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The Effect of Leisure-Based Screen Time on Physical Activity

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THE EFFECT OF LEISURE-BASED SCREEN TIME

ON PHYSICAL ACTIVITY

by

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GRADUATE COMMITTEE APPROVAL

of a thesis submitted by

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This thesis has been read by each member of the following graduate committee and by majority vote has been found to be satisfactory.

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As chair of the candidate's graduate committee, I have read the thesis of Mary Dawn Sperry in its final form and have found that (1) its format, citations, and bibliographical style are consistent and acceptable and fulfill university and department style requirements; (2) its illustrative materials including figures, tables, and charts are in place; and (3) the final manuscript is satisfactory to the graduate committee and is ready for submission to the university library.

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ABSTRACT

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The purpose of this study was to determine the effect of leisure-based screen time on physical activity. Ninety-four families participated in this six-week study. Each family was randomly assigned to one of three screen time groups: (1) control group (2) 2-hour-limit group or (3) one-hour-limit group. Family members wore a Walk4Life LS 2505® pedometer to measure steps. Daily screen time logs were filled out each night and leisure-based screen time and steps were recorded.

Analysis of variance (steps x group) was used to determine differences among the groups. Univariate tests showed there were no significant differences among any of the adult groups (F (2,101) = 1.02, p = .361). Similar to the adults, univariate tests in the 13 to 18-year-olds indicated there were no significant differences among any of the groups (F (2 ,62) = 368, p = .694). In the 5 to 12-year-olds, univariate tests determined significant group differences (F (2,164) = 3.35, p = .037). Estimated marginal mean differences indicated a significant difference between the control and 2-hour-limit groups (p = .011). In looking at all the children, males averaged more steps per day than females, and all groups in the 5 to 12-year-olds averaged more steps compared to the 13 to 18-year-olds (10,828 vs. 9,875 steps each day). The 5 to 12-year-olds in the 2-hour-limit and control groups viewed 72 minutes and 114 minutes of screen time each day, respectively. In conclusion, getting about 42 minutes less of screen time each day may increase physical activity to ~1,300 more steps each day.

Key Words: *Pedometer, Steps, BMI, Children, Families*

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Abstract

The purpose of this study was to determine the effect of leisure-based screen time on physical activity. Ninety-four families participated in this six-week study. Each family was randomly assigned to one of three screen time groups: (1) control group (2) 2-hour-limit group or (3) one-hour-limit group. Family members wore a Walk4Life LS 2505® pedometer to measure steps. Daily screen time logs were filled out each night and leisure-based screen time and steps were recorded.

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Key Words: *Pedometer, Steps, BMI, Children, Families*

Introduction

The number one killer for men and women in the United States is cardiovascular disease.[1] Some of the risk factors associated with cardiovascular disease are tobacco use, high blood cholesterol, high blood pressure, physical inactivity, overweight, obesity, and diabetes mellitus.[1] In 2001, coronary heart disease accounted for 54% of the deaths attributed to cardiovascular disease.[2] Physical inactivity increases relative risk of coronary heart disease by 1.5 to 2.4 times, and is similar to the risk ratios of hypercholesterolemia, hypertension, and smoking.[3]

The average adult does not get an adequate amount of physical activity. The minimum physical activity recommendation is 30 minutes of moderate-intensity physical activity on most, preferably all days of the week.[3,4] In 2001, 54.6% of people were not active enough to achieve these recommendations.[4] Therefore, the minimum amount of recommended physical activity is not accomplished by more than half of the US population.

Sedentary activities such as television viewing are a common pastime among all age groups. Combined data of children, teens, women, and men indicate typical viewing time each week to be 28 hours and 13 minutes or roughly 4 hours of viewing time per day.[5] The hours/minutes viewed per week for men and women 25-54 years of age are 27:33 and 30:35, respectively.[5] The hours/minutes viewed per week for children 2-11 years of age and teens 12-17 years of age are both 19:40. [5]

Typical viewing times are high for children, teens, and adults. Perhaps being so comfortable with this sedentary lifestyle has contributed to a lack of physical activity. In fact, evidence suggests that sedentary activities such as television viewing are increasing and are associated with obesity.[6] Studies have found television viewing and obesity in children to be related.[7-9] Television viewing has been linked to the obesity epidemic in children given that television viewing is the most prevalent sedentary activity for the majority of children.[10]

In the United States, 2 to 7-year-old children and 8 to 18-year-old children are watching television, videos and playing videogames an average of 2.5 hours each day and 4.5 hours each day, respectively.[11] According to 1997 Nielsen Media Research, children in the United States spend more than three years of their waking lives watching television by age 17; this does not include time spent watching videos, playing videogames, or computer time.[12]

The three potential mechanisms linking television viewing and obesity are (1) energy expenditure decreasing from television viewing displacing physical activity; (2) energy intake increasing from eating while watching television or an alteration in diet as a result of the food advertisements; and (3) resting metabolic rate decreasing while watching television.[13] The first potential mechanism was the focus of this study. The purpose of this study was to assess the effect of leisure-based screen time on physical activity and determine if less screen time results in more physical activity time.

Methods

Participants

Ninety-four families were involved in this study, lasting a period of six weeks. The families were recruited through multiple advertising techniques, including flyers, personal recruitment, and referral. Each family was asked two questions: 1. Do you have any restrictions in your home for computer or television use? and 2. If yes, what kind of restrictions do you have in your home? Families with little or no television privileges were excluded from the study.

The criteria to be a participant in the study were: a parent home when children arrived home from school (no latchkey children) and internet access to read e-mails. Each family had a mother, father, and at least two children, ranging in age from 5-18 years. All persons living in the home, even those not in this age range were expected to participate and follow the guidelines of the study.

The parents and all 5 to 18-year-olds each received a pedometer. Children living in the home not yet in kindergarten (ages 3-4) and children older than 18 years of age also received a pedometer. Children younger than 3 years of age did not receive a pedometer. Data for individuals not in the 5-18 age range, although they were told they were part of the study, were not included in the statistical analyses.

Design

Each family was randomly assigned to one of three screen time groups. The three groups were (1) control group; (2) 2-hour-limit group; or (3) 1-hour-limit group. Specific group instructions were given to each group before the study began.

The control group was instructed to continue living the same lifestyle without modifying behavior. The amount of screen time or activity they normally received was not supposed to be changed because of involvement in this study. The 2-hour-limit group was instructed to limit screen time to two hours or less of leisure-based screen time each day. Likewise, the one-hour-limit group was instructed to limit screen time to one hour or less of leisure-based screen time each day.

Screen time

Leisure-based screen time was any kind of sedentary activity that involved a screen-based activity. For example, watching television or a video, playing videogames, computer screen activities, etc. counted as leisure-based screen time. Homework or work screen time did not count as leisure-based screen time, so using the computer to complete a homework or work assignment was not accounted for. The 2-hour-limit group was instructed to receive two hours or less of leisure-based screen time per day. The one-hour-limit group was instructed to receive one hour or less of leisure-based screen time per day.

Instruments and Measurement Methods

Each family member wore a Walk4Life LS 2505® (Walk4Life Inc, Plainfield, Illinois) pedometer to measure how many steps were taken each day. Leisure-based screen time and steps were recorded, along with leisure reading time, hours of sleep each night, and activity time. Reading time and hours of sleep were detractor questions so the real purpose of the study would hopefully not be identified. After daily screen time logs were filled out each night, pedometers were reset. Parents were asked to complete daily screen time logs for younger children who needed assistance.

The Walk4Life LS 2505® pedometer is both a valid and reliable instrument for assessing physical activity.[14] In a recent study, Walk4Life LS pedometers were examined by Crouter et al. and determined valid for research studies.[14]

The Walk4Life LS 2505® pedometer was worn on the waistband of shorts or pants near the left hip, for the entire six-week period. Proper pedometer placement instructions were e-mailed to each family, as pedometer placement can vary depending on the individual. Pedometers were taken off while sleeping, showering, bathing, or during activities such as wrestling or basketball games that did not allow a pedometer to be worn.

The first week of the study was an acclimation period for participants. The expectation was for participants to become familiar with the pedometer, the different modes available, the reset button, proper pedometer placement, and to make wearing the pedometer a habit. This was also a time to develop a routine to accurately complete the daily screen time logs. Families were unaware week one was an acclimation period.

Along with the daily screen time log, a 24 hour leisure-based screen time log was given to each family member to more accurately keep track of screen time. Week one was also a period to become familiar with this log. Each night, the 24 hour leisure-based screen time log was referenced to add up the total amount of screen time that occurred for that particular day. The entire amount of screen time was then recorded on the daily screen time log.

To determine BMI, weight and height measurements were self-reported or measured by the participant or by the help of a parent. Scales (weight) and measuring tapes (height) were available at the orientation meetings and also taken to family's homes for participants who unaware of weight and height measurements.

Procedures

Before the study began, an orientation meeting was held, and families were invited to attend. The principal investigator visited homes of families unable to attend the meeting. The same procedures that occurred at the meeting were followed. Families were taught how to fill out the daily screen time logs and 24 hour leisure-based screen time logs. Parents were asked to fill out the daily screen time logs and 24 hour leisure-based screen time logs for themselves and for any children not old enough to record the information correctly by themselves. The importance of filling out the logs honestly and accurately was emphasized.

Instructions were given on pedometer placement, the pedometer modes, and the pedometer reset button. As a follow-up proper pedometer placement instructions were e-mailed to each family the first week of the study. Pedometer was placed on the waistband directly above the kneecap. Participants were then taught to open the pedometer, reset the pedometer, close the pedometer, and take 100 steps. After taking 100 steps, the pedometer should then be opened (while still on the waistband).

If the number of steps shown on the pedometer were within three steps of the 100 steps actually taken, then the pedometer was placed in an accurate spot. When steps were not within three, participants were asked to slide the pedometer closer to the umbilicus and try the proper pedometer placement activity again. When the subject found a spot that yielded results within three steps of 100 steps then proper pedometer placement was accomplished. After correct placement was identified, participants were asked to wear the pedometers at that same spot on the waistband each day. Pedometer belts were also available for overweight or obese participants to wear to ensure that the pedometer was nearly perpendicular to the ground.

Each family was given a folder with their pedometers, daily screen time logs, and 24 hour leisure-based screen time logs. Self-addressed stamped envelopes were also in the folder. Samples of how to fill out the daily screen time logs and 24 hour leisure-based screen time logs were also included in the folder. The random group assignment instructions were given to each family in an envelope as they left the orientation meeting. Families were instructed to comply with their screen time group assignment.

To maintain the integrity of the study, families were asked not to talk with other families participating in the study until the study was finished. As a way of communicating with the families, e-mails were sent three times a week (Monday, Wednesday, and Friday). The e-mails offered encouragement, support, and served as reminders of many things (i.e. mailing in the daily screen time logs, accurately recording screen time, answering all questions on the daily screen time logs, etc).

Treatment of the Data

To determine a weekly average for steps and screen time, participants needed accurate data for at least 3 out of 5 weekdays and 1 of 2 weekend days. If this requirement was not met, that weekly average was taken out. If participants in the 2-hour limit or 1-hour-limit groups went over their allotted screen time, averages for that week were still included in the analyses, as each person was analyzed as being part of the group. An intraclass correlation of at least .80 or higher was the cut-point for determining the number of weeks needed to compute grand means for average number of steps and average screen time for 5 weeks of data.

Design and Statistical Analysis

Data from week 1 were not used in the analysis. Weekly totals for steps and screen time were generated for the next five weeks. The weekly totals were then used to create a grand average total and computed into a daily average for leisure-based screen time and steps. The analyses were performed for all participants, adults only, all children, 5 to12-year-olds, and 13 to 18-year-olds.

Gender and BMI were controlled in all analyses. They were controlled as steps differ depending on gender and BMI. In addition, Pearson correlations were performed to assess the relationships between BMI, average steps, and gender in each age specific group. For gender females were coded as ‘0’ and males were coded as ‘1’, therefore a positive correlation between steps and gender would indicate that males took more steps than females.

Pearson product moment correlation coefficients were used to analyze the relationships between steps and BMI, steps and gender, and BMI and gender. Between group differences for steps were identified using ANOVA. Pairwise comparisons, using least squared means, were performed for any significant group main effects. The statistical analyses were performed using Statistical Package for the Social Sciences (SPSS Incorporated, Chicago, Illinois).

Results

The age-specific demographic and descriptive statistics for average number of steps per day and average leisure-based screen time in minutes per day are presented in Table 1 for females and males. Intraclass correlations for adults, 5 to 12-year-olds, and 13 to 18-year-olds were .885 or higher for steps and leisure-based screen time between each of the 5 weeks of data collection, indicating that only two weeks of data were needed to calculate a grand mean (see Table 2).

All Participants

Analysis of variance (steps x group) was used to determine differences between the groups. Daily average steps for all participants combined in the control, 2-hour limit, and 1-hour-limit groups were 9,443, 10,000, and 9,519, respectively. Univariate tests indicated significant group differences when controlling for BMI and gender ($F\ (2,400) = 3.57$, $p = .029$) (see Table 3).

Pairwise comparisons, using the least-squared-means technique, were conducted to determine which groups were different from each other. Estimated marginal differences indicated a significant difference between the control and 2-hour-limit groups ($p = .008$). Statistical significance was not found between any other groups (see Table 4). Significant correlations were seen between BMI and average steps ($r = -.396$, $p < .001$) and gender and average steps ($r = .176$, $p < .001$) (see Table 5).

Adults

Daily average steps in the adults-only participant category for the control, 2-hour limit, and 1-hour-limit groups were 8,268, 8,822, and 8,162, respectively. Univariate tests determined there were no significant differences among the groups ($F_{(2,164)} = 1.02$, $p = .361$) (see Table 3). As can be seen in Table 4, pairwise comparisons also indicated none of the groups were significantly different from each other. There was a significant correlation between BMI and average steps ($r = -.252$, $p = .001$), but not between gender and average steps ($r = .004$, $p = .954$) (see Table 5).

All Children

In the 5 to 18-year-olds daily average steps for the control, 2-hour limit, and 1-hour-limit groups were 10,317, 10,813, and 10,504, respectively. Univariate tests indicated a significant group difference ($F_{(2,231)} = 3.14$, $p < .045$) (see Table 3).

Pairwise comparisons indicate a significant difference between the control and 2-hour-limit groups ($p = .013$). There was no significant difference between any other groups (see Table 4). Correlation analysis in the children showed a significant negative relationship between BMI and average steps ($r = -.256$, $p < .001$) and a significant positive relationship between average steps and gender ($r = .323$, $p < .001$) (see Table 5).

5 to 12-year-olds

In a more specific age-group analysis in 5 to 12-year-olds, daily average steps for the control, 2-hour limit, and 1-hour-limit groups were 10,414, 11,237, and 10,848, respectively. Univariate tests indicated significant group differences ($F_{(2,164)} = 3.35$, $p = .037$) (see Table 3).

Estimated marginal mean differences indicated a significant difference between the control and 2-hour-limit groups ($p = .011$). Statistical significance was not found between any other groups (see Table 4). Average steps and gender were the only significant correlations in this age group (r = .346, p < .001) (see Table 5).

13 to 18-year-olds

Finally, analysis of variance was conducted for the 13 to 18-year-olds for the average steps-by-group assignment. Daily average steps for the control, 2-hour limit, and 1-hour-limit groups were 10,002, 10,046, and 9,455, respectively. Univariate tests indicated results similar to the adults; there were no significant differences between any of the groups (F (2,62) = .368, p =.694) (see Table 3). Pairwise comparisons also indicated no significant differences between the groups. Correlations were found between BMI and average steps (r = -.382, p =.001) and gender and average steps (r = .291, p =.015) (see Table 5).

Discussion

The results of this study indicate that leisure-based screen time may influence physical activity. More leisure-based screen time was indicative of lower average steps when all participants were considered together, and more specifically in the 5 to 12-year-olds than in the adults and older children. When BMI and gender were controlled, the children in the 2-hour-limit group had, on average, significantly (p =.011) more steps each day than the control group.

According to the results, 5 to 12-year-olds in the 2-hour-limit group had about 1,300 more steps each day than those in the control group. This means children in the 2-hour-limit group would average 9,100 more steps each week and 474,500 more steps each year. An average of 1,300 more steps each day means an increase in steps of almost

11% a day. Unfortunately, the average stride length of 5 to 12-year olds is variable. Thus, translating 1,300 more steps per day into weekly and/or yearly mileage would be difficult to calculate.

In addition, if this study were done at a different time of year perhaps the participants in the limited screen time groups would have achieved even more steps per day, compared to the control group. Although, limited screen time groups appeared to follow their group instruction correctly, more physical activity may have resulted with warmer weather. Another possibility is the control group may achieve more screen time when school is out of session as the opportunity for screen time may be more frequent.

The three groups appeared to follow their specific leisure-based screen time instruction as screen time decreased from the control group to the 2-hour-limit group to the 1-hour-limit group. In other words, the control group had the most screen time, followed by the 2-hour-limit group, followed by the 1-hour-limit group. There were statistically significant differences between the control and 2-hour-limit groups for number of steps in the following categories: all participants (p =.008), all children (p =.013), and 5 to 12-year-olds (p =.011), but statistically significant differences were not found in the adults (p =.189) and 13 to 18-year-olds (p =.495)

The 2-hour-limit group was given instructions to have 2 hours or less of leisure-based screen time each day, and screen time averages in the 2-hour-limit group were less than in the control group. The control group had about 42 minutes more screen time compared to the 2-hour-limit group. However, even the 5 to 12-year-old’s average screen time in the control group was still well below the national average of three hours per day.[5] M

In the 13 to 18-year-olds and adults, significant differences were not found in physical activity between any of groups ($p > .189$). Screen time for the 13 to 18-year-olds and adult control groups were 99.39 and 85.21 minutes, respectively. Nielsen Media Research reports 2-17 year olds have an average television viewing time of almost three hours per day and 25-54 year olds ordinarily view about four hours each day.[5] The average screen times, which includes television viewing, for all participants in this study did not appear to be typical of viewing time for adults or children, according to the Nielsen report.

Interestingly, no group of participants averaged more than two hours a day of screen time. Involvement in this study may have changed behaviors of participants, even in the control group. The instructions for the control group were to continue living the same lifestyle, without behavior modification. The anticipation was that screen time and physical activity habits would not change because of involvement in this study. Behaviors may have changed, even though control group participants were told not to change.

The 2-hour-limit groups, in all age categories, almost met the requirement to be in the 1-hour-limit group. Either the families involved do not watch a typical average amount of television or there may have been a potential study effect. Study participants may have also been guilty of underreporting screen time or wishful thinking when reporting the amount of screen time they actually participated in.

Average screen time for the 5 to 12-year old 1-hour-limit group was 60.15 minutes per day, with boys showing more screen time than girls. Maybe the boys that went over the 1 hour screen time limit affected the results, as more screen time may have decreased activity and lowered step averages. Getting 1 hour or less of screen time per day was a difficult request for some children to follow. Regardless, underreporting screen time may have been another factor influencing the results.

The President's Challenge recommends adults get at least 10,000 steps a day.[15] Average steps/day for adults in the control, 2-hour limit, and 1-hour-limit groups were 8,268, 8,822, and 8,162, respectively. Hence, average step recommendations were not achieved in any of the groups. Based on recent evidence, Tudor-Locke and Bassett offer healthy adults the following classification for pedometer-determined physical activity: (1) <5,000 steps/day ("sedentary lifestyle index"); (2) 5,000-7,499 steps/day ("low active"); (3) 7,500-9,999 ("somewhat active"); (4) 10,000-12,499 steps/day ("active"); (5) >12,500 steps/day ("highly active").[16]

According to these guidelines, the adults in this study would be considered "somewhat active". Additionally, ~6,000-7,000 steps/day indicates normal daily activity (not including physical activity from sports or exercise).[16] Thus, it appears the adults in this study had more steps than the typical sedentary or low-active adult, but pedometers were also worn for all activities, including exercise and sports.

The President's Challenge also urges 6 to 17-year-old girls and boys get at least 11,000 and 13,000 steps a day, respectively.[15] Likewise, other research suggests 6 to 12-year-old girls and boys average 11,000 and 13,000 steps a day, respectively.[17] The 5 to

12-year-old's average steps/day in the control, 2-hour limit, and 1-hour-limit groups were 10,414, 11,237, and 10,848, respectively. In looking at Table 1, neither the boys nor girls met the recommendation, and all groups in the 5 to 12-year-olds averaged more steps per day compared to the older children. This finding is consistent with other research that suggests children (grades 1-6) achieve more steps than adolescents (grades 7-12).[18] The 5 to 18-year-old boys averaged more steps per day than the girls (9,329 vs. 11,345), but still did not meet current recommendations.[15, 17]

According to the findings of this study, average steps were lower in all age groups than current national recommendations. Additionally, this study was conducted at a time of year, three weeks in January and three weeks in February, when climate may have affected activity patterns. Salt Lake City is located about 40-85 miles from the geographic areas of the study. According to Salt Lake City Climate Data, the average temperature for January was 34.4°F with 1.44 inches of precipitation and 6.7 inches of snowfall.[19] The average temperature for February was 35.0°F with 1.23 inches of precipitation and 11.3 inches of snowfall.[19]

Future research may consider a study at a warmer time of year, when weather may not be as much a factor and the opportunity for outside play or physical activity is not limited by climate. Perhaps, steps were lower than the recommended amount because of the seasonal influence. In fact, for adults living in the United States, the months of January (35.3%) and February (35.0%) have the highest percentages of no leisure-time physical activity and June (24.7%) has the lowest prevalence rate.[20] Winter months showing high physical inactivity prevalence rates and summer months showing low inactivity prevalence rates was identified for both men and women.[20] Also, conducting this study when school is not in session and the majority of the day is not spent at school may result in different findings.

Future research may also need a larger sample size in order to have an adequate number of participants for all groups. The intraclass correlations indicate children and adults have the same type of behaviors each week related to the variables of interest. A valuable finding of this study, that may impact future research, was that only two weeks of data are needed for determining typical means on steps and screen time. The intraclass correlations in the children and adults were .89 or higher for steps and screen time. Thus, performing a study like this for only three weeks of time (using the first week as an acclamation period), instead of six weeks, would reduce the burden of the study for both researchers and study participants.

Other experimental or quasi-experimental studies may consider limiting screen time and additionally providing play and activity options, with one group asked to only limit screen time and another group asked to both limit screen time and increase physical activity. By performing a study like this, it may be possible to conclude if limiting screen time with physical activity encouragement makes it possible to achieve more physical activity than only limiting screen time. Instead of parents telling their child to turn off the television or video game, parents may begin telling their child to turn off the television or video game and encourage physical activity or active play.

The conclusion of this study is that 5 to 12-year-olds, viewing 72 minutes of screen time each day, acquire more steps than children averaging 114 minutes of screen time each day. Consequently, getting approximately 42 minutes less of screen time each day may increase physical activity by ~1,300 steps each day.

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Table 1. Demographic and Descriptive Statistics

		Female			Male			Both Female and Male		
Adults		**N**	**Mean**	**SD**	**N**	**Mean**	**SD**	**N**	**Mean**	**SD**
Age (y)		92	39.12	5.95	93	40.99	5.51	185	40.06	5.73
Height (in)		92	66.46	3.05	93	71.03	3.40	185	68.75	3.23
Weight (lbs)		89	162.36	38.36	92	196.25	35.92	181	179.31	37.14
BMI		89	25.76	5.30	92	27.34	4.65	181	26.55	4.98
Steps/day	Control	31	8,263.42	3,781.37	28	8,116.40	2,820.86	59	8,189.91	3,300.99
	2-hour limit	30	8,958.24	2,741.43	30	8,685.30	3,180.15	60	8,821.77	2,960.79
	1-hour limit	27	7,880.18	2,680.30	27	8,409.95	3,700.79	54	8,145.07	3,190.55
Screen time (min/day)	Control	32	84.20	60.03	32	86.22	61.91	64	85.21	60.97
	2-hour limit	32	68.19	47.95	31	60.68	28.04	63	64.44	38.00
	1-hour limit	28	45.38	22.48	30	50.17	27.49	58	47.78	24.99
Children 5 to 12-y										
Age (y)		100	8.86	2.12	90	8.78	2.07	190	8.82	2.10
Height (in)		100	54.29	6.42	90	53.60	5.53	190	53.95	5.98
Weight (lbs)		100	75.84	30.32	90	70.46	20.77	190	73.15	25.55
BMI		100	17.49	3.80	90	16.90	2.67	190	17.20	3.24

Steps/day	Control	23	9,168.31	2,590.41	35	11,232.99	2,417.00	58	10,200.70	2,503.71
	2-hour limit	34	10,275.82	2,079.12	22	12,723.62	3,603.12	56	11,499.70	2,841.12
	1-hour limit	29	9,780.86	2,142.84	36	12,038.10	3,957.01	55	10,909.50	3,049.93
Screen time (min/day)	Control	26	115.20	43.04	36	113.52	58.52	62	114.36	50.78
	2-hour limit	37	69.00	27.62	24	75.46	33.95	61	72.23	0.79
	1-hour limit	33	52.07	17.01	30	68.23	23.75	63	60.15	20.38
Children 13 to 18-y										
Age (y)		48	15.17	1.58	49	14.57	1.50	97	14.86	1.54
Height (in)		46	64.65	3.13	48	68.26	4.17	94	66.46	3.65
Weight (lbs)		45	127.18	25.17	48	142.42	39.84	93	134.80	32.51
BMI		45	21.45	4.04	48	21.26	4.90	93	21.36	4.47
Steps/day	Control	9	8,851.43	1,894.85	12	10,652.42	2,175.80	21	9,751.93	2,035.33
	2-hour limit	15	9,780.71	1,549.82	16	10,295.12	3,218.56	31	10,037.90	2,384.19
	1-hour limit	10	8,116.34	2,754.17	8	11,128.07	3,749.50	18	9,622.21	3,251.84
Screen time (min/day)	Control	14	82.27	72.90	16	116.51	65.88	30	99.39	69.39
	2-hour limit	17	74.85	38.11	19	83.57	32.45	36	79.21	35.28
	1-hour limit	16	43.13	26.97	12	52.68	17.07	28	47.91	22.02

Table 2. Intraclass Correlations

Weeks	Steps	Screen time
Adults		
2,3	.900	.902
2,3,4	.940	.934
2,3,4,5	.953	.943
2,3,4,5,6	.965	.954
Children 5 to 12 y		
2,3	.885	.892
2,3,4	.924	.903
2,3,4,5	.889	.924
2,3,4,5,6	.912	.941
Children 13 to 18 y		
2,3	.919	.909
2,3,4	.892	.928
2,3,4,5	.925	.952
2,3,4,5,6	.938	.964

Table 3. Differences in Average Daily Steps by Screen Time Group: Controlling for Gender and BMI

	Screen Time Group				
Variable	Control Mean ± SD	< 1 hr/day Mean ± SD	< 2 hrs/day Mean ± SD	F	*p*
All Participants	9444 ± 3112	9519 ± 3507	10000 ± 3061	3.57	.029*
All Adults	8259 ± 3691	8162 ± 3240	8822 ± 2947	1.02	.361
All Children	10317 ± 2581	10504 ± 3381	10813 ± 2883	3.14	.045*
Children 5 to 12 y	10414 ± 2667	10848 ± 3305	11237 ± 3001	3.35	.037*
Children 13 to 18 y	10002 ± 2323	9455 ± 3489	10046 ± 2524	.37	.694

* Indicates significance at the $p < .05$ level.

Table 4. Pairwise Comparisons Based On Estimated Marginal Means

	Mean Difference (average steps/day)	Standard Error	*p*
All Participants			
Control vs. 2-hour limit	-924.26	348.24	.008*
Control vs. 1-hour limit	-399.86	360.96	.269
2-hour limit vs. 1-hour limit	524.40	350.37	.135
Adults Only			
Control vs. 2-hour limit	-763.44	578.26	.189
Control vs. 1-hour limit	-114.88	596.63	.848
2-hour limit vs. 1-hour limit	648.56	583.77	.268
All Children			
Control vs. 2-hour limit	-1,077.52	431.00	.013*
Control vs. 1-hour limit	-646.72	446.34	.149
2-hour limit vs. 1-hour limit	430.80	428.04	.315
Children 5 to 12 y			
Control vs. 2-hour limit	-1,358.67	528.28	.011*
Control vs. 1-hour limit	-813.52	526.92	.125
2-hour limit vs. 1-hour limit	545.15	527.40	.303
Children 13 to 18 y			
Control vs. 2-hour limit	-513.61	747.63	.495
Control vs. 1-hour limit	22.51	843.57	.979
2-hour limit vs. 1-hour limit	536.13	739.80	.471

* Mean difference is significant at the $p = .05$ level.

Table 5. Correlations between Average Daily Steps and Covariates: Gender and BMI

			Gender	BMI
All Participants				
	Average Steps	Pearson Correlation	.176	-.396
		Sig. (2-tailed)	<.001*	<.001*
		N	412	405
All Adults				
	Average Steps	Pearson Correlation	.004	-.252
		Sig. (2-tailed)	.954	.001*
		N	173	169
All Children				
	Average Steps	Pearson Correlation	.323	-.256
		Sig. (2-tailed)	<.001*	<.001*
		N	239	236
Children 5 to 12 y				
	Average Steps	Pearson Correlation	.346	-.141
		Sig. (2-tailed)	<.001*	.067
		N	169	169
Children 13 to 18 y				
	Average Steps	Pearson Correlation	.291	-.382
		Sig. (2-tailed)	.015*	.001*
		N	70	67

* Indicates significance at the <.05 level.

Appendix A

Prospectus

Chapter 1

Introduction

The number one killer for men and women, in the United States, is cardiovascular diseases.[1] Some of the risk factors associated with cardiovascular disease are tobacco use, high blood cholesterol, high blood pressure, physical inactivity, overweight, obesity, and diabetes mellitus.[1] In 2001, coronary heart disease accounted for 54% of the deaths attributed to cardiovascular disease.[2] Physical inactivity increases relative risk of coronary heart disease by 1.5 to 2.4 times, and is similar to the risk ratios of hypercholesterolemia, hypertension, or smoking.[3]

The average adult does not get an adequate amount of physical activity. The minimum physical activity recommendation is 30 minutes of moderate-intensity physical activity on most, preferably all days of the week.[3,4] In 2001, 54.6% of people were not active enough to achieve these recommendations.[4] Therefore, the minimum amount of recommended physical activity is not accomplished by more than half of the US population.

Sedentary activities such as television viewing are a common pastime among many individuals. Combined data of children, teens, women, and men indicate typical viewing time each week to be 28 hours and 13 minutes.[5] This roughly equates to approximately 4 hours of typical viewing time per day. The hours/minutes viewed per week for men and women 25-54 years of age are 27:33 and 30:35, respectively.[5] The hours/minutes viewed per week for children 2-11 years of age and teens 12-17 years of age are both 19:40.[5]

Physical activity appears to be decreasing, and evidence seems to suggest that sedentary activities like television viewing are increasing and are associated with obesity.[6] Living a sedentary lifestyle is not only common among adults but is also a common practice among children. Studies have found television viewing and obesity in children to be related.[7-9]

Television viewing has been linked to the obesity epidemic in children given that television viewing is the most prevalent sedentary activity for the majority of children.[10] In the US, 2-7-year-old children and 8-18-year-old children are watching television, watching videos, and playing videogames an average of 2.5 hours each day and 4.5 hours each day, respectively.[11] According to 1997 Nielsen Media Research, children in the United States spend more than three years of their waking lives watching television by age 17; this does not include time spent watching videos, playing videogames, or computer time.[12]

The three potential mechanisms linking television viewing and obesity are: (1) energy expenditure decreasing from television viewing displacing physical activity; (2) energy intake increasing from eating while watching television or an alteration in diet as a result of the food advertisements; and (3) resting metabolic rate decreasing while watching television.[13] The first potential mechanism is the focus of this study. According to Robinson[13] more experimental studies are needed in natural settings; more effective methods of measuring physical activity are also necessary to establish the true effect television viewing has on physical activity.

Statement of the Problem

More experimental studies, in natural settings, are needed because past studies have not determined a direct link between television viewing and physical activity.[13] The purpose of this study is to determine the effect of leisure-based screen time on physical activity.

Hypothesis

Leisure-based screen time significantly decreases physical activity. As leisure-based screen time decreases, physical activity increases.

Null Hypothesis

Leisure-based screen time does not significantly decrease physical activity. As leisure-based screen time decreases, physical activity does not increase.

Operational Definitions

Family Unit- mother, father, and at least two children ranging in grades from kindergarten through twelfth.

Pedometer- an instrument that records the activity time, steps, and distance a person completes by sensing the motion of each step.

Physical Activity**-** any bodily movement produced by skeletal muscles, which results in energy expenditure.[14]

Leisure-Based Screen time- any kind of sedentary activity that involves a screen-based activity, i.e. television, videos, videogames, computers, etc.; homework or work screen-based activities will not count as leisure-based screen time.

Latchkey children- children without a mother at home when the child comes home from school.

Natural Setting- an uncontrolled environment where habitual living occurs.

Normal Living- to continue living the same lifestyle without behavior modification (i.e. leisure-based screen time and physical activity).

Assumptions

1. The subjects will follow the pedometer instructions and wear the pedometer on a continual basis throughout the six week testing period.
2. The subjects will adhere to the amount of leisure-based screen time they have been assigned to each day.
3. The subjects will honestly record the leisure-based screen time logs and physical activity logs each day.

Delimitations

The sample used in this study will be family units. The family unit will consist of a mother and father with at least two children ranging in grades from kindergarten through twelfth. There will not be any latchkey children included in the study. Families will be required to have internet and e-mail access to be involved in the study. The parents will sign the informed consent form for themselves and their children. The children will sign an informed assent form. Each family member will keep a leisure-based screen time log and physical activity log on a daily basis. Physical activity will be measured using a Walk4Life LS 2505® pedometer.

Limitations

1. The subjects may not follow all pedometer instructions correctly.
2. The subjects total activity time and number of steps taken may not be accounted for, if the pedometer is taken off during activity time.
3. The subjects may not record leisure-based screen time and steps on the daily screen time logs.
4. The subjects daily screen time logs are self-reported.
5. Younger children recording the daily screen time logs may inaccurately report the information.
6. Activity level may be influenced by seasonal weather patterns.
7. There will not be a way to account for physical activities like biking, swimming, etc.

Significance of the Study

Television viewing and other screen-based behaviors are common sedentary activities and may be significant contributors to overall inactivity. The proposed experimental study will help define the true link between leisure-based screen time activities and physical activity. Leisure-based screen time activities include any kind of sedentary activities that involves a screen-based activity i.e. television, videos, videogames, and computer use, etc. However, work or school screen-based activities will not count. The purpose of this study is to determine the effect of leisure-based screen time on physical activity.

Chapter 2

Review of Literature

The average US adult does not get an adequate amount of physical activity. The minimum physical activity recommendation is 30 minutes of moderate-intensity physical activity on most, preferably all days of the week.[3,4] However, the recommended amount of physical activity is not accomplished by more than half of the US population.[4]

Sedentary activities such as television viewing are a common pastime among many individuals. Combined data of children, teens, women, and men indicate typical viewing time each week to be 28 hours and 13 minutes.[5] This roughly equates to approximately 4 hours of typical viewing time per day.

Physical activity appears to be decreasing and evidence seems to suggest that sedentary activities like television viewing are increasing and are associated with obesity.[6] Living a sedentary lifestyle is not only common among adults but is also a common practice among children. Studies have found television viewing and obesity in children to be related.[7-9]

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The three potential mechanisms linking television viewing and obesity are (1) energy expenditure decreasing from television viewing displacing physical activity; (2)

energy intake increasing from eating while watching television or an alteration in diet as a result of the food advertisements; and (3) resting metabolic rate decreasing while watching television.[13] The first potential mechanism is the focus of this study. According to Robinson[13] more experimental studies are needed in natural settings; more effective methods of measuring physical activity are necessary to establish the true effect television viewing has on physical activity.

There have been cross-sectional, cohort, and experimental studies conducted to determine the relationship between television viewing and physical activity. Some of the studies have shown an association between television viewing, physical activity, or obesity prevalence.[7,15-28,36-42] Other studies have not revealed the same relationship between television viewing, physical activity, or obesity prevalence or have shown a weak relationship between television viewing, physical activity, or obesity prevalence.[7,10,22,29-36,42] This literature review will help illustrate the contrasting results that have been discovered.

Cross Sectional

Tucker and Friedman looked at television viewing and obesity in 6,138 adult males.[15] After controlling for confounding variables, men watching > 3 hours of television per day increased the likelihood of becoming obese by two times, compared to men viewing < 1 hour of television per day.

In another study, Tucker and Bagwell investigated television viewing and obesity in 4,771 adult females.[16] After controlling for confounding variables women watching < 1 hour of television each day, compared to women watching 3-4 hours of television each day had almost twice the obesity prevalence. Furthermore, women watching > 4 hours of television per day had more than double the obesity prevalence of those watching < 1 hour of television per day.

Tucker also examined the television viewing and exercise habits of 8,885 adults.[17] The television viewing time groups were categorized into < 1 hour per day, 1-2 hours per day, and > 3 hours per day. Exercise was categorized into none/light, moderate, and heavy groups. Among the none/light exercise group (51%), there were 3-4 hours or more of television viewed daily by 33.6% of that group. The moderate exercise group (33%) viewed 3-4 hours or more of television each day by 25.9% of that group. The heavy exercise group (16%) viewing 3-4 or more hours of television each day was 23.8%. Thus, television viewing time and exercise time were inversely related.

Ching et al. studied the relationships between non-sedentary activity level, television viewing time (TV/VCR), and overweight risk among men.[18] They concluded as TV/VCR viewing time increased the prevalence and odds ratios for being overweight also increased. Men watching television > 41 hours per week were 4.06 times more likely to be overweight compared to men watching < 1 hour of television each week. Men watching only 2-5 hours per week were 1.42 times more likely to be overweight compared to men watching the smallest amount of television each week.

Salmon et al. studied the effect of physical activity on television viewing and overweight by interviewing 3,392 adults.[19] There was not a direct association found between physical activity (divided into four categories) and being overweight, but a relationship was seen between physical activity and television viewing. The low, moderate, and high physical activity groups watching > 4 hours of television each day were twice as likely to be overweight compared to those watching < 1 hour of television each day. As television viewing time increased, the odds ratio for being overweight also increased. Compared to subjects watching < 1 hour of television a day, watching 1 to 2.5 hours and 2.5 to 4 hours of television a day increased obesity risk by 93% and 183%, respectively.

A study conducted by Vioque et al. found leisure-time physical activity was not associated with obesity in individuals 15 years of age and older.[20] However, work-time physical activity had an inverse relationship with obesity risk. When all the other variables were controlled, watching television ≥ 4 hours each day increased obesity risk more than watching television ≤ 1 hour each day. The prevalence odds ratio for obesity was 30% higher for every additional hour of television watched each day.

Klesges et al. studied the effects of television viewing on resting energy expenditure (REE) in obese and normal weight children from age 8-to-12-year olds.[21] Two measurements of REE were obtained at rest and one measurement was attained while watching television. Statistically significant results ($p=0.0001$) indicate that television viewing decreases REE for both obese and normal weight children. The obese children decreased energy expenditure by 211 kcals per day. They concluded television viewing not only decreases physical activity but reduces REE.

Crespo et al. examined the relationship between television viewing, physical activity, and obesity in 8-16-year olds.[22] Approximately half of the children watched > 2 hours of television each day. Obesity prevalence increased as television viewing increased. The children watching ≤ 1 hour of television each day had the lowest obesity prevalence. The children watching ≥ 4 hours of television each day had the highest obesity prevalence. Weekly physical activity participation and obesity prevalence did not reveal any trends among the boys or girls.

Bernard et al. examined the relationship between overweight and adolescent children and low physical activity and high television viewing time.[23] Results suggest that overweight children participated in less physical activity than the non-overweight children (2.1 vs. 3.1 times each week) and watched more television than the non-overweight children (14.2 vs. 11.6 hours each week).

Another study that surveyed 11,631 high school students was designed to determine the association between physical activity and other health behaviors.[24] Results revealed that students who watched television or played video games ≥ 3 each day were less likely to be active compared to students who did not exhibit the same behavior. Specifically, Whites watching television or playing video games > 3 hours each day were about two times as likely to be low active compared to Whites watching < 3 hours each day. African Americans watching television or playing video games > 3 hours each day were almost half as likely to be low active compared to African Americans watching television < 3 hours each day. Hispanics television viewing time was not related to physical activity.

In another study, researchers investigated the association between physical activity and television viewing with obesity prevalence in 9-16-year old school children.[25] Results suggest that obesity odds increased 12% for every additional hour of television watched each day and decreased 10% every additional hour of moderate/vigorous activity performed each day. They concluded that physical activity and television viewing were related to obesity, but VCR and videogames were not.

Dowda et al. assessed the relationship between physical activity and television viewing on body weight in 8-16-year-olds.[26] They discovered that females watching ≥ 4 hours of television a day increased the likelihood of becoming overweight compared to females watching < 4 hours of television a day. The 14-16-year-old males participating in an exercise program or sport decreased the likelihood of being overweight compared to the males not participating.

Another group of researchers analyzed 15,349 high school students' patterns of television viewing and its associations with overweight and sedentary lifestyle among different races.[27] On average school days, 42.8% of students watched television > 2 hours each day and 13.9% of students watched television at least 5 hours each day. Television viewing occurred more among Black students than White students. Students in lower grades watched television more frequently. Among all students, a sedentary lifestyle was associated with watching > 2 hours of television each day.

Wake et al. investigated the relationships between children's BMI and television, videogame, and computer usage.[28] Results determined BMI scores had a statistically significant ($p<0.001$) relationship to television but were not significantly related to videogame or computer time ($p=0.09$). However, when considering all the other variables television only accounted for a small proportion of the variance.

Andersen et al. conducted a study that considered the relationship between physical activity, television watching, and body weight among children.[7] They found that boys and girls who watched ≥ 4 hours of television a day had a greater BMI than the children watching < 2 hours a day. Television viewing was associated more with increased skinfold measurements and BMI than vigorous activity, but there was no television viewing and physical activity interaction effect.

Robinson and Killen examined 1,912 ninth graders' relationship between television viewing and adiposity, physical activity, and dietary fat intake.[10] Television viewing was associated with a greater consumption of dietary fat but television viewing was not considered an important cause of adolescent obesity or decreased physical activity levels.

Fitzgerald et al. looked at television viewing, physical activity, and the relationship with obesity in men and women Pima Indians 21-59 years old.[29] Television viewing and physical activity were negatively associated in the 21-39-year olds. The 40-59-year olds relationship between television viewing and physical activity was not significant. In men, physical activity and television watching were related to the body mass index (BMI). In women, physical activity was related to BMI. The study concluded, increasing physical activity and decreasing sedentary activity may be a possible intervention strategy to prevent obesity in this population.

Heath et al. examined physical activity patterns in 11,631 high school students in grades 9-12 using self-reported surveys.[30] They found 37% of the students reported being vigorously active at least 3 times per week. At least 70.1% and 37.6% of students reported watching television at least 1 hour and 3 hours or more each day, respectively. An inverse relationship was not seen between television viewing and vigorous activity but more vigorously active girls were less inclined to watch television 1-3 hours each day compared to sedentary girls.

Another study by DuRant et al. was a follow-up investigation on the relationship between television watching, observed physical activity level and body composition for 5-6-year-old children.[31] Results indicated the leanest children did not view more or less television than the fattest children. Physical activity levels were lower when watching television. The activity levels of these 5-6-year olds were similar to the activity levels when they were 3-4 years old.

Grund et al. evaluated television viewing and physical activity in overweight and normal weight children.[32] The children were divided into two groups: group one (< 1 hour of television each day) and group two (> 1 hour of television each day). Results found group two had higher body composition measurements and prevalence of overweight but physical activity was similar between the groups.

DuRant et al. studied the relationship between observed time of television watching, observed physical activity level, and body composition for 3-4 year old children.[33] Television watching and physical activity levels had a weak and negative correlation. Physical activity levels were lower during television viewing time compared to television non-viewing time with physical activity being the lowest during the longest television viewing times. Body composition was not associated with television viewing.

Another investigation by Katzmarzyk et al. evaluated television viewing and physical activity in 9-18-year-olds.[34] The subjects in the highest and lowest quartiles of television time, daily energy expenditure, and moderate to vigorous physical activity did not differ significantly. The study concluded that television viewing has a weak association with physical activity.

Cohort

There have only been a few cohort studies performed on physical activity and television viewing. Ching et al. studied the relationships between non sedentary activity level, television viewing time (TV/VCR), and overweight risk among men between 1988 and 1990.[18] The men watching ≥ 21 hours of TV/VCR time each week in 1988 were 40% more likely of becoming overweight in 1990, compared to men watching ≤ 1 hour of TV/VCR time each week. Furthermore, every 10 hour per week increase in TV/VCR time predicted a BMI increase of 0.05 or about one-third of a pound weight gain between the years 1988-1990.

Robinson et al. examined the relationships between hours of television viewing and physical activity among female adolescents over a two year time period.[35] The average after school television viewing time for the obese and nonobese subjects were 2.44 hours and 2.49 hours, respectively but results were not statistically significant. The relationship between baseline hours of television viewing and physical activity change over time was not statistically significant either.

Coakley et al. studied the predictors of weight gain in 19,478 male health professionals.[36] For the younger aged men, a 1.5 hour per week increase in physical activity decreased body weight by 0.2 kg; whereas, a 10 hour per week increase in television viewing was associated with weight gain. For the middle aged men, more physical activity resulted in weight loss. TV/VCR use were not associated with significant weight gain. For the older men, physical activity and TV/VCR use were not related to weight gain.

Experimental

There have only been a small number of experimental studies conducted on television viewing and physical activity. Epstein has conducted two experimental studies on decreasing sedentary behavior (including television viewing) and childhood obesity. The first experiment[37] randomized 61 families with obese children 8-12 years of age into one of three treatment groups: increasing exercise (exercise), decreasing sedentary behavior (sedentary), or both increasing exercise and decreasing sedentary behavior (combined). The treatments also focused on diet and behavioral principles. After four months, the percentage overweight among the sedentary group and the exercise group decreased 19.9 and 13.2, respectively. After one year, the percent overweight in the sedentary group, combined group, and exercise group decreased 18.7, 10.3, and 8.7, respectively. Thus, the focus on decreasing sedentary behavior appears to be most effective in decreasing overweight followed by the combined treatment and then the exercise only treatment.

The second study by Epstein et al. included 90 families with obese 8-12-year-old children and their parents.[38] The families were randomly assigned to one of four treatment groups that targeted behaviors (sedentary vs. physical activity) and treatment dose (low vs. high). The treatments also focused on diet and behavioral principles. The results showed significant decreases in percent overweight and significant decreases in percent body fat at six months and two years for all groups, and results were not significantly different between the groups. There were significant increases found in activity time at two years. The targeted sedentary behaviors decreased significantly, but nontargeted sedentary behaviors increased at six months. The results of the two studies performed by Epstein are not consistent in terms of intervention effectiveness, but both studies indicated that weight loss can occur by decreasing sedentary behaviors.

The investigation Gortmaker et al. performed was a school-based randomized two-year study with sixth-, seventh-, and eighth-graders.[39] The 10 schools were randomized into a control group (n = 5) or intervention group (n = 5). The intervention focus was to decrease television viewing to < two hours per day, increase moderate and vigorous activity, decrease intake of high-fat foods, and increase fruit and vegetable intake to at least five a day. Results revealed that the females in the intervention group decreased percent body fat; whereas, the females in the control group increased percent body fat. The boys' percent body fat decreased for the intervention group and the control group. Both the boys and girls in the intervention group decreased television viewing time compared to the control group. In the girls intervention group, energy intake decreased less and fruit and vegetable intake increased more compared to the control group. Furthermore, for each hour reduction in television viewing, a decrease in the prevalence of obesity was seen in girls.

Faith et al. tested the effects of contingent television on physical activity and television viewing in a randomized study.[40] The experimental groups television viewing was dependent upon pedaling a stationary cycle ergometer. Results found on average the experimental group pedaled 64.4 minutes per week and the control group pedaled 8.3 minutes per week. Television viewing for the experimental group was 1.6 hours per week, compared to approximately 21 hours per week for the control group.

Saelens and Epstein performed a study similar to the Faith study on obese children for a two-day period.[41] Baseline age, weight status, and activity choice were not significantly different between groups. Average physical activity for the contingent group and the control group were 4.9 and 4.8 minutes each day, respectively. Average video and videogames use were 70.4 and 76.7 minutes each day, respectively. Results indicated that the contingent group physical activity increased for day one and day two by 21.5 minutes and 16 minutes, respectively. The video and videogame use decreased for day one and day two by 43.6 minutes and 39.1 minutes, respectively. The control group had no significant changes in video and videogame use.

Another study by Robinson assessed the effects of decreasing television viewing, videotape, and videogame use on body composition, physical activity, and dietary consumption on 198 third-and fourth-grade students.[42] This was a randomized school-based trial with an intervention group and a control group. The intervention was a program designed to reduce television, videotape, and videogame use. They found BMI, triceps skinfold thickness, waist circumference, and hip circumference increased in both groups as anticipated; however, the intervention group had a statistically significant less increase compared to the control group. According to parents and child reports, the intervention decreased television viewing compared to the control. The intervention found no significant differences between servings of high-fat foods, physical activity levels, or cardiorespiratory fitness between the groups.

In conclusion, there have been numerous studies on television viewing and physical activity. Some of the studies have also focused on the relationship between television viewing and obesity or being overweight. Although, several studies determined television viewing decreases physical activity and increases obesity or overweight prevalence, other studies have not found television viewing to be associated with physical inactivity.

There have not been many experimental studies conducted on television viewing and physical activity. Some studies found decreasing sedentary behaviors like television viewing to have positive outcomes; whereas, this same relationship was not found among other studies. More experimental studies are necessary to establish the true effect television viewing has on physical activity.[13]

The focus of past experimental studies have been to have a treatment group with the aim of decreasing sedentary behaviors and then compare the results with a control group. The results of this study should not only determine if leisure-based screen time significantly decreases physical activity but the purpose is to demonstrate the effect of leisure-based screen time on physical activity.

Chapter 3

Methods

The purpose of this study is to determine the effect of leisure-based screen time on physical activity. The projected study will objectively measure physical activity and monitor leisure-based screen time over a six week period.

Participants

There will be 90 families involved in this study. The duration of the study will be six weeks. The families will be recruited through multiple advertising techniques, such as flyers, personal recruitment, and referral. There will not be any latchkey children included in the study. Each family recruited will consist of a mother, father, and at least two children. Children will range in grade from kindergarten through twelfth.

Persons living in the home not in this age range will be expected to participate and follow the guidelines of the study. Children living in the home not yet in kindergarten (ages 3-4) and individuals older than twelfth-grade will receive a pedometer. Children younger than 3 years of age will not receive a pedometer. Data for individuals not in the age range, although they will be told they are part of the study, will not be included in the statistical analyses.

The families will be randomly assigned to one of three screen time groups. The three groups ($n = 30$) are: (1) normal living group; (2) less than or equal to two hours of leisure-based screen time each day group; and (3) less than or equal to one hour of leisure-based screen time each day group. The normal living group will be instructed to continue living the same lifestyle without modifying behavior; meaning, behaviors like leisure-based screen time and physical activity time should not change because of involvement in the study.

Instruments and Measurement Methods

Each family member will wear a Walk4Life LS 2505® pedometer to measure physical activity. Physical activity will be assessed using two of the modes the Walk4Life LS 2505® pedometer offers: total activity time and number of steps taken. Physical activity logs will be recorded each night and pedometers will then be reset. Parents will record physical activity time and number of steps taken for their children.

The Walk4Life LS 2505® pedometer is a valid method of assessing physical activity.[43] In a recent study, Walk4Life LS pedometers were examined by the American College of Sports Medicine and determined valid for research studies.[43] Ten pedometers were evaluated to determine the effects walking speed has on steps taken. The Walk4Life LS pedometer gave average values within ± 1% of actual values, walking at 80 $m \cdot min^{-1}$ and above. Acceptable accuracy was also achieved walking at 54 $m \cdot min^{-1}$. The reliability coefficient of the pedometer was 0.84.

The Walk4Life LS 2505® pedometer will be worn on the waistband of shorts or pants near the left hip, for the entire six-week period. Pedometers may be taken off while sleeping, showering, bathing, or for other water activities. Week-one will be a period for subjects to become familiar with the pedometer and develop the habit of wearing the device. This will also be a period for subjects to learn how to switch modes on the pedometer, reset the pedometer, and make a habit of accurately completing the logs.

Data from week-one will not be used in the study. Individuals in each family will not be informed of this.

Family members will be asked to record leisure-based screen time immediately after they are finished with the screen-based activity. In order to do this, each family will receive leisure-based screen time logs to place next to screens in the home i.e. computers and televisions. Children will be assisted in filling out the log by a parent. Leisure-based screen time will include any type of screen-based activity i.e. television, videos, videogames, computers, etc. Leisure-based screen time will not include work or homework time; meaning, using the computer to complete a homework or work assignment will not count as leisure-based screen time. At the end of each day, total daily leisure-based screen time will be added up for each individual and accounted for on the leisure-based screen time and physical activity log.

If there are any questions regarding leisure-based screen time, individuals may contact Mary Dawn Sperry at marydawn@email.byu.edu or 801-367-6440 or Dr. Ron Hager at hager@byu.edu or 801-422-1183.

Procedures

At the beginning of the study there will be an orientation meeting parents and children will be encouraged to attend. Parents will sign the informed consent form for themselves and their children. The children will sign an informed assent form for themselves. BMI measurements will be given to each individual with the help of researchers.

Families will be instructed to comply with the amount of leisure-based screen time they have been assigned. The random group assignment will be given to each family in an envelope when they leave the meeting. Each family will be encouraged to continue living naturally and normally. Families will be told no to talk with other families until the completion of the study.

Training will be given on how to fill out the Daily screen time logs and 24 hour leisure-based screen time logs. Parents will fill out the Daily screen time logs and 24 hour leisure-based screen time logs for themselves and for their children. They will be encouraged to fill the logs out honestly and accurately.

Individuals will be taught how to use the pedometer and how to properly record information from the pedometer. They will be given thorough instructions on how to correctly wear the pedometer, when the pedometer may be taken off, how to switch modes on the pedometer, and how to reset the pedometer. Pedometers, leisure-based screen time logs, and physical activity logs will be given to each family. The researcher will visit homes of the families that are not able to attend orientation. The same procedures that occurred at the meeting will be followed.

Each family will receive biweekly e-mails to remind them of the importance of the study and of filling out the leisure-based screen time logs and physical activity logs correctly. There will be six self-addressed stamped envelopes given to each family to mail in weekly leisure-based screen time logs and physical activity logs. Logs will be mailed to: Brigham Young University, 106 SFH, Provo, Utah 84602. At the conclusion of the study, the Walk4Life LS 2505® pedometers will be mailed to BYU in a padded envelope with week six leisure-based screen time and physical activity logs.

Design and Statistical Analysis

The study will last a period of six weeks. Families will be randomly assigned to one of three screen time groups (n = 90): (1) normal living group; (2) less than or equal to two hours of leisure-based screen time each day group; and (3) less than or equal to one hour of leisure-based screen time each day group. The first week of the study will be an acclimation period and data will not be used. Weekly totals for physical activity and leisure-based screen time will be generated for each of the next five weeks. The weekly total will be computed into a daily average for steps and leisure-based screen time.

The age specific demographic and descriptive statistics for average number of steps per day and average leisure-based screen time in minutes will be calculated. Intraclass correlations of at least .80 or higher will be the cut-point for determining number of weeks needed to compute grand means for average number of steps and average screen time for 5 weeks of data.

Gender and BMI will be controlled for in all analyses performed for all participants, adults only, all children, 5 to 12-year-olds, and 13 to 18-year-olds. In addition, Pearson correlations will be used to assess the relationships between BMI, average steps, and gender in each age specific group. For gender coding females were coded as ‘0’ and males were coded as ‘1’, therefore a positive correlation between steps and gender would indicate that males took more steps than females.

Analysis of variance (steps x group) will be used to determine differences between the groups. Daily average steps for all participants combined in the control, 2-hour limit, and 1-hour-limit groups will be presented.

Pairwise comparisons using least squared means technique will be conducted to determine which groups were different from each other when significant main effects for groups are found.

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Appendix A-1

Consent Forms

SUBJECT CONSENT FORM

Introduction
This research study is being conducted by and Mary Dawn Sperry to determine what happens when families reduce the amount of leisure-based screen time in their home. You were selected to participate because your family meets the criteria for participation in this study.

Procedures
Each participant will wear a Walk4Life LS 2505® pedometer to measure physical activity using the two modes it offers: total activity time and number of steps taken. Physical activity logs and leisure-based screen time logs will be recorded daily and be mailed to the researcher each week in a self-addressed stamped envelope. Biweekly e-mails will be sent to each family to remind them of the importance of the study.

Risks/Discomforts
There are minimal risks for participating. However, you may feel emotional discomfort if randomly assigned to reduce leisure-based screen time and compliance does not occur.

Benefits
There are no direct benefits to subjects. However, it is hoped that researchers will learn more about what happens when leisure-based screen time is reduced at home.

Confidentiality
Information obtained from this study will only be for research purposes by Dr. Ron Hager, Mary Dawn Sperry, and other researchers involved in the study.

Questions about the Research
If you have any questions regarding this study, you may contact the principal investigator Mary Dawn Sperry at 801-367-6440 or marydawn@email.byu.edu or Dr. Ron Hager, Department of Exercise Sciences at 801-422-1183 or hager@byu.edu.

Questions about your Rights as a Research Participant
If you have any questions you do not feel comfortable asking the researcher, you may contact Dr. Renea Beckstrand, IRB Chair at 801-422-3873.

I have received a copy of this consent form. I have read and understand the above information and desire of my own free will to participate in this study. I understand I may withdraw or refuse to participate in this study at anytime.

____________________________________ _______________
Signature of Parent Date

____________________________________ _______________
Signature of Witness Date

ASSENT FOR PARTICIPATION IN RESEARCH

Introduction

This research study is being conducted by Dr. Ron Hager and Mary Dawn Sperry to determine what happens when families reduce the amount of leisure-based screen time in their home. You were selected to participate because your family meets the criteria for participation in this study.

Procedures

Each participant will wear a Walk4Life LS 2505® pedometer to measure physical activity using the two modes it offers: total activity time and number of steps taken. Physical activity logs and leisure-based screen time logs will be recorded daily and be mailed to the researcher each week in a self-addressed stamped envelope. Biweekly e-mails will be sent to each family to remind them of the importance of the study.

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Questions about your Rights as a Research Participant

If you have any questions you do not feel comfortable asking the researcher, you may contact Dr. Renea Beckstrand, IRB Chair at 801-422-3873.

I have received a copy of this assent form. I have read and understand the above information and desire of my own free will to participate in this study. I understand I may withdraw or refuse to participate in this study at anytime.

______________________________________ ________________
Signature of Participating Youth Date

I give consent for my child to participate in this research study.

__________________________________ ________________
Signature of Parent Date

______________________________________ ________________
Signature of Witness Date

Appendix A-2

Logs

Name (first and last): ______________________________ Pedometer #: __________

WEEK 1

Daily Survey

Date & Day	How much leisure-based screen-time did you have today?	How much leisure time did you spend reading today?	How many hours of sleep did you get last night? (to the nearest 15 minutes)	Did you wear your pedometer the entire day?		Pedometer Information	
						Total Steps	Exercise Time
Date:_______ **Monday**	_____hr. _____min.	_____hr. _____min.	_____hr. _____min.	Yes No	If No how long was it off? ______ hrs:min	Total Steps __________	_________ hr. _________ min. _________ sec.
Date:_______ **Tuesday**	_____hr. _____min.	_____hr. _____min.	_____hr. _____min.	Yes No	If No how long was it off? ______ hrs:min	Total Steps __________	_________ hr. _________ min. _________ sec.
Date:_______ **Wednesday**	_____hr. _____min.	_____hr. _____min.	_____hr. _____min.	Yes No	If No how long was it off? ______ hrs:min	Total Steps __________	_________ hr. _________ min. _________ sec.
Date:_______ **Thursday**	_____hr. _____min.	_____hr. _____min.	_____hr. _____min.	Yes No	If No how long was it off? ______ hrs:min	Total Steps __________	_________ hr. _________ min. _________ sec.
Date:_______ **Friday**	_____hr. _____min.	_____hr. _____min.	_____hr. _____min.	Yes No	If No how long was it off? ______ hrs:min	Total Steps __________	_________ hr. _________ min. _________ sec.
Date:_______ **Saturday**	_____hr. _____min.	_____hr. _____min.	_____hr. _____min.	Yes No	If No how long was it off? ______ hrs:min	Total Steps __________	_________ hr. _________ min. _________ sec.
Date:_______ **Sunday**	_____hr. _____min.	_____hr. _____min.	_____hr. _____min.	Yes No	If No how long was it off? ______ hrs:min	Total Steps __________	_________ hr. _________ min. _________ sec.

24-Hour Leisure-Based Screen-Time Log Name: ______________________________ _Week: 1_

Please place an "X" in each box indicating the time you spent in leisure-based screen-time activities. Leisure-based screen-time includes: ***watching television, watching videos, playing videogames, computer games, and other computer use, etc. tha is not specifically related to work or school***. Black boxes indicate AM times and clear boxes indicate PM times

	Su	*M*	*Tu*	*W*	*Th*	*F*	*S*		*Su*	*M*	*Tu*	*W*	*Th*	*F*	*S*		*Su*	*M*	*Tu*	*W*	*Th*	*F*	*S*
6:00-6:10								2:00-2:10								10:00-10:10							
6:10-6:20								2:10-2:20								10:10-10:20							
6:20-6:30								2:20-2:30								10:20-10:30							
6:30-6:40								2:30-2:40								10:30-10:40							
6:40-6:50								2:40-2:50								10:40-10:50							
6:50-7:00								2:50-3:00								10:50-11:00							
7:00-7:10								3:00-3:10								11:00-11:10							
7:10-7:20								3:10-3:20								11:10-11:20							
7:20-7:30								3:20-3:30								11:20-11:30							
7:30-7:40								3:30-3:40								11:30-11:40							
7:40-7:50								3:40-3:50								11:40-11:50							
7:50-8:00								3:50-4:00								11:50-12:00							
8:00-8:10								4:00-4:10								12:00-12:10							
8:10-8:20								4:10-4:20								12:10-12:20							
8:20-8:30								4:20-4:30								12:20-12:30							
8:30-8:40								4:30-4:40								12:30-12:40							
8:40-8:50								4:40-4:50								12:40-12:50							
8:50-9:00								4:50-5:00								12:50-1:00							
9:00-9:10								5:00-5:10								1:00-1:10							
9:10-9:20								5:10-5:20								1:10-1:20							
9:20-9:30								5:20-5:30								1:20-1:30							
9:30-9:40								5:30-5:40								1:30-1:40							
9:40-9:50								5:40-5:50								1:40-1:50							
9:50-10:00								5:50-6:00								1:50-2:00							
10:00-10:10								6:00-6:10								2:00-2:10							
10:10-10:20								6:10-6:20								2:10-2:20							
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10:40-10:50								6:40-6:50								2:40-2:50							
10:50-11:00								6:50-7:00								2:50-3:00							
11:00-11:10								7:00-7:10								3:00-3:10							
11:10-11:20								7:10-7:20								3:10-3:20							
11:20-11:30								7:20-7:30								3:20-3:30							
11:30-11:40								7:30-7:40								3:30-3:40							
11:40-11:50								7:40-7:50								3:40-3:50							
11:50-12:00								7:50-8:00								3:50-4:00							
12:00-12:10								8:00-8:10								4:00-4:10							
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12:40-12:50								8:40-8:50								4:40-4:50							
12:50-1:00								8:50-9:00								4:50-5:00							
1:00-1:10								9:00-9:10								5:00-5:10							
1:10-1:20								9:10-9:20								5:10-5:20							
1:20-1:30								9:20-9:30								5:20-5:30							
1:30-1:40								9:30-9:40								5:30-5:40							
1:40-1:50								9:40-9:50								5:40-5:50							
1:50-2:00								9:50-10:00								5:50-6:00							