

ORIGINAL ARTICLE

Motor Skills Performance and Pedometer-Determined Physical Activity in Young Children.

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Introduction

The development of motor skills in children is a very important process for subsequent motor and mental-emotional development, and physical activity is a significant factor for a healthy physical and mental development (Dubbart, 2002). It appears that children's learning to move their body in space, along with their ability to change direction, as well as their reaction to audio and video signals, are socially necessary motor skills, not only for their self-improvement, but also for their participation in sports in adulthood. It has been found that the perceived sport competence in primary school age has impacts on later physical activity (Barnett, Morgan, Van Beurden & Beard 2008).

More specifically, physical activity in preschoolers is a protective factor for coronary heart diseases in adults (Saakslahki et al., 2004). Additionally, it contributes to the prevention of vascular degenerative diseases, such as atherosclerosis and increased systolic pressure (Farpour-Lambert et al., 2009), as well as body fat (Ebbeling, Pawlak & Ludwig, 2002) and orthopedic complications (Reeg, 2004). Of special importance are the findings conveying physical activity contributes to a better brain development and school performance of students (Trudeau & Shephard, 2008).

Abstract

This study examined the association between motor skills and pedometer-determined physical activity in a sample of preschool children. One hundred and seventeen children (61 boys, 56 girls) 5-6 years old (M=67.18 months, SD=3.802) who live in Agrinio, Aitolokarnania Greece, volunteered to participate in the current study. A trained researcher administered the measurements for the assessment of children's motor skills by using the Short Form of the Bruininks-Oseretsky Test of Motor Proficiency-2 (BOTMP-SF). Physical activity was assessed by OMRON HJ-720IT pedometers. Based on performance in BOTMP-SF, participants were categorized into three groups, namely, "below average", "average", and "above average". The results showed a statistically significant association between motor skills performance and steps.day⁻¹ (Kruskal-Wallis $\chi^2=34.23$, $p<.001$). Comparisons between motor skills categories showed significant differences in steps.day⁻¹ between the "below average" and "average" groups (Mann-Whitney $U=50$, $p<.001$) and between "below average" and "above average" groups (Mann-Whitney $U=7$, $p<.001$). Results showed that increased levels of children's physical activity encourage and positively affect motor development.

Keywords: OMRON HJ-720IT, preschoolers, steps, BOT-2, motor proficiency, Greece.

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So, it is important to identify and highlight the relation of these two variables (motor performance and pedometer-determined habitual physical activity) in order to be able to design effective programs which beneficially affect the motor development of preschool children.

The aim of this study was to examine the relation between motor skills performance and pedometer-determined physical activity in 5-6 year-old children. It appears that the duration and the type of daily physical activity are related to motor performance (Kambas et al., 2012; Pate, Pfeiffer, Trost, Ziegler, & Dowda, 2004). Also physical activities outside the school environment (throwing-related and jumping-related activities, stationary-no movement, stationary-limb movement, slow, rapid trunk movement) contribute to motor skill proficiency (Raudsepp & Päll, 2006). The examination of possible relation between the type, intensity and volume of physical activity with motor performance, might be helpful for understanding the nature of this relation, and it may lead to the development of effective interventions for increasing motor skill performance in children.

The hypothesis of this study was that children who were more physically active would be more skilful than their counterparts of the same age who were less active or sedentary.

Method

Participants

One hundred and seventeen children 5-6 years old (61 boys, 56 girls) who attended kindergartens in Agrinio, Aitolokarnania Greece, without a diagnosed neurological, sensory or mobility impairment, participated in the current study ($M=67.18$, $SD=3.802$). The schools were selected by random sampling. All the data were collected at school environment. The children who participated in the study had been informed about the aim of the study and had been asked to provide their parents or legal guardians a written consent. Four of the participants (3 girls, 1 boy) did not wear the pedometer according to the measurement protocol and they excluded from the study.

Measures

Motor Proficiency

Motor skills performance was measured using the Bruininks-Oseretsky Test of Motor Proficiency - Short Form. The Bruininks-Oseretsky Test of Motor Proficiency (BOT2) is a test designed to measure the fundamental motor skill functioning of children. The test is suitable for individuals aged 4 to 21 years old (Bruininks & Bruininks, 2005). BOT2 is an appropriate and detailed assessment instrument for preschool children (Cools, De Martelaer, Samaey, & Andries, 2009).

The battery consists of 14 items, drawn from 8 subtests: **Subtest 1:** Fine Motor Precision: item 1: drawing lines through paths-crooked, item 2: folding paper, **Subtest 2:** Fine Motor Integration: item 3: copying a square, item 4: copying a star, **Subtest 3:** Manual dexterity: item 5: transferring pennies, **Subtest 4:** Bilateral coordination: item 6: jumping in place-same sides synchronized, item 7: tapping feet and fingers- same sides synchronized, **Subtest 5:** Balance: item 8: walking forward on a line, item 9: standing on preferred leg on balance beam, **Subtest 6:** Running

speed and agility: item 10: one-legged stationary hop, *Subtest 7*: Upper-limb coordination: item 11: dropping and catching a ball with both hands, item 12: dribbling a ball with alternating hands, *Subtest 8*: Strength: item 13: knee push-ups, item 14: sit-ups. The short form consists of 14 items among 8 subtests and takes approximately 20 minutes to complete.

Pedometry

Pedometer-determined habitual physical activity was measured using sealed multi-day-memory pedometers (Model OMRON HJ-720IT). The pedometers were placed in the children's right hip for one week, all day, except while sleeping, bathing or doing other water activities. The participants wore the pedometer from the morning (the time they woke up) until the night (the time they went to bed) for seven consecutive days. A collection of seven days data is a good indicator of physical activity in children (Trost, et al., 2000; Vincent & Pangrazi, 2002).

Parents and children were fully instructed how to operate the pedometers. Detailed written instructions were given to them, about the way to place the pedometer on hip. The findings from a comparative study (Hands, Parker & Larkin, 2006) indicate that the pedometer is more effective tool of measurement of free play physical activity in 5 and 6 year-old children compared to the accelerometer. Also, the Omron pedometers appear to be accurate in measuring step-counts independently of speed used under laboratory conditions (Giannakidou et al., 2012).

Statistical analysis

The data entered in the special management software "BOT-2 Assist" was calculated as an overall index of skill which is categorized into 1 of 5 categories of evaluation: well above average, above the average, average, below average, well below the average. However, for statistical reason in the present study, the BOT-2 scores were classified into 3 categories: above average, average and below average. The association between *motor skills level* (3 categories: above average, average and below average) and *steps.day⁻¹* (average number of steps walked in a typical week), was checked using the non-parametric test Kruskal-Wallis. Comparisons between categories were performed using the Mann-Whitney test, with the alpha level set at .05.

Results

The results showed a statistically significant relation between motor skills performance and *steps.day⁻¹* (Kruskal-Wallis $\chi^2=34.23$, $p<.001$). Comparisons between motor skills categories showed significant variations in the number in *steps.day⁻¹* between the "below average" and "average" groups (Mann-Whitney $U=50$, $p<.001$) and between "below average" and "above average" groups (Mann-Whitney $U=7$, $p<.001$). Non significant association was found between "average" and "above average" groups ($p=.058$).

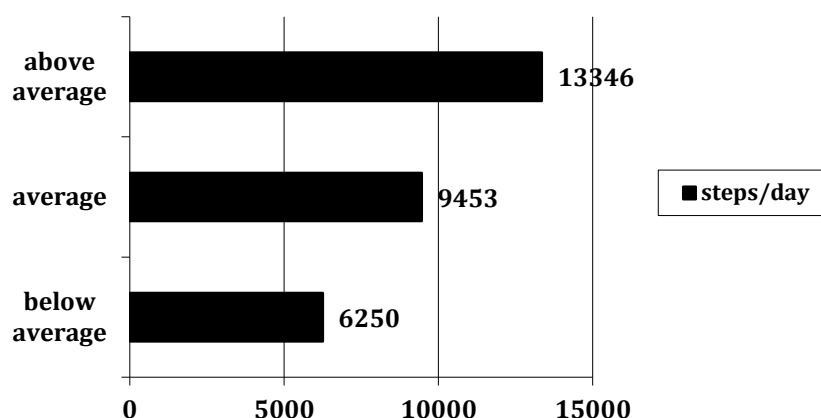


Figure 1. Relation between steps per day and motor skills category.

Discussion

This study examined the relation between motor proficiency of 5–6 years old children and pedometer-determined physical activity. The results of the study showed that increased levels of children’s physical activity encourage and positively affect motor development. More particularly, the children who achieved higher scores in motor performance recorded more steps during the day.

The results of this study concerning the relation of BOT2 standard score and physical activity as derived from pedometers do not differ from other similar studies. The recent study of Kambas et al., (2012) showed that motor proficiency is positively associated with physical activity variables such as steps, aerobic steps and aerobic walking time. Children who achieved more steps and spent more time in continuous walking had higher motor proficiency scores. Also, Wrotniak, Epstein, Dorn, Jones and Kondilis (2006) have found that children’s motor proficiency (8-10 years old) was positively associated with activity counts. Additionally, children (3 and 4 years old) with better developed motor skills have spent more time in moderate to vigorous and vigorous physical active (Williams et al, 2008). Another study found a significant but weak cross-sectional relationship between objectively measured physical activity and fundamental motor skills in preschool children (Fisher, Reilly & Kelly, 2005).

The current study has shown that children who spend more time in physical activity tend to have higher fundamental motor skills. More particularly children who took more steps during the day are better motor developed. So children who belong to the “below average” group are significantly less physically active than those that belong to “average” and “above average” category (according to BOT evaluation). Positive associations between several fundamental motor skills and physical activity are also mentioned in studies that used self-report measures of physical activity (Hamstra-Wright, Swanik & Sitler, 2006; Okely, Booth & Patterson, 2001).

On the other hand, children's motor development is affected by some other factors besides of steps children. For example other findings (Raudsepp & Päll, 2006) suggest that in order to increase the development of fundamental motor skills, participation of children in skill specific oriented physical activities outside the school environment would be required. Additionally, positive relation was found between object control and physical activity of children, (Barnett, Van Beurben, Morgan, Brooks & Beard, 2008; Cliff, Okely, Smith & McKeen, 2009). The above findings, suggest that there is a variety of parameters which may affect significantly the motor development of children.

Conclusively, the results of the present study are in line with recent results and showed once again that increased physical activity levels at preschool age are contributing positively to children's motor development. Also preventive intervention -with professionally training plans- in primary schools contributes to motor skill development in childhood (Graf et al., 2005). Taking the above into account, scientists should create appropriate programs in kinder gardens, if they wish to increase children's daily physical activity and consequently encourage their motor development. Skill proficiency development in primary school years, significantly impacts on later physical activity.

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