

A Systematic Analysis of Adolescents' Physical Activity Level and Sedentary Behavior

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Abstract

Physical activity (PA) promotion and sedentary behavior (SB) reduction are needed to address the increasing rates of noncommunicable diseases (World Health Organization. Noncommunicable diseases, 2018). In the last two decades, there has been an increase in the incidence of both overweight young people and diabetes. Many countries have been looking for solutions to help young people achieve well-being (Centers for Disease Control and Prevention, 2011). However, few studies have been conducted to examine PA levels among adolescents, which leaves gaps to be filled regarding the understanding of overall health in adolescents. The purpose of this study was to examine the extent to which adolescents engage in regular PA as opposed to sedentary activities, such as watching television and using the internet, after controlling for sex and age. Finally, this study helped address how adolescents spend their time engaging in PA. The data were obtained from the National Youth Risk Behavior Survey (NYRB-S) 2007 by the Centers for Disease Control (<http://www.cdc.gov/HealthyYouth/yrbs/data/>). The participants in this study consisted of (14041) adolescents ranging in age from 12 to 18 years old. The NYRB-S was an instrument used to assess risk factors that affect adolescents. We concluded that there were significant overall effects of daily time watching television and age on PA level. Subjects who spent 4 to 14 hours daily watching television had a significantly higher mean level of PA than subjects who watched television for 0 to 4 hours daily. The analysis also showed that the seven age groups differed significantly. There were significant correlations between time spent engaging in SB, age and PA levels. An increase in television viewing was related to a decrease in PA, and subjects between the ages of 13 and 16 tended to watch television more frequently.

Introduction

In the last two decades, there has been an increase in the incidence of both overweight young people and diabetes. Many countries have been looking for solutions to help young people achieve well-being (Centers for Disease Control and Prevention, 2011; World Health Organization. Noncommunicable diseases, 2018). For example, two countries, the United States and Kuwait, have seen dramatic increases in the rates of obesity and diabetes among young people (Al-Isa, Campbell, & Desapriys, 2010; Centers for Disease Control and Prevention, 2011; World Health Organization. Noncommunicable diseases, 2018). Previous studies have shown that physical inactivity and the prevalence of sedentary lifestyles are leading contributors to this epidemic. Al-Isa et al. (2010) and the Centers for Disease Control and Prevention (2011) recommended increasing the level of physical activity (PA), which plays a vital role in reducing the risk of contracting these diseases. PA promotion and sedentary behavior (SB) reduction are needed to address the increasing rates of noncommunicable diseases (World Health Organization. Noncommunicable diseases, 2018).

However, few studies have been conducted to examine PA levels among adolescents, which leaves gaps to be filled regarding the overall health status of adolescents. Recently, SB has become an epidemic in many countries, but little is known about how adolescents choose to spend their time or whether or not they are physically active. For instance, there was only one study published on SB among Kuwaiti

adolescents (Al-Haifi, Al-Fayez, Al-Athari, Al-Ajmi, Allaf, Al-Hazzaa, & Musaiger, 2013). The results of this study revealed that, "With regard to sedentary behavior, time spent watching television and time spent on the computer were not significantly related to BMI in boys or girls" and needs to be examined further (p. 9). The lack of information demands an investigation on how PA affects a substantial portion of the adolescent population. This study examined the extent to which adolescents engage in regular PA as opposed to sedentary activities, such as watching television and using the internet, after controlling for sex and age. Finally, this study helped address how adolescents spend their time engaging in PA.

Literature Review

The U.S. Department of Health and Human Services discusses the importance of performing regular PA among adolescents. They found a direct correlation between regular PA and health among adolescents. The National Association for Sports and Physical Education & the American Heart Association (2010) have provided an excellent example of the correlation between regular PA and health, claiming that "adolescents who are physically active have vigorous cardiopulmonary and respiratory systems: strong hearts and lungs. They have less body fat. And they have strong bones and muscles" (p. 3). Recently, there has been increasing interest in adolescent health and health care services to determine how to improve overall well-being within that demographic group (Al-Qallaf Al-Otaibi, & Heyam, 2012).

In many countries there are many barriers to increasing the rate of PA. One of these problems is the current level of physical inactivity, which is partly due to insufficient participation in PA during leisure time. According to the American Heart Association and the American Stroke Association's Statistical Fact Sheet (2013), 13.8% of adolescents in the United States "were inactive during the previous 7 days, as indicated by their response that they did not participate in 60 minutes (as recommended in Healthy People, 2010) of any kind of PA that increased their heart rate and made them breathe hard on any 1 of the previous 7 days". In the last decade, many researchers and organizations (e.g., the National Association for Sport and Physical Education, 2010; the American Heart Association, 2010; Al-Isa, Campbell, & Desapriys, 2010) have studied how young people spend their time engaging in PA and the benefits of being physically active. There is no existing formal data that describes how much PA adolescents engage in.

Recently, more research has been conducted that has hypothesized that SB correlates with a lack of PA or a single behavior. SB is defined as activity that does not increase energy exertion significantly above the resting level and includes activities such as sleeping, sitting, using the internet, and watching television and other forms of screen-based entertainment (Pate, O'Neill, & Lobelo, 2008). A high level of SB negatively impacts youths' health, independent of other factors such as body weight, diet, and PA.

According to several studies, television, tablet use, smartphone use, and screen viewing in general presents the main means of engaging in SB (Regan & Heary, 2013; Salmon, Tremblay, Marshall, & Hume, 2011; O'Neill, & Lobelo, 2008). Recently, the time spent watching television and using tablets among adolescents has dramatically increased. Nelson, Neumark-Stzainer, Hannan, and Sirard (2006) found that

the estimated time spent watching television among adolescents is 2.5–3 hours per day, and an additional 1.5–2 hours is spent using computers and tablet sin the U.S. and Kuwait. This investigation shows that adolescents spend at least five hours a day viewing screens, which accounts for 32–56% of an adolescent's total sedentary time, as mentioned by Biddle, Gorely, & Marshall (2009). On the other hand, these results show that adolescents do not follow the recommendation of the American Academy of Pediatrics (2001), which suggests that adolescents limit television and other screen time to no more than 2 hours per day. These studies show that adolescents are prioritizing sedentary activities over physical activities (Biddle, Gorely, & Marshall, 2009).

The amount of PA and SB among adolescents exhibits gender differences, which were specifically investigated by Vihjalmsson & Kristjansdottir (2003). This Icelandic study of students in the 6th, 8th, and 10th grades showed that girls enrolled in sports clubs less than boys due to gender differences. Gender differences are also responsible the low level of strenuous activity and high rate of withdrawal from sports clubs among girls. Vihjalmsson & Kristjansdottir cite the “disadvantages of the female gender” as a factor involved in their higher level of physical inactivity, as opposed to males. They claimed that “the structure and/or culture of organized sport favors boys and men” (P. 2).

Age is also a factor in PA level and SB. De Bourdeaudhuij, Philippaerts, Crombez, Matton, Wijndaele, Balduck, and Lefevre (2005) addressed levels of PA among age groups by dividing adolescents into three groups, based on age and activity level: precontemplation, contemplation, and preparation. They found that “the level of PA during adolescence was higher than during adulthood. There may have been few adolescents in the precontemplation and contemplation stages, resulting in low statistical power” (P. 2).

While PA is immensely beneficial for adolescents, SB is more prevalent in that demographic, particularly in girls compared to boys. Adolescents do tend to be more active than adults, but the levels of PA in adolescents are difficult to measure because “it is not known whether adolescents are able to adequately evaluate their own level of physical activity” (De Bourdeaudhuij, I., et. al., 2005, P. 2).

The purpose of this study, therefore, will be to examine the amount of SB, for example, “watching television and using the internet”, among adolescents and how time spent in SB affects PA levels. The study will control for age and gender to determine what effects those variables have on levels of PA and engagement in SB.

Research Question

The primary focus of this study will be to determine the levels of PA and SB among adolescents. This study intends to determine *what effect* the number of hours that students spend engaging in SBs on a typical day have on adolescents' PA level after controlling for sex and age. See Fig. 1

Path Diagram

Four Hypotheses

1)

After controlling for sex and age, students who spend four or more hours engaging in SBs on a typical day are more likely to be overweight than are students who spend less than four hours engaging in SBs on a typical day (Crosstabs).

2)

After controlling for sex and age, students who spend four or more hours engaging in SBs on a typical day have a lower level of PA than students who spend less than four hours engaging in SBs on a typical day (ANOVA).

3)

After controlling for sex and age, the number of hours that a student spent engaging in SBs on a typical day is *negatively* related to adolescents' PA level (Regression).

4)

After controlling for sex and age, the more time that students spend engaging in SBs on a typical day, the more likely it is that they will be less physically active (Logistic Regression).

Methods

Sample and Data Source

The data were obtained from the National Youth Risk Behavior Survey (NYRB-S) 2007 by the Centers for Disease Control (<http://www.cdc.gov/HealthyYouth/yrbs/data/>). The participants in this study consisted of (14041) adolescents ranging in age from 12 to 18 years old. The NYRB-S is an instrument used to assess risk factors that affect adolescents.

The independent variables included the adolescents' age and gender. "Age" had seven categories arranged numerically with "1" indicating "12 years or younger" and "7" indicating "18 years or older". "Gender" was divided into two categories labeled numerically, with "1" indicating female and "2" indicating male. The first dependent variable was SB, which was labeled "TVhour". The variable "TVhour" had seven categories identified by letters: "A. I do not watch TV on an average school day", "B. Less than 1 hour per day", "C. 1 hour per day", "D. 2 hours per day", "E. 3 hours per day", "F. 4 hours per day" and "G. 5 or more hours per day". The second dependent variable was level of PA, which was assessed by two factors: "Vig7D", the number of days the adolescents engaged in vigorous PA within the last seven days, and "Mod7D", the number of days the adolescents engaged in moderate PA within the last seven days. Both "Vig7D" and "Mod7D" had seven categories indicating the days of the week. All variables were included in the SPSS data set.

Results

Basic descriptive statistics to analyze adolescents' SB can be seen in Table 1. As Table 1 shows, there were approximately equal percentages of boys and girls in the sample and approximately equal numbers

of participants from the 9th, 10th, 11th, and 12th grades.

Table 1
Descriptive Statistics for Physical Activity Study Variables

Characteristic	<i>M</i>	<i>SD</i>
Height (m)	1.69	0.10
Weight (kg)	68.55	16.99
<i>n</i>		%
GENDER		
BOYS	6,992	49.8%
GIRLS	7,036	50.1%
GRADE		
9TH GRADE	3,467	24.7%
10TH GRADE	3,482	24.8%
11TH GRADE	3,480	24.8%
12TH GRADE	3,529	25.1%

For the first hypotheses, the Crosstab method was used, and the results can be seen in Table 2. Table 2 illustrates the results of a chi square analysis of the relationship between two categories of body mass index (BMI) and two categories of hours of SB, controlling for gender. For both boys and girls, there was no significant relationship between the two variables.

Table 2
Characteristics (%) of Participants: BMI by Sex and Sedentary Behavior (n = 12,844)

Characteristic	BMI less than 25	BMI 25 or greater	χ^2	df	p
Boys	<i>n</i> = 4269	<i>n</i> = 2161	0.00	1	p > .05
Less than 4 hours sedentary	66.40	33.60			
4 + hours sedentary	66.40	33.60			
Girls	<i>n</i> = 4676	<i>n</i> = 1738	1.81	1	p > .05
Less than 4 hours sedentary	75.00	25.00			
4 + hours sedentary	72.60	27.40			

For the second hypotheses, the analysis of variance (ANOVA) method was used, and the results can be seen in Table 3. As shown in Table 3, there was a significant overall effect of daily time watching television and age on PA level ($F(1,7) = 15.89, p < .001$). Subjects who spent 4 to 14 hours daily watching television had a significantly higher mean level of PA than subjects who watched television 0 to 4 hours daily ($F(1,6) = 8.26, p < .005$). The analysis also showed that PA differed significantly among the seven age groups ($F(6,6) = 16.54, p < .001$).

Table 3
Analysis of Variance for Physical Activity

Source	M	SE	n	df	F	p
Source: Reduced Model				7	15.89	$p < .001$
Time Per Day Spent Watching Television				1	8.26	$p < .005$
0–4 Hours	5.78	0.28	1097			
4–14 Hours	6.15	0.28	11242			
Age				6	16.54	$p < .001$
12 years or younger	4.64	0.90	20			
13 years	7.01	1.53	7			
14 years	6.42	0.13	1154			
15 years	6.45	0.09	2807			
16 years	6.06	0.09	3180			
17 years	5.68	0.08	3194			
18 years or older	5.51	0.10	1977			
Within-group error				16	(12.33)	
<i>Note:</i> Values enclosed in parentheses represent mean square errors.						
eta ² = .009 for main effects ($p < .001$)						

For the third hypotheses, the regression method was used, and the results can be seen in Table 4. As shown in Table 4, SB, sex, and age were all significant predictors of PA. There was a significant negative relationship between SB and PA. The significant negative relationship between gender and PA, with boys as the reference group, indicates that boys tended to have a higher level of PA than girls. The significant negative relationship between age and PA indicates that older subjects tended to have a lower level of activity than younger subjects.

Table 4
**Summary of Regression Analysis for Variables Predicting
Physical Activity Level (N = 14,041)**

Variable	B	SE B	β	p
Main Effects:				
Constant	9.01	0.17		p < .001
Sedentary Behavior	-0.12	0.02	-0.07	p < .001
Gender				
Girls	-1.57	0.72	-0.19	p < .001
Boys (Reference)				
Age	-0.31	0.03	-0.19	p < .001
<i>Note:</i> R ² = .046 (p < .001)				

For the fourth hypotheses, the logistic regression method was used, and the results can be seen in Table 5. Table 5 shows the results of a logistic regression predicting PA (in two levels) based on dichotomized SB. The significant negative coefficient and the odds ratio less than 1.00 for SB indicate that subjects who engaged in 4 to 10 hours of SB were less likely to have a high level of PA compared to the likelihood of subjects who engaged in 0 to 3 hours of SB.

Table 5
Summary of Logistic Regression Analysis Predicting Physical Activity Level (N = 14,041)

Variable	b	SE	Odds ratio	95% Confidence Interval		Wald statistic	df	p
				Lower	Upper			
Main Effects:								
Constant	0.227	0.056	1.254			16.499	1	p < .001
Sedentary Behavior								
4 to 10 hours of sedentary behavior	-0.239	0.036	0.787	0.733	0.845	43.776	1	p < .001
0 to 3 hours of sedentary behavior	(reference)							
<i>Note:</i> Model Chi Square = 43.873, df = 1 (p < .001); -2 Log Likelihood = 17090.981, Nagelkerke R ² = .005								

Conclusion

All the results above addressed the research question and the primary focus, which was to determine the amount of PA and SB among adolescents. This study explored the effect of the number of hours that students spend engaging in SBs on a typical day on adolescents' PA level after controlling for gender and age. We hypothesized that after controlling for gender and age, students who spend four or more hours engaging in SBs on a typical day are more likely to be overweight than students who spend less than four hours engaging in SBs on a typical day.

However, we concluded that there was a significant overall effect of daily time spent watching television and age on PA level. Subjects who spent 4 to 14 hours daily watching television had a significantly higher mean level of PA than subjects who watched television for 0 to 4 hours daily. The analysis also showed that the seven age groups differed significantly. There were significant correlations between time spent engaging in SB, age and PA levels. An increase in television-viewing time was related to a decrease in PA, and subjects between the ages of 13 and 16 years tend to watch television more frequently.

Declarations

Ethics

The data were obtained from the National Youth Risk Behavior Survey (NYRB-S) 2007 by the Centers for Disease Control (<http://www.cdc.gov/HealthyYouth/yrbs/data/>).

Consent for publication

"Not applicable"

Availability of data and material

The data were obtained from the National Youth Risk Behavior Survey (NYRB-S) 2007 by the Centers for Disease Control (<http://www.cdc.gov/HealthyYouth/yrbs/data/>).

Competing interest

On behalf of all authors "Salem A;Sammari, Sultan Alsahali", I am Dr. Heyam Boushehry, the corresponding author of the present study, I declare that this paper did not receive any funds from any institution. It was self-funded by the authors.

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Authors contribution

Al-Shammari Salem, Boushehry Heyam, Alsahli Sultan.

A.S. B.H., & A.S; Designed and performed the study, analyzed data and co-wrote the paper. B.H., A.S; Supervised the research. A.S; finalize the study, review, & edit. A.S. B.H., & A.S; agree with Final approval of the version to be published

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Figures

Path Diagram

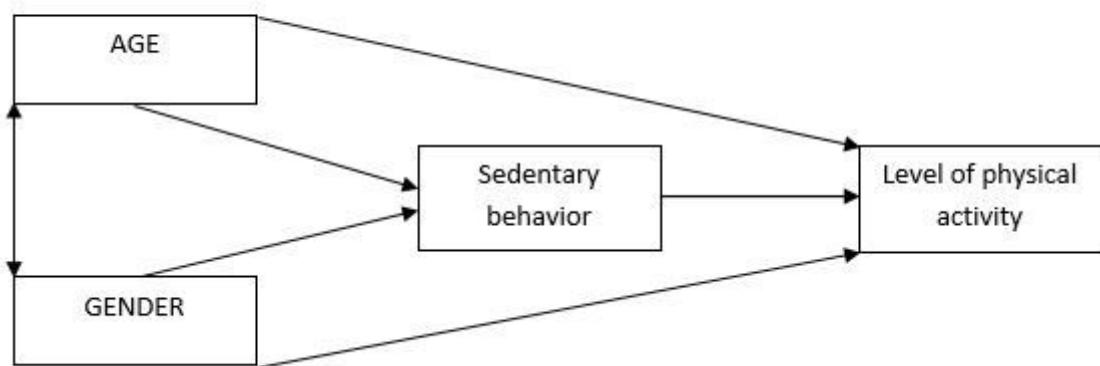


Figure 1

Path Diagram