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Quality of Life Associated with Physical Activity but not Sedentary Time in Youth

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Abstract

Purpose: It has been reported that youth who engaged in more screen time had lower quality of life scores compared to those that were more physically active. Furthermore, increased sedentary behavior increases health risks particularly the risk for obesity. A cross-sectional analysis was completed to examine the relationship between health-related quality-of-life (HRQOL) and accelerometer-measured sedentary time (ST) and physical activity (PA) in 9-10-year-old youth who were recruited for the family-based, childhood obesity intervention, iCook 4-H. It was hypothesized that objectively measured ST would be negatively correlated and PA would be positively correlated with HRQOL.

Methods: A subset of participants (n=118) wore Actigraph GT3X+ accelerometers for 7 days and completed the Pediatric Quality of Life survey (PedsQLTM, version 4.0) to assess HRQOL. Mean daily minutes of accelerometer-measured ST (547 ± 60) and PA including light-intensity (LPA=240 ± 49), moderate-intensity (MPA=35 ± 11), vigorous-intensity (VPA=17 ± 9), and moderate-to vigorous-intensity (MVPA=52 ± 19) were evaluated during waking hours. Multiple linear regressions were used to assess relationship between ST and PA intensities with HRQOL. Statistical significance was set at $p \leq 0.05$.

Results: There were no significant associations between ST or LPA with HRQOL. MPA, VPA and MVPA were positively associated with multiple HRQOL domains.

Conclusion: The lack of relationship between objectively measured ST and LPA with the total HRQOL score and subscales merits further investigation. The findings of the current study support the need for lifestyle interventions that engage families in behavior that increases MVPA.

Keywords: Physical activity; Childhood obesity; Pediatric; Quality of life

Introduction

Currently 31.8% of children in the United States (US) ages 2-19 years are overweight or obese [1]. The effects of childhood obesity have long term consequences related to chronic diseases such as cardiovascular disease, cancer, type 2 diabetes, sleep apnea, and hypertension [2]. In addition to chronic disease outcomes, it has also been established that childhood obesity decreases quality of life in youth [3]. Quality of life refers to the effect that the aspects of life have on one's social well-being, self-esteem, and physical and mental health [4]. More specifically, health-related quality of life (HRQOL) refers to the effect that chronic diseases, body mass index (BMI), and physical activity (PA) have on one's health and overall well-being [4]. Research has determined that PA enhances one's quality of life, therefore, quality of life is a key benefit of PA [5,6].

PA in youth, specifically moderate-to vigorous-intensity PA, has been associated with a decreased risk for childhood obesity [7]. The Physical Activity Guidelines for Americans state that children should achieve ≥ 60 minutes of moderate-to vigorous-intensity PA (MVPA) per day [7], however, most children are not meeting this recommendation [7-10]. In 2008, researchers assessing accelerometer-measured PA in children ages 6-11 years reported that 42% met PA guidelines [10]. In 2014, Fakhouri et al., reporting on the 2012 NHANES data, found that only 24.8% of children ages 12-15 were meeting recommended PA guidelines, indicating a decrease in PA with age [8].

Youth spend a large portion of their day in sedentary behaviors, such as sitting to watch television, play video games, or be on computers. Furthermore, increased sedentary behavior has been associated with increased health risks [11-14]. LeBlanc et al. reported that, internationally, youth aged 9-11 years spent about 8.6 hours per day in sedentary behaviors, which included about 2.6 hours per day in front of a screen [13]. In the study, sedentary behavior was associated with higher percent body fat and not meeting the PA guidelines, and youth with more screen time had a higher waist circumference and were less active [13]. Furthermore, Gopinath et al. reported that youth who engaged in more screen time had lower quality of life scores compared to those that were more physically active [8]. Suchert et al., in a systematic review to investigate the relationship between sedentary behavior and mental health, reported similar findings in the relationship between sedentary behavior and quality of life with screen time used as the measure of sedentary behavior [16].

Excessive sedentary behavior has been associated with negative health outcomes; however, there is limited evidence that supports an association between objectively measured sedentary time and health in youth. Colley et al. reported that objectively measured ST was associated with increased waist circumference and BMI percentile in boys and girls between the ages of 6-14 years [12]. It is important to note that decreased PA and increased ST are independent determinants of chronic disease [11,12,14]. Achieving the recommended 60 minutes per day of PA is only known to prevent the risk of chronic disease in children when activity is at the moderate-to-vigorous intensity level [7]. However, meeting the recommended guidelines for PA does not completely prevent the risk of chronic disease when the remainder of the day is spent being sedentary [15,17,18]. Multiple researchers have reported that even when achieving the recommended amounts of PA, high amounts of ST has been associated with increased health risks and even mortality [8,11,14].

Although the relationship between sedentary behavior and quality of life has been investigated [15,16,19-24]; the relationship between objectively measured ST and quality of life is not well elucidated [23,24]. When screen time is used as a measure of sedentary behavior, other sedentary activities, such as time spent seated at a school desks, are often overlooked and may underestimate actual time spent in sedentary activities. An objective measure using accelerometers should be used to investigate the relationship between ST and quality of life [23,24]. Therefore, the primary objective of the current study was to complete a cross-sectional analysis to investigate the relationship between accelerometer-measured ST and PA with HRQOL in a sample of 9-10 year old youth at baseline of the iCook 4-H Program, a lifestyle, family-based intervention for obesity prevention in youth. The hypothesis for this study was that objectively measured ST would be negatively correlated and PA would be positively correlated with HRQOL in 9-19 year old youth. Additionally, differences in HRQOL scores by BMI percentile category and those meeting PA recommendations were explored.

Methods and Procedures

Study design and population

This is a cross-sectional analysis using the baseline data from a sample of 9-10 year-old youth recruited from lower income populations. The youth were recruited to participate in iCook 4-H Program, a five-state, randomized, treatment-control, childhood obesity prevention intervention. The iCook 4-H program was designed for 9-10 year-old youth and their adult main food preparer to participate as a pair, and included participants from Maine, Nebraska, South Dakota, Tennessee, and West Virginia.

Study population

Youth were recruited from schools located in communities of lower income as indicated by number of children receiving free or reduced price school meals. Recruitment efforts yielded a total child sample at baseline of 228 (ME 63, NE 41, SD 35, TN 43, WV 46). Youth were eligible if they were 9 years old before September 2013, and did not turn 11 years old before December 31, 2013. The youth were being recruited to participate in an intervention delivered as cooking classes and aimed at cooking and physical activity with an overall goal to teach families to, "Cook, Eat, and Play Together." Other requirements included being free from life-threatening illness or other medical conditions; free from food allergies and/or free from activity-related medical restrictions that would prevent participation in a face-to-face nutrition and PA program; willing to eat meat and dairy; and having regular access to a computer with Internet. Data used in this analysis were from the baseline assessments. University review boards for the protection of human subjects at each of the participating states approved the study protocol. Children provided verbal assent and all parents provided written informed consent.

Demographic information

Demographic information was collected through a survey at baseline. Youth were queried for state location, ethnicity, and date of birth for age calculation. Parents and/or the main meal preparers of the youth were queried for enrollment in any food assistance programs, which was used as a measure of socioeconomic status. Those indicating use of the program were considered lower socioeconomic status.

Assessment of height and weight and BMI

Weight was determined to the nearest 0.1 kg using SECA 874 digital scale or a HealthOMeter 752KL portable health scale. A SECA 213 or Charder HM 200P portable standiometer was used to assess height to the nearest 0.1 cm. All instruments were calibrated prior to assessments. All measurements were done in duplicate and taken by trained study personnel. All personnel had to meet inter-rater reliability standards of Pearson correlation coefficient ≥ 0.80 prior to taking study measurements.

BMI (kg/m^2) was converted to BMI percentile using Centers for Disease Control and Prevention height and weight standards [25]. Underweight was defined as less than the 5th percentile, normal weight was defined as 5th percentile to less than the 85th percentile, overweight was defined as 85th percentile to less than the 95th percentile, and obese was defined as at or greater than the 95th percentile [25].

Assessment of sedentary time and physical activity

Accelerometers were used to obtain objective ST and PA data. Based on the total sample recruited and the timing of assessments, 68% (n=153 of 228) of the total sample were fitted with accelerometers.

Accelerometers (GT3X+) were initialized using the ActiLife 5 Data Analysis Software to accumulate raw acceleration data at a sample rate of 30 Hertz [26]. Accelerometers were provided to participants on an elastic belt, with instructions to wear the belt around the waist with the accelerometer placed above the right hip. Specific instructions were also provided for wear time of the device. Participants were expected to put on accelerometer when they woke up and remove when they went to bed. However, instructions did include to remove while bathing and swimming and record non-wear time and reason on a log sheet. Accelerometers were collected after the seventh day of wear was completed.

Wear time compliance criteria for accelerometers required youth to wear the device for three valid weekdays and one valid weekend day. A valid day was defined as a minimum of 9 hours of wear time during the set waking hours of 7 am-9 pm. Non-wear time was defined as ≥ 60 consecutive minutes of zero activity counts. All activity from compliant youth was used to calculate PA. Each adult-youth pair was also given a log sheet to record times when the accelerometer was not worn, times when the child participated in unusual activity (i.e. riding long hours in a car), or times when the child forgot to wear the accelerometer. At baseline, 124 of 153 participants met compliance criteria.

Mean minutes per day ± standard deviation (SD) of ST and PA, including light-intensity (LPA), moderate-intensity (MPA), vigorous-intensity (VPA), and MVPA were calculated using age specific cut-points by Evenson et al. that were linearly scaled to accommodate 10 second epochs [27]. Participants averaging ≥ 60 minutes of MVPA per day were categorized as meeting PA guidelines.

Assessment of quality of life

HRQOL was assessed using the PedsQL™ Version 4.0, which consisted of 23 self-report questions assessing Physical, Emotional, Social, and School Functioning scores [28]. The PedsQL 4.0 was validated with self-report children ages 5-18 years and parents of children ages 2-18 years. The sample included chronically ill children, acutely ill children, and healthy children. The mean scores of the sample were similar to the mean scores reported in the validation paper [29]. Internal consistency reliability alpha coefficients approached or exceeded a reliability standard of 0.70 for children between the ages of 5 to 18 [29]. Summary scores of the PedsQL™ included Total Quality of Life, composed of all 23 questions, and the Psychosocial Health Summary score which included Emotional, Social, and School Functioning questions. Physical Functioning was assessed with 8 questions about difficulty in walking, running, sports activities, bathing, chores, and if the child had low energy or aches. Emotional Functioning was assessed with 5 questions about feelings of being afraid, sad, angry, worried about the future, and if the child had trouble sleeping. Social Functioning was assessed with 5 questions about friendships, getting along with others, being teased about being able to do things other children could do, and keeping up when playing with other children. School Functioning was assessed with 5 questions about paying attention in class, forgetting things, keeping up with schoolwork, and missing school because of doctor visits and/or not feeling well [28]. Response choices were never=0, almost never=1, sometimes=2, often=3, and almost always=4. All responses were reverse coded and scaled as follows 0=100, 1=75, 2=50, 3=25, and 4=0. All scores ranged from 0-100. The Total Quality of Life score was calculated by summing the scores of each question and dividing by 23, the total number of questions. Scores for Physical, Emotional, Social, and School Functioning were calculated by summing the scores for each question associated with that category and dividing by the total number of questions associated with the respective category. A Psychosocial Health Summary score was computed by summing the scores from the Emotional, Social, and School Functioning questions and dividing by 15, the total number of questions in the three subscales. Higher scores indicated greater HRQOL [28].

Statistical analysis

Descriptive statistics were calculated for each variable and presented as means ± SD. Associations between ST and PA intensity levels and HRQOL variables were assessed using multiple linear regressions while adjusting for state, BMI, sex, and socioeconomic status using R data analysis software [30]. State was included as a confounder as there were differences by state in those who were accelerometer compliant versus non-compliant. BMI was included as a confounder in the regression analysis as PA differed by BMI category (data not reported in manuscript). Sex and socioeconomic status were included based on historical data [2,32-37]. PedsQL™ 4.0 scores were skewed toward the high end of the scale and were transformed by taking the square root of the reverse of the score (sqrt (100-score)) to create a more normal distribution.

HRQOL scores from participants dichotomized into underweight/normal weight or overweight/obese and meeting PA guidelines or not meeting PA guidelines were compared for differences. Differences between groups were determined using two sample t-tests. Statistical significance was set at p ≤ 0.05.

Results

One hundred fifty-three youth (ME 49, NE 6, SD 27, TN 25, WV 46) were fitted with accelerometers, and 124 (ME 39, NE 4, SD 17, TN 20, WV 44) met accelerometer compliance standards at baseline. Differences (state, sex, race and ethnicity) between those who were compliant versus non-compliant were assessed and only state was significant (x^2 13.03, df 4, p=0.01). Of the 124 youth who were accelerometer compliant, 118 also completed the PedsQLTM (**Figure 1**). Therefore, included in the data analysis were 118 youth (51% females; 49% males; mean age 9.4 ± 0.6 years). Of the 118 youth, 79% were Caucasian and 31% participated in food assistance programs (e.g., free or reduced price school meals). Mean daily minutes, evaluated during waking hours, of accelerometer-measured activity were ST=540 ± 60, LPA=240 ± 49, MPA=35 ± 11, VPA=17 ± 9, and MVPA=52 ± 19. There were no associations between ST and LPA with any HRQOL domain (**Table 1**).

There were significant positive associations between total HRQOL, Physical Functioning, School Functioning, and Psychosocial Functioning with MPA, VPA, and MVPA. There were no associations between subscales of Emotional Functioning and Social Functioning with MPA, VPA, nor MVPA (**Table 1**).

HRQOL scores are reported in **Table 2**. On a scale of 0-100, Total Quality of Life was 77 ± 15, indicating a high quality of life overall for the sample. There were no significant differences in HRQOL scores between those categorized as under/normal weight versus those categorized as overweight/obese. Only 33% of youth met PA guidelines. Those meeting the PA guidelines reported significantly higher HRQOL scores (Total Quality of Life p=0.03; Physical Functioning p=0.04; School Functioning p=0.01; Psychosocial Health Summary p=0.04) with no differences in Emotional and Social Functioning scores (**Table 2**).

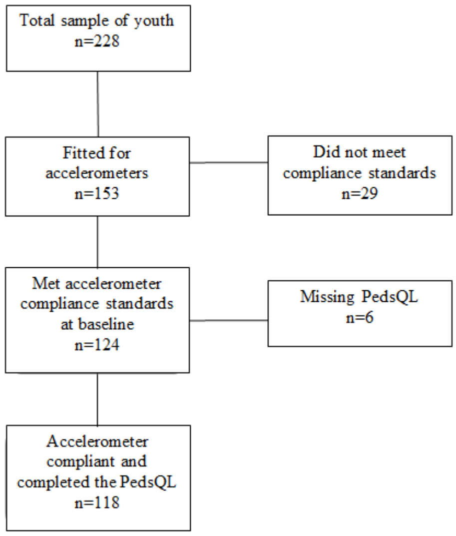

Figure 1: Flow diagram of iCook 4-H youth recruitment.

Table 1: Associations between accelerometer measured sedentary time and physical activity with quality of life in 9-10 year old youth.

	Sedentary Time		Light Physical Activity		Moderate Physical Activity		Vigorous Physical Activity		Moderate-Vigorous Physical Activity	
HRQOL[b] n=18	B (95% CI)[a]	p-value	B (95% CI) [a]	p-value	B (95% CI) [a]	p-value	B (95% CI) [a]	p-value	B (95% CI) [a]	p-value
Total Quality of Life	0.004(-0.002, 0.009)	0.16	-0.002(-0.009, 0.004)	0.454	-0.034(-0.064, -0.004)	0.026	-0.039(-0.071, -0.006)	0.022	-0.021(-0.037, -0.004)	0.016
Physical Functioning	0.006(-0.000, 0.013)	0.088	-0.005(-0.014, 0.004)	0.258	-0.042(-0.083, -0.000)	0.048	-0.058(-0.104, - 0.013)	0.012	-0.028(-0.051, -0.005)	0.017
Emotional Functioning	0.002(-0.006, 0.009)	0.667	-0.000(-0.009, 0.008)	0.917	-0.025(-0.066, 0.016)	0.23	-0.013(-0.059, 0.033)	0.581	-0.011(-0.034, 0.012)	0.341
Social Functioning	0.004(-0.004, 0.011)	0.321	-0.002(-0.010, 0.007)	0.675	0.039(-0.080, 0.003)	0.065	-0.041(-0.086, 0.004)	0.076	-0.023(-0.045, 0.000)	0.053
School Functioning	0.005(-0.003, 0.012)	0.207	-0.003(-0.012, 0.006)	0.48	-0.047(-0.088, -0.006)	0.024	-0.046(-0.091, -0.001)	0.045	-0.027(-0.050, -0.004)	0.022
Psychosocial Health Summary Score	0.003(-0.003, 0.008)	0.349	-0.001(-0.007, 0.005)	0.749	-0.032(-0.063, -0.002)	0.037	-0.030(-0.064, 0.003)	0.076	-0.018(-0.035, -0.000)	0.039

[a]Linear regression analysis used to calculate standardized β and p-values. Scores listed as multivariable-adjusted means ± 95% confidence interval adjusted for state, sex, BMI, and socioeconomic status.

[b]HRQOL scores were collected using the PedsQL™, version 4.0. Response scores for all 23 questions were transformed on a scale from 0-100, with higher scores indicating higher HRQOL. If >50% of question responses were missing, the scaled score was not calculated.

Significance set at p ≤ 0.05.

Table 2: Health-related quality of life scores for 9-10 Year old youth categorized by BMI percentile category and physical activity.

HRQOL Scores							
	Total Sample	BMI Percentile Category			Physical Activity Group		
	(n=118)	Underweight/Normal (n=6)	Overweight/Obese (n=42)	p-value	Meeting PA Guidelines (n=39)	Not Meeting PA Guidelines (n=79)	p-value
Total Quality of Life	77(15)	78(15)	75(15)	0.22	81(11)	75(17)	0.03
Physical Functioning Score	80(19)	82(18)	76(20)	0.13	85(16)	78(20)	0.04
Emotional Functioning Score	70(19)	70(19)	70(20)	0.97	73(17)	69(20)	0.25
Social Functioning Score	79(18)	81(18)	75(19)	0.12	83(13)	77(20)	0.06
School Functioning Score	77(16)	78(16)	76(17)	0.66	83(13)	74(17)	0.01
Psychosocial Health Summary Score	75(15)	76(15)	74(16)	0.42	79(12)	73(17)	0.04

Two sample t-test was utilized to determine significance between HRQOL Categories with BMI percentile groups and physical activity groups.

[a]Scores listed as Means (SD).

[b]HRQOL scores were collected using the PedsQL™, version 4.0. Response scores for all 23 questions were transformed on a scale from 0-100, with higher scores indicating higher HRQOL.

[c]Meeting PA Guidelines was defined as an average of ≥ 60 minutes of MVPA.

Significance was set at $p \leq 0.05$.

Discussion

The objective of the current study was to examine the relationship between self-reported pediatric quality of life and accelerometer-measured ST and PA in 9-10 year old youth in the iCook 4-H Program. Using the objective accelerometer measure, there was no relationship between ST or LPA and HRQOL which does not support our hypothesis. However, there were significant positive associations between MPA, VPA, and MVPA and multiple HRQOL domains. The lack of association between ST and HRQOL differs from findings of those comparing sedentary behaviors to HRQOL [19,24]. Carson et al. reported that screen time, such as television, video games, and computer had an inverse association with self-esteem, fitness, and pro-social behavior [37]. However, sedentary behaviors such as reading and homework have a positive association with academic achievement [37]. This lack of relationship between objectively measured ST and HRQOL in our study maybe a reflection of what youth are doing in this ST. Other researchers have reported that children indicate sedentary activity such as watching movies or playing video games with siblings is entertaining and fun. It may be these "fun" yet sedentary activities influence the youth perception of their quality of life [1,3]. The youth in our study were not queried about how they spent their ST; even though, youth spent approximately 9 of their waking hours in sedentary time and 4 hours in LPA. Another potential reason for lack of relationship maybe that the study was underpowered to detect differences. With a moderate effect size of 0.15, α of 0.05, and power of 0.80, the sample size to detect differences is estimated to be 133. Thus, the lack of relationship between objectively measured ST and LPA with the total HRQOL score and subscales merits further investigation.

Although, previous researchers have reported that overweight/obese youth report lower quality of life than their underweight/normal counterparts [2,31-36], these differences were not observed in the iCook 4-H youth in this study. In a review of obesity and quality of life, Tsiros et al. reported that a strong inverse relationship exists between weight status and Physical Functioning score [35]. In a report of preteens and teens, Halfon et al. reported that overweight and obesity was associated with poor general health, lower Psychosocial Functioning score, lower Emotional Functioning score, and poor physical health [32]. The lack of differences in HRQOL scores reported in this study compared to those reported in the literature may be due to the recruitment efforts. Although the iCook 4-H youth were recruited from geographically disperse audience, the recruitment was for youth and parents who were interested in participating in a health-related study.

The high amount of ST and high percentage of iCook 4-H youth not meeting the recommended minutes of MVPA is concerning. The data were collected during the summer months (July-August) when it is assumed that the youth would be more active and not influenced by the school environment. However, in the study sample, 67% of youth did not meet an average of 60 minutes of MVPA per day. Researchers have found that the quality of life measures, including Social Functioning, as well as Total Quality of Life and the Psychosocial Health Summary Scores, were higher in youth meeting PA guidelines versus those who did not meet the guidelines [15,17,18,23,24].

Strength of the current study is that ST and PA were measured using accelerometers, which is considered the gold standard for objective PA and ST assessment [38]. Furthermore, participants were recruited from geographically different regions across the US and included those from low-income populations. Even though, the recruitment occurred in geographically different areas, a limitation is that participants were recruited from a convenience sample that may have been more interested in health and wellness programing. Additionally, the sample was limited in size and may be underpowered to detect the association between ST and LPA and HRQOL. Therefore, the results may not be generalizable to all populations. Physical measures of health status were not collected to validate the physical health of the students. However, eligibility for inclusion was to have the ability to participate in physical activity. Although objectively measured ST was studied, youth were not queried for what they did during their waking hours and HRQOL was measured through a self-reported survey. Continued research to explore ST and relationship to HRQOL may need to include objectively measured ST and querying for activities performed during this time.

A significant relationship between objectively measured ST and HRQOL was not found in the current study. However, there was a positive relationship between objectively measured PA and HRQOL. The children who participated in higher levels of PA, particularly in MPA, VPA, and MVPA, reported higher HRQOL scores in Total Quality of Life and subscales of Physical Functioning, School Functioning, and Psychosocial Health. Because ST and PA are independent risk factors for chronic diseases, public health strategies and obesity prevention interventions need to be implemented at both decreasing ST as well as increasing PA to improve overall health. The findings of the current study support the need for lifestyle interventions, such as the iCook 4-H Program to teach families to engage in PA together with the outcome of increasing MVPA.

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