ORIGINAL ARTICLE

Pedometer determined physical activity of preschool children, during and after school

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Abstract

The purpose of this study was to describe the sex-specific patterns of preschooler's daily pedometer-determined physical activity (PA) during (DS) and after (AS) school hours. The random sample of the one hundred and forty four children (71 boys and 73 girls, age = 5 - 6 yr), who attend the kindergartens in Greece, wore pedometers for four days (3 school days and 1 weekend day) and recorded steps during school and after school hours. For the statistical analysis of the data, ANOVAs repeated measures were used. From the results gender seems to be the main effect ($F_{1,142} = 14.937$, $p < .05$) on children's PA. Boys took significantly ($F_{1,143} = 11.193$, $p = .001$) more steps per day than girls: 5.735 ± 2.820 vs 4.337 ± 2.159 during school. Furthermore, boys took more steps per day than girls: 11.353 ± 5.319 vs 9.586 ± 4.254 steps per day. Consequently, these data give an understanding of the sex-specific patterns of preschoolers' daily pedometer-determined physical activity (PA) during (DS) and after (AS) school hours.

Keywords: *pedometry, preschoolers, Omron HJ-720IT*

Introduction

Obesity is among the most dangerous diseases of modern times, having multiple effects on physical and mental health of people experiencing it, and therefore, the phenomenon of obesity is often characterized as the "syndrome of the New World", (Nammi, Koka, Chinnala, & Boini, 2004). Obesity starts from a very early age as the results of multiple related investigations alarmingly state. Furthermore, childhood obesity is linked with a variety of chronic diseases that are experienced, later in adulthood.

Unfortunately, childhood obesity is an increasingly spreading problem all over the world, and its prevalence has increased at an alarming rate. It is interesting to note that based on WHO, over 42 million children globally, under the age of five, are estimated to be overweight (WHO, 2010). Thirty five million of these are living in developing countries. Mediterranean countries in particular tend to present high prevalence rates of overweight (OW) and obesity (OB) (Tzotzas et al., 2011). Greece, a recently modernized Mediterranean country, suffers from this fast developing epidemic, as well. Factors that may contribute to the problem of excessive body weight in Greece are sedentary life style, diet and the lack of physical activity. These factors, especially diet and PA, seem to influence health both as a combination

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or independently. Regarding their effect on obesity, there is usually an interaction between diet and PA, but the additional health benefits that come from increased physical activity, should not be overlooked, as well as the fact that poor diet induces risks that are not related to obesity (WHO, 2004). Moreover, childhood physical inactivity constitutes a serious problem. Low levels of physical activity may be responsible for children's obesity in later life, while increase physical activity is considered beneficial for the health of school-aged children and youth. (Hills, Okely, & Baur, 2010; Hills, King, & Armstrong, 2007). It prevents children and adolescents from becoming overweight or obese, and it also reduces the risk of obesity in adulthood (Hills, Andersen, & Byrne, 2011). That is the reason why it is essential to start promoting physical activity even at preschool age (Cardon & Bourdeaudhuij, 2007).

International findings (Sijtsma, Sauer, Stolk, & Corpeleijn, 2011; Pagels, Boldemann, & Raustorp, 2010; Al-Hazzaa, 2007; Tudor-Locke et al., 2006; Cox, Schofielda, Greasleyb & Kolta, 2006) have recorded lower levels of physical activity than the ones recommended by the literature (Tudor-Locke et al., 2011). Especially for preschoolers, due to a lack of data available about PA patterns it is even more important to objectively and accurately measure their PA. Pedometers can be used to explore these patterns, since there easy to be used, have no great cost and allow for intervention, monitoring and evaluation.

In the world literature, a study of 224 Saudi preschool children aged 5 to 6 years, by Al-Hazzaa (2007) recorded steps of 6773 (±5301) per day, a study of 122 children aged 4 to 5.9 years by Cardon and Bourdeaudhuij (2007) recorded 9980 (± 2605) steps per day and a study of 55 children 3.4 to 5.7 years by Pagels, Boldemann, and Raustorp (2010) recorded steps 7313 (±3042) per day. In regards to gender more studies have shown that boys are more physically active as expressed of the number of steps taken per day than girls (Hills, Andersen, & Byrne, 2012; Tudor-Locke et al., 2006; Cox, Schofielda, Greasleyb, & Kolta , 2006).

A paper by Tudor-Locke, Hatano, Pangrazi and Kang (2008) which established pedometer-determined PA for children (6-12 years), recorded values for boys as: 1) <10.000; 2) 10.000-12.499; 3)12.500-14.999; 4)15.000-17.499; 5) ≥17.500 steps/day. The values for girls were: 1) <7000; 2) 7.000-9.499; 3) 9.500-11.999; 4) 12.000-14.499; 5) ≥14.500 steps/day. According to these values , the escalating categories could be defined as "sedentary", " low active", "somewhat active", "active" and "highly active" , for both sexes.(Tudor-Locke et al., 2011).

The purpose of this study was to record the PA levels of children attending kindergarten and to examine the sex-specific patterns of daily pedometer determined PA during school and after school hours. Statistical analysis showed significant difference between boys and girls. We hypothesized that boys would be more physically active than girls according to their daily pedometer determined PA.

Method

Participants

Data was collected during the 2011- 2012 school year between Januarys to March 2012. Participants attended kindergartens in the Municipality of Athens, in Greece. The sample of the study was consisted of one hundred and forty four (144) children (71 boys and 73 girls, 49.3% of boys and 50.7 % of girls, respectively) aged 5 to 6 years (60 to 72 months) who attended kindergartens in Athens, without a diagnosed neurological, sensory or mobility impairment. The schools were randomly selected. Parents or 'legal guardians' of the children, who participated in the study, were informed about the aim of the study and were asked to provide written consent. Approval to conduct the study was granted by the Committee of the Dept of Physical Education of Sports Sciences, of the Democritus University of Thrace, Komotini Greece, Greek Department of Education and the principals of the schools approved the study.

Procedure

Anthropometric measures

In order to measure the weight of the children an electronic scale (model Seca) was used, whereas to measure the height, a special stadiometer tape measure graduated to the nearest millimeter was used. All measurement was taken from participants wearing light clothes and no shoes.

Pedometer determined physical activity

We used a pedometer (Walking Style Pro Omron, HJ-720IT) that has been used in several research studies as it has no great cost, it is easy to use and it is a valid and reliable instrument for assessing physical activity. The Walking Style Pro Omron, HJ-720IT, is easy to handle; the information can be stored easily as this is a brief activity during the day. Additionally, the Walking Style Pro Omron, HJ-720IT, is a good choice of measuring physical activity because it can measure steps at any speed (Giannakidou et al, 2008).

The number of steps was measured by having the participants wear the pedometers during the day, both during school and out of school. Detailed written and verbal instructions were given to the children and their parents on how to place the pedometer (on hip). All preschool teachers and parents were informed about pedometers and their use. Parents were asked to ensure that their children wear the pedometers as long as possible during the day. The pedometers were placed on the children for 7 consecutive days. As a result, data were collected on 4 days, 3 weekdays and 1 weekend day, during all day, except while sleeping, bathing or doing other water activities.

Statistics

All the results are obtained using the statistical package SPSS version 16.0. The level of significance was set at $p<.05$. For the statistical analysis of the data, ANOVAs repeated measures were used with two variables, one independent (sex) and one dependent (school environment: 1. During and 2.

Out of school) to examine the differences of sex–specific patterns of the participants.

Results

Results are obtained from the analysis of variance based on 144 children (71 boys and 73 girls) who completed data collection requirements. Descriptive data of the participants, given as mean, appear in Table 1.

Table 1: Descriptive data given as mean of the participating preschool children.

	Boys (n1=71)	Girls (n2=73)	Total (N=144)
Age(yr)	5.63	5.63	5.62
Height(cm)	1.15	1.15	1.15
Weight(kg)	22.05	21.89	22.07

According to the analysis of variance assessed by ANOVAs repeated measures with gender and school environment, as variables, gender appears to be a factor that influences physical activity (steps) ($F_{1.142}$=14.937, p<.05).There were statistically significant ($F_{1.143}$=11.193, p=.001) sex-specific differences in physical activity (steps) during school hours with boys recorded more steps than girls.

More specific, regarding pedometer determined PA over four days for preschoolers, boys took significantly more steps per day than girls: (Mean: 5.735,2 ±2820.3 vs 4337.17 ±2159.27) during school (Table 2). There was a statistically significant difference between boys and girls in PA (steps) during school. Boys took 1.398 ±417.8 more steps/day than the steps girls had recorded.

In total, the boys recorded more steps per day than girls' both during and after school hours: 11.353 ±5.319 vs 9.586 ±4.254 steps/day. In contrast, there was no significant difference in the total number of steps per day which boys and girls took after school hours. Boys seem to be more active than girls in the group age of 5-6 years old (60-72 months).

Table 2: Number of steps of the participating children presented by gender.

	Total steps/day in school		Total steps/day out school		N
	Mean	SD	Mean	SD	
Boys	5735.2*	2820.33	5617.96	2499.46	71
Girls	4337.17	2159.27	5248.94	2195	73
	5026.48	2594.84	5430.89	2349.1	144

* Significant differences between boys and girls at p<.05 level.

Discussion

The main purpose of this study was to record PA levels and to describe the sex-specific patterns of kindergarteners daily pedometer-determined physical activity (PA) during (DS) and after (AS) school hours. Our results agree with the findings of other studies, showing that boys are by nature more habitually active than girls (Hills, Andersen, & Byrne, 2012; Tudor-Locke et al. 2006; Cox et al. 2006). Those studies involved either, preschoolers or children and adolescents (Cox et al. 2006; Al-Hazzaa, 2007; Pagels et al. 2010; Sijtsma et al, 2011; Tudor-Locke et al. 2011). Our findings do not agree with those of Cardon and Bourdeaudhuij (2007). In their study of 122 children, aged 4 to 5.9 years, the recorded steps/day were 9.980 (±2.605) and no sex-specific differences of PA levels were found. In the present study, we found that boys took more steps /day than girls. Boys seem to be more active (Mean=11.353 steps/day) than girls (Mean=9.586 steps/day) in this age group and this difference is more significant during school hours.

It is often reported that boys are more active than girls. An explanation for boys being more physical active could be i.e., that boys prefer to play in groups and participate in games which require body contact. In contrast, girls prefer playing in small groups, not involving body contact and always seem to be more mature than boys. Additionally, differences on recorded steps between sexes can be influenced by family, environment or weather conditions (Trost, Sirard, Dowda, Pfeiffer, & Pate, 2003). In this study, parents also mentioned that there were times when their children couldn't be active enough as they wish, as weather conditions or way of life didn't give them enough opportunities.

Nevertheless, the total steps of both sexes in the present study, were between 9.500 steps/day – 11.500 steps/day, which numbers are considered low, compared to the average steps that have been recorded in the world literature. According to this, the average steps pedometer determined PA suggested patterns for boys are 12.000 to 16.000 steps / day and for girls 10.000 to 13.000 steps / day, respectively (Tudor-Locke et al., 2006, 2011).

The results of this study reveal that there are sex-specific differences between boys and girls in PA; further study is needed in Greek preschool children. Little data is available concerning physical activity at preschool age in Greece. The limitation of the present study is that all data were collected from January to the end of March, when there were adverse weather conditions, which were not positively conducive to the study.

In summary, preschoolers in their majority had fewer steps/day recorded than children and adolescents. The sex of children seemed to play an important role in the number of steps/day which is recorded, in the particular study.

Conclusions

There appears to be a strong relationship between pedometers determined physical activity and gender of a sample of preschool children in Athens, Greece. Although the recorded steps are considered low, both during and after school hours, there seems to be differences between boys and girls. The lack of physical education in the kindergarten in Greece seems to be a factor that affects physical activity in this age.

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