locked. Any information linking your daughter’s name to her ID number will be destroyed at the completion of the study data analysis. Researchers may need to break confidentiality to report situations of child abuse, child neglect, or any life-threatening situation to appropriate authorities. However, researchers are not seeking this type of information in this study nor will participants be asked questions about these issues. For more information on this policy visit http://www.umass.edu/research/mandatory-reporting-and-research.

**COMPENSATION**

For your time and effort in completing the surveys and wearing the monitors, your family will receive up to $30. You will receive:
1. $10 for participating in the first set of physical activity and sleep measures at the beginning of the study
2. $10 for participating in the 4-week interview/measures
3. $10 for participating in the 8-week interview/measures
If you and/or your daughter decide to terminate your involvement early, your compensation will be pro-rated based on the amount of time you were involved in the study. There is no cost to participate in this study.
REQUEST FOR ADDITIONAL INFORMATION

Take as long as you like before you make a decision. We will be happy to answer any question you have about this study. If you have further questions about this project or if you have a research-related problem, you may contact the researcher, (Sofiya Alhassan, 413-545-6104). If you have any questions concerning your rights as a research subject, you may contact the University of Massachusetts Amherst Human Research Protection Office (HRPO) at (413) 545-3428 or humansubjects@ora.umass.edu

PARTICIPATION STATEMENT OF VOLUNTARY CONSENT

I have read this form and decided that I will participate in the project described above. The general purposes and particulars of the study as well as possible risks and inconveniences have been explained to my satisfaction. I understand that I can withdraw at any time.

________________________________________________
Parent/legal guardian Name (print)

________________________________________________
Parent/legal guardian Signature __________________
Date

________________________________________________
Child’s Name (print)

Study Representative Statement

By signing below I indicate that the participant has read and, to the best of my knowledge, understands the details contained in this document and has been given a copy.

______________________________________________
Study Representative Name (Print)

__________________________________________     __________________
Signature        Date
INFORMED ASSENT

What will happen to me in this program?

We would like to see if you would like to be in this program. We want to see how your physical activity and sleep change if you participate in an after-school dance and sleep education program. Only if you want to, you will have to do a few things if you are in this program:

1. We will measure how tall you are, your weight, your body fat, activity and sleep level.
2. You will be chosen (like flipping a coin) to be in either a dance class PLUS sleep education program, a sleep education PLUS dance program OR to be in a health education program, where you will receive weekly mini-lessons on health.
3. The dance program will be at a local community site and will be given 4 days per week for 8 weeks. **These classes will be offered to those in dance PLUS sleep education program for the whole 8 weeks and the sleep education program in weeks 5-8. The sleep education PLUS dance program will be offered the sleep education program in weeks 1-4 and the dance program during weeks 5 – 8 of the program. AS A REMINDER, GIRLS IN THIS GROUP WILL NOT PARTICIPATE IN THE DANCE CLASSES OR SLEEP SESSIONS.** However, we will offer the dance class to all the girls in the health education group twice per week for four weeks at the end of the study.
4. All girls will get healthy snack and homework tutoring Monday-Thursday from 4:30-5:30 p.m. throughout the entire program. The dance classes will take place Monday-Thursday from 5:30-6:30 p.m. for girls who are currently participating in them.

Can anything bad happen to me?

1. Similar to being involve in your school PE class, you could get hurt during the physical activity program if you are in the dance class PLUS sleep education program or the sleep education PLUS dance program.
2. If you are in the health education program there are no additional risks.

Can anything good happen to me?

1. Participating in the dance PLUS sleep education program or sleep education PLUS dance program may be fun and may improve your activity and sleep level. We might find out something that will help other children be more active. But we do not promise that this study will be good for you.
2. If you are in the health education program, you may learn valuable information from the weekly mini-lessons that could improve your overall health.

**Do I have other choices?**

You can choose not to be in this study.

**Who can I talk to about the study?**

You can ask questions any time. You can ask now. You can ask later. Your mom/dad has my phone number.

**What if I do not want to do this?**

You don’t have to be in this study. No one will be mad at you if you don’t want to do this. If you want to or don’t want to be in this study, you just have to tell me. And, remember, you can say “yes” now and change your mind later. It’s up to you. If you decide you want to be in this study, I need your to write and sign your name.

I, _________________________________, want to be in this research study.

(Print your name here)

__________________________________________  _______________
(Sign your name here)  (Date)
### APPENDIX 12

**CHILDREN’S SLEEP HABITS QUESTIONNAIRE**

**Child’s Sleep Habits**  
(Preschool and School-Age)

The following statements are about your child’s sleep habits and possible difficulties with sleep. Think about the past week in your child’s life when answering the questions. If last week was unusual for a specific reason (such as your child had an ear infection and did not sleep well or the TV set was broken), choose the most recent typical week. Answer **USUALLY** if something occurs 5 or more times in a week; answer **SOMETIMES** if it occurs 2-4 times a week; answer **RARELY** if something occurs never or 1 time during a week. Also, please indicate whether or not the sleep habit is a problem by circling “YES,” “NO,” or “Not applicable (N/A).

#### Bedtime

**Write in child’s bedtime:**

<table>
<thead>
<tr>
<th></th>
<th>3 Usually (5-7)</th>
<th>2 Sometimes (2-4)</th>
<th>1 Rarely (0-1)</th>
<th>Problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child goes to bed at the same time at night</td>
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<tr>
<td>Child falls asleep within 20 minutes after going to bed</td>
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<tr>
<td>Child falls asleep in own bed</td>
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<tr>
<td>Child falls asleep in parent’s or sibling’s bed</td>
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<tr>
<td>Child falls asleep with rocking or rhythmic movements</td>
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<tr>
<td>Child needs special object to fall asleep (doll, special blanket, etc.)</td>
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<tr>
<td>Child needs parent in the room to fall asleep</td>
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<tr>
<td>Child is ready to go to bed at bedtime</td>
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<tr>
<td>Child resists going to bed at bedtime</td>
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<tr>
<td>Child struggles at bedtime (cries, refuses to stay in bed, etc.)</td>
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<tr>
<td>Child is afraid of sleeping in the dark</td>
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<tr>
<td>Child is afraid of sleeping alone</td>
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</tr>
</tbody>
</table>

#### Sleep Behavior

**Child’s usual amount of sleep each day:** _______ hours and _______ minutes

(combining nighttime sleep and naps)

<table>
<thead>
<tr>
<th></th>
<th>3 Usually (5-7)</th>
<th>2 Sometimes (2-4)</th>
<th>1 Rarely (0-1)</th>
<th>Problem?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child sleeps too little</td>
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<tr>
<td>Child sleeps too much</td>
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<tr>
<td>Child sleeps the right amount</td>
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<tr>
<td>Child sleeps about the same amount</td>
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</tbody>
</table>
each day
Child wets the bed at night
Child talks during sleep
Child is restless and moves a lot during sleep
Child sleepwalks during the night
Child moves to someone else’s bed during the night (parent, brother, sister, etc.)

### Sleep Behavior (continued)

<table>
<thead>
<tr>
<th>Problem?</th>
<th>Usually (5-7)</th>
<th>Sometimes (2-4)</th>
<th>Rarely (0-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child reports body pains during sleep. If so, where?</td>
<td>Yes No N/A</td>
<td></td>
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</tr>
<tr>
<td>Child grinds teeth during sleep (your dentist may have told you this)</td>
<td>Yes No N/A</td>
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<tr>
<td>Child snores loudly</td>
<td>Yes No N/A</td>
<td></td>
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<tr>
<td>Child seems to stop breathing during sleep</td>
<td>Yes No N/A</td>
<td></td>
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<tr>
<td>Child snorts and/or gasps during sleep</td>
<td>Yes No N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child has trouble sleeping away from home (visiting relatives, vacation)</td>
<td>Yes No N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child complains about problem sleeping</td>
<td>Yes No N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child awakens during night screaming, sweating, and inconsolable</td>
<td>Yes No N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child awakens alarmed by a frightening dream</td>
<td>Yes No N/A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Waking during the night

<table>
<thead>
<tr>
<th>Problem?</th>
<th>Usually (5-7)</th>
<th>Sometimes (2-4)</th>
<th>Rarely (0-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child awakes once during the night</td>
<td>Yes No N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child awakes more than once during the night</td>
<td>Yes No N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child returns to sleep without help after waking</td>
<td>Yes No N/A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Write the number of minutes a night waking usually last: __________
**Morning Waking**

Write in the time of day child usually wakes in the morning: __________

<table>
<thead>
<tr>
<th>Problem?</th>
<th>3 Usually (5-7)</th>
<th>2 Sometimes (2-4)</th>
<th>1 Rarely (0-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child wakes up by him/herself</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Child wakes up with alarm clock</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Child wakes up in a negative mood</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Adults or siblings wake up child</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Child has difficulty getting out of bed in the morning</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Child takes a long time to become alert in the morning</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Child wakes up very early in the morning</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Child has a good appetite in the morning</td>
<td>Yes</td>
<td>No</td>
<td>N/A</td>
</tr>
</tbody>
</table>
APPENDIX 13

SEDENTARY BEHAVIOR QUESTIONNAIRE

SEDENTARY BEHAVIOR

YESTERDAY / LAST FRIDAY

BEFORE SCHOOL

Yesterday <or last Friday>, how much time did you spend before school (from the time you woke up until the start of school (or until noon))...

|   | 1. Watching television
<table>
<thead>
<tr>
<th></th>
<th>(not including videos on a VCR or DVDs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>15 minutes or less</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>2. Watching movies or videos on a VCR or DVD</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>15 minutes or less</td>
</tr>
<tr>
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<td></td>
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</tbody>
</table>

|   | 3. Playing video games
<table>
<thead>
<tr>
<th></th>
<th>(like Nintendo or Sega, not including games on a computer)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>15 minutes or less</td>
</tr>
<tr>
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</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>4. Playing on a computer (not including homework)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>15 minutes or less</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>Activity</td>
<td>Time Options</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>-------------------------------</td>
</tr>
<tr>
<td>5. Doing homework (including reading a book or magazine for school or working on a computer)</td>
<td>None, 15 minutes or less, 30 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours or more</td>
</tr>
<tr>
<td>6. Reading a book or magazine NOT for school (including comic books)</td>
<td>None, 15 minutes or less, 30 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours or more</td>
</tr>
<tr>
<td>7. Listening to music on the radio, tapes or CDs</td>
<td>None, 15 minutes or less, 30 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours or more</td>
</tr>
<tr>
<td>8. Playing a musical instrument</td>
<td>None, 15 minutes or less, 30 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours or more</td>
</tr>
<tr>
<td>9. Doing artwork or crafts (like drawing, painting or making things)</td>
<td>None, 15 minutes or less, 30 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours or more</td>
</tr>
<tr>
<td>10. Playing quiet games indoors (like playing with toys, puzzles or board games)</td>
<td>None, 15 minutes or less, 30 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours or more</td>
</tr>
<tr>
<td>11. Playing outside</td>
<td>None</td>
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<tr>
<td>12. Talking on the phone</td>
<td>None</td>
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</table>

Yesterday / LAST FRIDAY  AFTER SCHOOL

Yesterday <or last Friday>, how much time did you spend after school (from the end of school until you went to sleep)...  

<table>
<thead>
<tr>
<th>Activity</th>
<th>None</th>
<th>15 minutes or less</th>
<th>30 minutes</th>
<th>1 hour</th>
<th>2 hours</th>
<th>3 hours</th>
<th>4 hours</th>
<th>5 hours</th>
<th>6 hours or more</th>
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</thead>
<tbody>
<tr>
<td>1. Watching television (not including videos on a VCR or DVDs)</td>
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<tr>
<td>2. Watching movies or videos on a VCR or DVD</td>
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<tr>
<td>3. Playing video games (like Nintendo or Sega, not including games on a computer)</td>
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<tr>
<td>4. Playing on a computer (not including homework)</td>
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<tr>
<td>5. Doing homework (including reading a book or magazine for school or working on a computer)</td>
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<td>6. Reading a book or magazine NOT for school (including comic books)</td>
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<tr>
<td>7. <strong>Listening to music on the radio, tapes or CDs</strong></td>
<td>None</td>
<td>15 minutes or less</td>
<td>30 minutes</td>
<td>1 hour</td>
<td>2 hours</td>
<td>3 hours</td>
<td>4 hours</td>
<td>5 hours</td>
<td>6 hours or more</td>
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<tr>
<td>8. <strong>Playing a musical instrument</strong></td>
<td>None</td>
<td>15 minutes or less</td>
<td>30 minutes</td>
<td>1 hour</td>
<td>2 hours</td>
<td>3 hours</td>
<td>4 hours</td>
<td>5 hours</td>
<td>6 hours or more</td>
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</tr>
<tr>
<td>9. <strong>Doing artwork or crafts (like drawing, painting or making things)</strong></td>
<td>None</td>
<td>15 minutes or less</td>
<td>30 minutes</td>
<td>1 hour</td>
<td>2 hours</td>
<td>3 hours</td>
<td>4 hours</td>
<td>5 hours</td>
<td>6 hours or more</td>
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<tr>
<td>10. <strong>Playing quiet games indoors</strong> (like playing with toys, puzzles or board games)</td>
<td>None</td>
<td>15 minutes or less</td>
<td>30 minutes</td>
<td>1 hour</td>
<td>2 hours</td>
<td>3 hours</td>
<td>4 hours</td>
<td>5 hours</td>
<td>6 hours or more</td>
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<tr>
<td>11. <strong>Playing outside</strong></td>
<td>None</td>
<td>15 minutes or less</td>
<td>30 minutes</td>
<td>1 hour</td>
<td>2 hours</td>
<td>3 hours</td>
<td>4 hours</td>
<td>5 hours</td>
<td>6 hours or more</td>
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</tr>
<tr>
<td>12. <strong>Talking on the phone</strong></td>
<td>None</td>
<td>15 minutes or less</td>
<td>30 minutes</td>
<td>1 hour</td>
<td>2 hours</td>
<td>3 hours</td>
<td>4 hours</td>
<td>5 hours</td>
<td>6 hours or more</td>
</tr>
</tbody>
</table>
**LAST SATURDAY MORNING**

Last Saturday, how much time did you spend in the **morning** (from when you woke up until NOON)... 

<table>
<thead>
<tr>
<th>Activity</th>
<th>None</th>
<th>15 minutes or less</th>
<th>30 minutes</th>
<th>1 hour</th>
<th>2 hours</th>
<th>3 hours</th>
<th>4 hours</th>
<th>5 hours</th>
<th>6 hours or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watching television (not including videos on a VCR or DVDs)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Watching movies or videos on a VCR or DVD</td>
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<tr>
<td>Playing video games (like Nintendo or Sega, not including games on a computer)</td>
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</tr>
<tr>
<td>Playing on a computer (not including homework)</td>
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<tr>
<td>Doing homework (including reading a book or magazine for school or working on a computer)</td>
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<tr>
<td>Reading a book or magazine NOT for school (including comic books)</td>
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</tr>
<tr>
<td>Activity</td>
<td>Time Options</td>
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</tr>
<tr>
<td>7. Listening to music on the radio, tapes or CDs</td>
<td>None, 15 minutes or less, 30 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours or more</td>
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<td></td>
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</tr>
<tr>
<td>8. Playing a musical instrument</td>
<td>None, 15 minutes or less, 30 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours or more</td>
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<tr>
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<td></td>
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<td>10. Playing quiet games indoors (like playing with toys, puzzles or board games)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Playing outside</td>
<td>None, 15 minutes or less, 30 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours or more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Talking on the phone</td>
<td>None, 15 minutes or less, 30 minutes, 1 hour, 2 hours, 3 hours, 4 hours, 5 hours, 6 hours or more</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
**LAST SATURDAY AFTERNOON**

_Last Saturday_, how much time did you spend in the _afternoon_ (from NOON until you went to sleep)...

<table>
<thead>
<tr>
<th>Activity</th>
<th>None</th>
<th>15 minutes or less</th>
<th>30 minutes</th>
<th>1 hour</th>
<th>2 hours</th>
<th>3 hours</th>
<th>4 hours</th>
<th>5 hours</th>
<th>6 hours or more</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Watching television (not including videos on a VCR or DVDs)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>2. Watching movies or videos on a VCR or DVD</td>
<td></td>
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<tr>
<td>3. Playing video games (like Nintendo or Sega, not including games on a computer)</td>
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<tr>
<td>4. Playing on a computer (not including homework)</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>5. Doing homework (including reading a book or magazine for school or working on a computer)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Reading a book or magazine NOT for school (including comic books)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>None</td>
<td>15 minutes or less</td>
<td>30 minutes</td>
<td>1 hour</td>
<td>2 hours</td>
<td>3 hours</td>
<td>4 hours</td>
<td>5 hours</td>
<td>6 hours or more</td>
</tr>
<tr>
<td>----------------------------------------------------</td>
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</tr>
<tr>
<td>7. Listening to music on the radio, tapes or CDs</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Playing a musical instrument</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Doing artwork or crafts (like drawing, painting or making things)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Playing quiet games indoors (like playing with toys, puzzles or board games)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Playing outside</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Talking on the phone</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 14

PHYSICAL ACTIVITY QUESTIONNAIRE FOR YOUNGER CHILDREN

Subject ID: __ __ __ __
Date: __ __ / __ __ / __ __ __ __

We would like to know about the physical activity you have done in the last 7 days. This includes sports or dance that made you sweat or made your legs feel tired, or games that made you huff and puff, like tag, skipping, running, and climbing. REMEMBER: There are no right or wrong answers – this is not a test. It is OK to ask your parents to help you answer the questions. PLEASE ANSWER ALL QUESTIONS AS HONESTLY AND ACCURATE AS YOU CAN – THIS IS VERY IMPORTANT.

1. PHYSICAL ACTIVITY (Do not include P.E. classes)
Have you done any of the following activities in the LAST 7 DAYS? If yes, shade in the circle that matches how many times per week you did each individual activity and write down, on average, how many minutes at a time you did it. Shade “None” if you did not do the activity. Finally, if the activity was organized, that is, a coached sport or lessons, shade in the “Yes, Organized” circle. Start with today and go backwards for seven days total. Note: Shade only one circle per row for “Times in the Last Week.”

<table>
<thead>
<tr>
<th>Organized</th>
<th>Times in the Last Week</th>
<th>Avg. Minutes per session</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None</td>
<td>1 to 2</td>
</tr>
<tr>
<td>Aerobic Dance</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baseball, Softball</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basketball</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bicycling, Scooter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cheerleading, poms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creative Play</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dance (Ballet, Jazz)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Football</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Four Square, Tetherball</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Golf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gymnastics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Horseback Riding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ice Hockey, Skating</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Marching Band,</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activity</td>
<td>Symbol 1</td>
<td>Symbol 2</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Flags</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Martial Arts, Tae Kwon Do</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Running, Track/Field</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Skateboarding, Rollerblading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sledding, Skiing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soccer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Swimming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tag, Climbing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tennis, Badminton</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Volleyball</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking Briskly for Exercise</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight Lifting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. In the last 7 days, DURING YOUR PHYSICAL EDUCATION (P.E.) CLASSES, how often were you active (playing hard, running, jumping and throwing)? Shade the first one if you did not have P.E. in the last week. Shade only one.
   - I didn’t do P.E. in the last seven days
   - Hardly ever
   - Sometimes
   - Quite often
   - Always

3. In the last 7 days, what did you do most of the time DURING THE MORNING or if you were in school, and had a morning recess, what did you do DURING A MORNING RECESS? Morning means the time after waking and before lunch. Shade only one.
   - Sat down (talking, reading, doing school work)
   - Stood around or walked around
   - Ran or played a little bit
   - Ran around and played quite a bit
   - Ran and played hard most of the time

4. In the last 7 days, what did you normally DO AT LUNCH (besides eating lunch)? Shade only one.
   - Sat down (talking, reading, doing school work)
   - Stood around or walked around
   - Ran or played a little bit
   - Ran around and played quite a bit
   - Ran and played hard most of the time

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5. In the last 7 days, on how many days DURING THE AFTERNOON, did you do sports, dance, or play games in which you were very active? Afternoon means the time after lunch and before dinner. Shade only one.
   - None
   - 1 afternoon in the last week
   - 2 to 3 afternoons in the last week
   - 4 to 5 afternoons in the last week
   - 6 to 7 afternoons in the last week

6. In the last 7 days, on how many EVENINGS did you do sports, dance, or play games in which you were very active? Evenings mean the time after dinner. Shade only one.
   - None
   - 1 evening in the last week
   - 2 to 3 evenings in the last week
   - 4 to 5 evenings in the last week
   - 6 to 7 evenings in the last week

7. How many times did you do sports, dance, or play games in which you were very active LAST WEEKEND (Saturday and Sunday)? Shade only one.
   - None
   - 1 time last weekend
   - 2 to 3 times last weekend
   - 4 to 5 times last weekend
   - 6 or more times last weekend

8. Which ONE of the following five statements describes you best for the last 7 days? Read all 5 before deciding on the one answer that describes you. Shade only one.
   - All or most of my free time was spent doing things that involved little physical effort, for example, watching TV/videos/DVD, doing homework, doing instant messaging/email/internet, or playing video/computer/electronic games
   - I sometimes (1 to 2 times in the last week) did physical things in my free time, for example, played sports, went running, swimming, bike riding, did aerobics.
   - Ran or played a little bit
   - Ran around and played quite a bit
   - Ran and played hard most of the time

9. How many hours per day did you WATCH TELEVISION in the last week? Include the time you spent watching movies or programs on video or DVD. Do not count television or videos watched in school. Shade only one.
   - I watched less than 1 hour/day or not at all
   - I watched at least 1 hour/day, but less than 2 hours/day
   - I watched at least 2 hours/day, but less than 3 hours/day
   - I watched at least 3 hours/day, but less than 4 hours/day
   - I watched 4 hours/day or more
10. How many hours per day did you PLAY VIDEO, COMPUTER, OR ELECTRONIC GAMES in the last week? For example, Playstation®, Game boy®, computer games, or games on the web. Shade only one.
   - I did these less than 1 hour/day or not at all
   - I did these at least 1 hour/day, but less than 2 hours/day
   - I did these at least 2 hours/day, but less than 3 hours/day
   - I did these at least 3 hours/day, but less than 4 hours/day
   - I did these 4 hours/day or more

11. How many hours per day did you do instant messaging, email, or browse the Internet in the last week? Do not count school or work-related computer use. Shade only one.
   - I did these less than 1 hour/day or not at all
   - I did these at least 1 hour/day, but less than 2 hours/day
   - I did these at least 2 hours/day, but less than 3 hours/day
   - I did these at least 3 hours/day, but less than 4 hours/day
   - I did these 4 hours/day or more

12. How many MINUTES PER DAY did you talk on a phone in the last week? Do not count school or work-related phone use. Shade only one.
   - I talked on the phone less than 15 minutes/day or not at all
   - I talked on the phone at least 15 minutes/day, but less than 30 minutes/day
   - I talked on the phone at least 30 minutes/day, but less than 60 minutes/day
   - I talked on the phone at least 60 minutes/day, but less than 120 minutes/day
   - I talked on the phone 120 minutes/day or more

13. Were you SICK in the last week, or did anything prevent you from doing your normal physical activities?
   - Yes
   - No
   If yes, what prevented you? ____________________________________________

14. How often did you participate in physical activity (like playing sports, games, dancing, or any other physical activity) for each day in the last week? Work back 7 days from today and be sure to include spare time, sports teams, and school activities like P.E., recess, and intramurals. Shade only one circle per row. Shade “None” if you did not do any physical activity.

<table>
<thead>
<tr>
<th></th>
<th>None</th>
<th>Little Bit</th>
<th>Medium</th>
<th>Often</th>
<th>Very Often</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
<tr>
<td>Tuesday</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
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<tr>
<td>Wednesday</td>
<td>o</td>
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<tr>
<td>Thursday</td>
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<td>Friday</td>
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<tr>
<td>Saturday</td>
<td>o</td>
<td>o</td>
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<td>o</td>
<td>o</td>
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<tr>
<td>Sunday</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>
Before you stop, please go back to page one and make sure that you shaded how many times per week you did each individual activity and THE AVERAGE MINUTES AT A TIME YOU DID IT (people often forget to write down the average minutes), and if the activity was organized.

THANK YOU!
APPENDIX 15

SLEEP SELF-EFFICACY SCALE

For the following 9 items, please rate (by checking a number from 1 to 5) your ability to carry out each behavior. If you feel able to accomplish a behavior some of the time but not always, you should indicate a lower level of confidence.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Not Confident</th>
<th>Very Confident</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Lie in bed, feeling physically relaxed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Lie in bed, feeling mentally relaxed.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Lie in bed with your thoughts “turned off”.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>Fall asleep at night in under 30 minutes.</td>
<td></td>
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<tr>
<td>5.</td>
<td>Wake up at night fewer than 3 times.</td>
<td></td>
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<tr>
<td>6.</td>
<td>Go back to sleep within 15 minutes of waking in the night.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Feel refreshed upon awakening in the morning</td>
<td></td>
<td></td>
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<tr>
<td>8.</td>
<td>Wake after a poor night’s sleep without feeling upset about it.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>Not allow a poor night’s sleep to interfere with daily activities.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX 16

CHILD SELF-PERCEPTION OF ADEQUACY AND PREDILECTION FOR PHYSICAL ACTIVITY SCALE

WHAT’S MOST LIKE ME!!

INSTRUCTIONS:
In this survey you have to read a pair of sentences and then circle (O) the sentence you think is MORE LIKE YOU.

Try the following example.

SAMPLE QUESTION

<table>
<thead>
<tr>
<th>NOT TRUE</th>
<th>TRUE</th>
<th>NOT TRUE</th>
<th>TRUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Some kids have one nose on their face!</td>
<td>BUT</td>
<td>Other kids have three noses on their face!</td>
</tr>
</tbody>
</table>

That shouldn't be too hard for you to decide! Once you have circled the sentence that is more like you, then you have to decide if it is REALLY TRUE for you or SORT OF TRUE for you.

Here is another sample question for you to try. Remember; first circle the sentence that is more like you and then put a check (✓) in the correct box if it is really true or only sort of true for you. THERE ARE NO RIGHT OR WRONG ANSWERS, JUST WHAT IS MOST LIKE YOU.

SAMPLE QUESTION

<table>
<thead>
<tr>
<th>NOT TRUE</th>
<th>TRUE</th>
<th>NOT TRUE</th>
<th>TRUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Some kids like to play with computers</td>
<td>BUT</td>
<td>other kids don’t like playing with computers.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>REALLY TRUE for me</td>
<td>SORT OF TRUE for me</td>
<td>TRUE</td>
<td>SORT OF TRUE for me</td>
</tr>
<tr>
<td>--------------------</td>
<td>---------------------</td>
<td>------</td>
<td>---------------------</td>
</tr>
<tr>
<td>☐</td>
<td>☐</td>
<td>BUT</td>
<td>☐</td>
</tr>
<tr>
<td>Some kids can't wait to play active games after school.</td>
<td>Other kids would rather do something else.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>☐</td>
<td>BUT</td>
<td>☐</td>
</tr>
<tr>
<td>Some kids really enjoy physical education class.</td>
<td>Other kids don't like physical education class.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>☐</td>
<td>BUT</td>
<td>☐</td>
</tr>
<tr>
<td>Some kids don't like playing active games.</td>
<td>Other kids really like playing active games.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>☐</td>
<td>BUT</td>
<td>☐</td>
</tr>
<tr>
<td>Some kids don't have much fun playing sports.</td>
<td>Other kids have a good time playing sports.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>☐</td>
<td>BUT</td>
<td>☐</td>
</tr>
<tr>
<td>Some kids think physical education is the best class.</td>
<td>Other kids think physical education isn't much fun.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>☐</td>
<td>BUT</td>
<td>☐</td>
</tr>
<tr>
<td>Some kids are good at active games.</td>
<td>Other kids find active games hard to play.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>☐</td>
<td>BUT</td>
<td>☐</td>
</tr>
<tr>
<td>Some kids don't like playing sports.</td>
<td>Other kids really enjoy playing sports.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>☐</td>
<td>BUT</td>
<td>☐</td>
</tr>
<tr>
<td>Some kids always hurt themselves when</td>
<td>Other kids never hurt themselves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td>☐</td>
<td>BUT</td>
<td>☐</td>
</tr>
</tbody>
</table>
Some kids like to play active games outside. **BUT** Other kids would rather read or play video games.

Some kids do well in most sports. **BUT** Other kids feel they aren’t good at sports.

Some kids learn to play active games easily. **BUT** Other kids find it hard learning to play active Games.

Some kids think they are the best at sports. **BUT** Other kids think they aren’t good at sports.

Some kids find games in physical education hard to play. **BUT** Other kids are good at games in physical education.

Some kids like to watch games being **BUT** Other kids would rather play active
Some kids are among the last to be chosen for active games. **BUT** Other kids are usually picked to play first.

Some kids like to take it easy during recess. **BUT** Other kids would rather play active games.

Some kids have fun in physical education class. **BUT** Other kids would rather miss physical education class.

Some kids aren’t good enough for sports teams. **BUT** Other kids do well on sports teams.

Some kids like to read or play quiet games. **BUT** Other kids like to play active games.

Some kids like to play active games outside on weekends. **BUT** Other kids like to relax and watch TV on weekends.

THANK YOU VERY MUCH FOR COMPLETING THE CSAPPA SCALE! 😊
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