

Physical activity intensities during school time in healthy prepubertal boys and BMI

Şükrü Alpan Cinemre

Hacettepe University Faculty of Sport Sciences, Ankara, Turkey. E-mail: sacinemre@gmail.com

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SUMMARY: Cinemre ŞA. Physical activity intensities during school time in healthy prepubertal boys and BMI. Turk J Pediatr 2015; 57: 572-577.

The first aim of this study was to determine the intensity of physical activity (PA) by an objective measurement method - using an accelerometer in Turkish prepubertal boys. The second aim of this study was to correlate the intensity of PA with body mass index (BMI). For this aim 40 boys were participated in this study. PA levels were measured by using GT3X-bt accelerometer for 5 consecutive school days. Mean BMI was found 17.56 ± 2.39 . 101.20 ± 17.82 minutes was found as moderate to vigorous physical activity (MVPA) per school day. Significant negative moderate correlation was found among vigorous PA, weight and BMI ($r = -.39; -.38$). The main finding of this study is: there is a relationship between vigorous PA and BMI in prepubertal boys. This means that the most effective intensity of MVPA in preventing the increase of BMI in prepubertal boys is the vigorous PA.

Key words: physical activity intensities, GT3X-bt accelerometer, moderate-to-vigorous physical activity.

Overweight and obesity in childhood is a major health problem in developed and developing countries all around the world. Physical inactivity, which is the fourth leading risk factor of global mortality, causes many health problems such as obesity, cardiovascular health diseases, diabetes, etc. in adulthood^{1,2}. Studies state that physical activity levels decrease according to age while physical activity habits during childhood are transferred to adulthood³. For this reason, determination, observation and increasing of physical activity from early childhood is gaining more importance.

Researchers have been investigating the correlation between physical activity and Body Mass Index (BMI) for many years. According to these studies, strong correlation is stated between those two parameters. It is observed that one of the reasons of high BMI in children is low physical activity levels^{4,5,6}. WHO's main recommendation is at least 60 minutes of moderate to vigorous physical activity (MVPA) per day, to prevent overweight and obesity in childhood^{2,4,7}. But studies states that only a

small percentage of children are obeying this recommendation. For example, Troiano et al.⁸ state that only 42% of children between ages 6-11 apply at least 60 minutes MVPA recommendation of WHO. In the same study, it is observed that only 8% of children at the age of 12-19 apply the recommendation of WHO. Longitudinal studies show age-related decrease in daily physical activity in both genders^{9,10}. Also, it is increasingly understood that intensity of physical activity is more important than duration of physical activity for preventing overweight and obesity¹⁰⁻¹².

Children spend most of their waking hours at school. School takes up nearly half of day time of children¹³. Thus, it is important to observe and determine the physical activity levels during school time and to develop effective physical education lesson plans or strategies to beat physical inactivity¹⁴⁻¹⁷.

In many countries around the world, physical activity levels of children during school hours were investigated by using accelerometers^{11,13,18}. In these studies physical activity are categorized

into intensity levels by using activity counts²⁴. According to these counts certain physical activity levels (Light, Moderate, vigorous etc.) were determined in literature. There are some studies about physical activity levels of Turkish children in literature,¹⁹ however, these studies have not used an accelerometer. The first aim of this study was to determine the intensities physical activity by an objective measurement method - using an accelerometer (Actigraph GT3X-bt) - in Turkish prepubertal boys during school time. The second aim of this study was to correlate the intensity of physical activity with BMI.

Material and Methods

Study Sample

Randomly selected 40 healthy prepubertal boys (8.38 ± 0.67 years old) participated to this study. Participants were participated from Nene Hatun elementary school which is in Çankaya, Ankara. All measurements were made in this elementary school. According to National Education curricula, there is no physical education lesson but there is a two hours physical activity lesson per week during school time in this age group. All permissions from parents of participants and Hacettepe University Non-interventional Clinical Researches Ethics Board were taken.

Measurements

Anthropometric Measurements

Weight was measured by using SECA digital platform scale which measures with 0.1 kg precision. Height was measured by using Tanita Leicester portable stadiometer which measures with 0.1 cm precision²⁰.

Weight and height measures were made barefoot and in light school clothing. All measures were repeated twice and the highest score was taken to evaluation. Height and weight measures were used to calculate BMI (kg/m^2) and BMI percentiles were determined by using Childrens' BMI Tool for schools Metric version in EXCEL software²¹.

Determination of Physical Activity Level

Physical activity levels were measured by using three axis Actigraph GT3X-BT accelerometer which has high reliability ($\text{ICC} \geq 0.925$) (22).

The size of this device is 4.6 cm x 3.3 cm x 1.5 cm and weight is 19 g. Intensity of physical activity were evaluated by Actilife 6 software.

Accelerometers were fitted with an elastic waistband on right hip of participant during each test day by their classroom teacher²³. All physical activity measurements were made during school time, included recess time and other sporadic activities. Before measurements, classroom teachers were informed and accelerometers were fitted to participants by them.

Cut off points by Freedson et al.²⁴, which were developed to use in 6-18 year olds, were used to determine physical activity intensity rates. All activities during 1 minute were evaluated in 5 activity categories according to these cut off points by Actilife 6 software. According to these cut off points, less than 149 counts per minutes (cpm) were categorized as sedentary; cpm's between 150-499 were categorized as light intensity activity, cpm's between 500 and 3999 were categorized as moderate intensity activity, between 4000 and 7599 cpm's were categorized as vigorous intensity activity and more than 7600 cpm's were categorized as very vigorous intensity activity. The observed data were collected by 5 second epochs²⁴. The reason for this is to ensure that small children do and to be recognized by the speed and movement in all three axes²⁵. Participants were excluded if consecutive zero counts (non wear time) were more than 20 minutes during school time.

Statistics

Sample size was calculated by using g-power 3.1 software with Cohen's d 0.5 effect size, $\alpha=0.05$ and 0.80 power before²⁶. The physical activity levels of participants were measured by using GT3X-bt accelerometer and digitized by ACTILIFE 6 software. The digitized data was transferred to SPSS 20 statistical analysis software. The data were normally distributed according to Kolmogorov-Smirnov normality test ($p > 0.05$). Depending on this finding Pearson correlation test (r) was used to determine the correlation levels among physical activity levels and other parameters.

Table I. Descriptive Statistics of Anthropometric Measurements of Participants (n=40)

Parameters	Mean	SD	Minimum	Maximum
Age (year)	8.38	0.67	7.00	9.00
Height (cm)	132.28	6.65	122.00	148.60
Weight (Kg)	30.98	5.99	20.00	46.60
BMI	17.56	2.39	14.60	23.40
BMI Percentile (%)	65.57	24.92	19.40	98.70

BMI= Body mass index

Results

Descriptive Statistics of Age and Some Physical Measurements of Participants

Mean, standard deviation, minimum and maximum values of anthropometric measurements are shown in Table I.

Children in this study are in normal BMI percentile ranges according to Turkish population²⁷.

Physical Activity Levels

Physical activity levels were classified as physical activity intensities and MVPA durations were calculated according to cut off points²⁴. As a result of analysis, mean measurement duration was 6 hours 55 minutes per day/participant for 5 school days. Findings are presented in Table II.

The mean total times in minutes of physical activity intensities are shown in Table II. Over 5 school days, total sedentary time was found 279 minutes while the duration of total vigorous and very vigorous activities were only 21 minutes. Moderate physical activity, which was found 80 minutes (19,30 %), makes up the main part of MVPA duration. In addition to these findings, daily MVPA duration was found to be 101 minutes/school day (24.36 %).

According to Pearson correlation analysis, it is seen that light and moderate intensities of physical activity are not significantly correlated with body composition parameters. Vigorous activities (and very vigorous activities) has significant negative moderate correlation with weight and BMI. However, MVPA did not correlate significantly with weight and BMI.

Discussion

In this study, physical activity levels were observed for five school days by using an objective measurement method, using an accelerometer (Actigraph GT3X-bt). This study is also the first study in Turkish prepubescent boys which has correlated physical activity and BMI. According to measurements, the main finding was the significant correlation between vigorous physical activity and BMI (Table III). Kwon et al.²⁸ stated that moderate to vigorous physical activity is strongly effective on preventing adiposity in children and adolescents. The results in our study shows that vigorous activities are more important than moderate activities to take BMI under control with physical activity. In other words, the increase of vigorous activities affect BMI and weight more than light and moderate activities. This finding also supports the study of Lätt et al.¹⁰, which

Table II. Physical Activity Intensity Times and Percentages

Physical activity intensities	Time (min)	%
Sedentary	279	67,2
Light	35	8,56
Moderate	80	19,30
Vigorous and Very Vigorous	21	5,06
Total	415	100,00
MVPA	101	24,36

MVPA= Moderate to Vigorous Physical Activity

suggests that vigorous physical activity is the most important factor in predicting overweight and obesity in puberty. In the HELENA study, 45 minutes of moderate physical activity with 15 minutes of vigorous physical activity was recommended for both genders. Twenty minutes of vigorous physical activity is recommended for boys and 10 minutes for girls. In the same study it is also stated that total 60 minutes daily MVPA is important but vigorous physical activity is the key factor preventing from obesity during adolescence¹¹. In our study, the total of vigorous and very vigorous physical activity duration was found 21 minutes per school day in boys. According to results of this study, vigorous physical activity is important to prevent weight and BMI. This finding is similar with the study of Latt et al¹⁰. In that study, significant negative moderate correlation was found between vigorous physical activity and BMI at the end of a 2 year follow up. Similar findings were presented in the study of Martinez-Gomez et al.¹¹.

Strong et al.²⁹ claimed that more intensive and longer sessions of activity decrease the percentage of fatness in boys and girls, although evidence for this is limited. This view is also supported by Gutin et al.³⁰ in which it is stated that adolescents who engaged in vigorous activities are fit and lean. In our study, the correlation with weight and vigorous activity was moderate but negatively significant in prepubertal boys ($p < 0.01$).

In our study significant correlation was found among intensity of PA and BMI but not with BMI%. Both BMI and BMI% can be used to measure the fatness or adiposity in children. But BMI% is not at all suitable when both measurement were discussed³¹. BMI% which

are criteria based on age-sex specific cut-off points, shows only the range of BMI where children stand with their peers in same sex and cohort²⁹. In our view, although BMI% is important to specify children BMI range, BMI itself is a more valid measure to compare with PA levels and sedentary time.

In this study, the percentage of the total duration of MVPA in-school time was found $24.21 \pm 4.54\%$. This finding means 101.20 ± 17.82 minutes/school day of MVPA. The finding of MVPA duration shows that participants of this study are physically active according to WHO's 60 minutes/day MVPA recommendations for children. MVPA durations in this study are similar with other studies. For example, Kettner et al.¹⁸ who observed participants for a whole day found 144 min/day MVPA. Aznar et al.³² found 81.81 ± 34.76 min/day during week days in 9 year old boys. In that study, it is expressed that in-school time is the most active time of children during day time. Ridgers et al.³³ found 24.9% MVPA, whereas sedentary time was found to be 48% during school time in 11.3 ± 1.1 year old boys. In another study of Ridgers et al.³⁴ which was made in Hungary, MVPA duration was found to be 55.3% in third grade (9 year olds) and 36.4% in fourth grade (10 year olds) during school time. Sedentary times during school time was found to be 30.9% in third grade and 43.9% in fourth grade. Ortega et al.⁹ found 94 minutes MVPA during weekday in 9.6 years old boys at the end of HELENA study. The duration of MVPA (min/day) during weekday decreases to 56 minutes per day in 15.6 years old boys. The study also compared Swedish and Estonian cohorts for the same year. MVPA durations were lesser in the Estonian cohort than the Swedish cohort.

Table III. Correlations Among Physical Activity Percentages, Weight, BMI and BMI Percentiles (r)

Physical activity percentages	Body Composition Parameters (r)		
	Weight (kg)	BMI (kg/m ²)	BMI percentile (%)
Sedantery (%)	.34	.02	-.09
Light intensity (%)	.04	.17	.19
Moderate (%)	.08	.11	.14
Vigorous and very vigorous (%)	-.39*	-.38*	-.26
MVPA (%)	-.09	-.10	.02

* $p < 0.05$ MVPA = Moderate to vigorous physical activity

Nilsson et al.³⁵ studied 9.7±0.4 year old boys in four European countries. Nilsson et al.³⁵, published the diversity of MVPA durations among countries, revealing 90 to 121 minutes/day MVPA durations.

In this study, rather than mean MVPA duration as per WHO recommendations, sedentary time takes up the most time during school day (67.2%). There have been recent studies which investigated the relationship with sedentary time and adiposity or BMI in children. In most of these studies, it is stated that no correlations were found between sedentary time and adiposity or BMI when physical activity is considered³⁶. Studies shows that sedentary time and behaviour is independent from dietary intake. For example, television viewing is independently associated with adiposity rather than computer usage in children. It is stated that it depends on several reasons but the main factor is that the increase of junk food during television viewing³⁷. Children spend most of their time in the classroom sitting³⁸. But the difference between this and sitting in front of the television is that the intake of unhealthy food during lesson time is forbidden. It is known that most resting energy expenditure takes place when compared with food digestion and physical activity³⁹. It is thought that this is one of the reason of normal ranges of BMI percentile of participants in this study.

This study had some limitations as measurements were done only with prepubertal boys. In literature, it is stated that boys are physically more active than girls in this age group. According to literature, prepubertal boys have their peak level of physical activity. This was one of the reason to choose prepubertal boys as sample group in this study. One of our limitations was that the measurements were only taken during school time. The reason for this is that school time is the main time in which this group is awake. It is also their most physically active time. For this reason the measurements were done only during school time. The mean duration of physical activity measurements during school time was 6 hour 55 minutes in which a total of 80 minutes of recess time was included. This is similar with other studies in literature^{40,41}. It is thought that the difference between 101.20 minutes MVPA /day and 80 minutes were the sporadic

movements during lessons in classroom.

Conclusion

The main finding of this study is: there is a relationship between vigorous physical activity and BMI in prepubertal boys. Which means that the most effective intensity of MVPA in preventing the increase of BMI in prepubertal boys is the vigorous physical activity. In other words, the application of vigorous activities for preventing overweight and obesity is gaining importance. A longitudinal study should be designed to compare the results of short term studies to increase the validity of these findings in Turkish population. The type and duration of vigorous activities should be determined for prepubescents of both sexes.

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