UNIVERSA MEDICINA

September-December, 2012 *Vol.31 - No.3*

Gender impacts on motor skill proficiency-physical activity relationship in children

Diana Samara*, Nuryani Sidarta*, Dian Mediana*, and Noviyanti*

ABSTRACT

BACKGROUND
Physical activity is the greatest contributor to achievement of adequate physical activity. Children performing adequate daily physical activity will get positive benefits from their activity. Several studies indicate a difference in motor skills between boys and girls. To understand the development of motor skill proficiency and physical activity in boys and girls, a study was conducted to determine the role of gender on motor skill proficiency and physical activity in children aged 6-12 years.

METHODS
A cross-sectional observational study was conducted and a total of 162 children were included at a primary school in the Grogol area, West Jakarta. Data collection was by questionnaire-based interviews, covering age, gender, and physical activity (watching TV, playing games, and outdoor play). Assessment of motor skills was performed using the Bruininks-Oseretsky Test–Second Edition (BOT-2). Data analysis was performed using SPSS for Windows release 17.0 and level of significance was set at 0.05.

RESULTS
Multiple linear regression results showed that in boys the strength subset was the most influential factor on TV watching activity, with the higher scores for strength indicating a lower TV watching activity (â=-0.125;p=0.021). Age was the most influential factor on outdoor playing activity in girls, with older girls having lower outdoor playing activity (â=-0.375;p=0.016).

CONCLUSIONS
This study revealed that gender difference impacts on motor skills and physical activity in children. Higher motor proficiency increases outdoor playing activity only in boys. Primary school pupils should be given opportunities for performing outdoor playing activities to improve their motor proficiency.

Keywords: Motor proficiency, strength subset, outdoor play. boys, girls

*Department of Anatomy,
Facultas of Medicine,
Trisakti University

Correspondence
dr. Diana Samara, MKK
Department of Anatomy,
Facultas of Medicine,
Trisakti University
Jl. Kyai Tapa Grogol,
Jakarta Barat
Phone: +6221-5672731
ext: 2101
Email:
dianasamara2@gmail.com

Univ Med 2012;31:192-9

Gender berdampak terhadap hubungan antara kemampuan motorik dan aktivitas fisik pada anak-anak

ABSTRAK

LATAR BELAKANG

Aktivitas fisik merupakan penyumbang terbesar untuk mencapai kesehatan yang baik. Anak-anak yang melakukan aktivitas fisik setiap hari dengan baik akan mendapat manfaat yang positif. Beberapa penelitian menunjukkan adanya perbedaan ketrampilan motorik antara anak laki-laki dan perempuan. Untuk dapat memahami mengenai perkembangan kemampuan motorik dan aktivitas fisik pada anak laki-laki dan perempuan, maka perlu dilakukan penelitian yang bertujuan untuk menentukan peran gender terhadap hubungan antara kemampuan motorik dan aktivitas fisik pada anak-anak berusia 6-12 tahun.

METODE

Penelitian menggunakan studi observasional dengan desain potong lintang yang mengikutsertakan 162 murid Sekolah Dasar di daerah Grogol Jakarta Barat. Data dikumpulkan dengan cara wawancara menggunakan kuesioner yang meliputi usia, jenis kelamin, dan aktivitas fisik (berupa menonton TV, bermain game, dan bermain di luar rumah). Pengukuran kekuatan motorik dilakukan dengan menggunakan metode Bruininks-Oseretsky Test–Second Edition *(BOT-2). Analisis data dengan menggunakan SPSS for Windows versi 17.0 dan tingkat kemaknaan yang digunakan bersarnya 0,05.*

HASIL

Analisis regresi linear ganda menunjukkan pada anak laki-laki strength subset *merupakan faktor yang paling berperan terhadap kegiatan menonton televisi, semakin tinggi skor* strength subset, *semakin berkurang kegiatan menonton televisi (â=-0,125; p=0,021). Usia merupakan faktor yang paling berperan terhadap kegiatan main di luar pada anak perempuan, semakin bertambah usianya maka kegiatan main di luar akan semakin berkurang (â=-0,375; p=0,016).*

KESIMPULAN

Penelitian ini menunjukkan perbedaan jender berdampak terhadap hubungan antara kemampuan motorik dan aktivitas fisik pada anak-anak. Pada anak laki-laki kemampuan motorik yang tinggi meningkatkan aktifitas bermain di luar. Murid-murid sekolah dasar harus diberikan kesempatan bermain di luar untuk memperbaiki ketrampilan motoriknya.

***Kata kunci**: Kemampuan motorik,* strength subset, *bermain di luar, anak laki, anak perempuan*

INTRODUCTION

Physical activity is the greatest contributor to achievement of good health. According to the U.S.Surgeon General, children with moderate to vigorous daily physical activity will get positive benefits from their activity.[1] There are many children who perform less than the recommended amount of physical activity and their physical activity will worsen as they grow older.[2] There are many factors that play a role in physical activity of children, such as perception about physical activity, enjoyment of physical activity, parents, siblings, and friends. Another determinant of physical activity in children is their motor competence or mastery of basic movements used in physical activity.[3] Children with high motor competence perform physical activity with ease and prefer to do it in groups. In contrast, children with low motor competence prefer sedentary play, because they cannot perform the difficult movements.

Motor competence is the ability to execute different motor movements, including coordination of fine and gross movements (static and dynamic balance). Some children experience considerable difficulties coordinating and controlling their body movements and are often described as having developmental coordination disorder.[4,5] Motor proficiency in childhood appears to be an important factor in developing a positive self-perception of competence in the physical domain and seems to be connected to increased physical activity and fitness in adolescence.[6] Recent findings suggest that children with low motor competence demonstrate significantly poorer performance on important components of physical fitness, such as aerobic and anaerobic endurance and muscular strength, than their peers who are developing typically.[7,8]

Assessment of motor skills may be performed by one of the several standardized, comprehensive tests in existence. Most of these tests include multiple balance tasks and some even offer a specific balance subscale score, e.g. the Bruininks-Oseretsky test second edition (BOT-2) for 4 to 21years old,[9] the peabody developmental motor scales second edition (PDMS-2) for 0 to 5 years old,[10] and the movement assessment battery for children second edition (M-ABC-2) for 3 to 16 years old.[11] In the present study we used the BOT-2 instrument for assessment the motor skills.

Several previous studies have shown a significant positive relationship between motor skills, visual coordination, gross motor development, and physical activity in youth.[12,13] Children who perform physical activities also tend to perform these as adults. Thus physical activity in children is indirectly associated with their future health status.[14] Several studies showed a difference in motor skills between boys and girls.[15,16] To understand the development of motor ability and physical activity in both boys and girls, it is necessary to conduct a study with the objective of determining the role of gender in motor skills and physical activity among children aged 6-12 years.

METHODS

Study design

This was a cross-sectional observational study conducted from January to March 2012 at a primary school in the Grogol area, West Jakarta.

Study subjects

All first to sixth grade form primary school pupils aged between 6 and 12 years who agreed to be tested with permission of their parents, and who gave informed consent were included in this study.

Assessments

Data were collected by questionnaire-based interviews, covering age and gender. The Bruininks-Oseretsky test second edition (BOT-2)[9] was used to assess motor skills of the children. The BOT-2 is a standardized, norm-referenced measure of fine and gross motor skills for individuals from 4 through 21 years of age. The test consists of 8 subset to assess gross motor development, including running speed and agility, balance, bilateral coordination, and strength; gross and fine motor development, including upper limb coordination, fine motor precicion, fine motor integration, and manual dexterity. A total standard score, adjusted for child age, was used to interpret test performance.

In the present study. physical activity was measured by a questionnaire covering the following items: watching TV, playing games, and playing outdoors. If the answer was yes, the frequency of physical activity was asked (every day, every 2 days, every 3 days, every 4 days, every 5 days) expressed as the frequency of physical activity in one week.

Data analysis

The independent t-test was used to compare age, motor proficiency subsets and BOT scores, physical activity between boys and girls. Pearson product-moment correlations were computed to determine relationships between age, physical

activity, motor proficiency subsets, and BOT score in all subjects, boys and girls. Multiple linear regression analysis was then used to whether motor proficiency subsets and BOT scores accounted for a significant amount of child activity after controlling for age and gender. Data analysis was performed using SPSS for Windows release 17.0 and level of significance was set at 0.05.

Ethical clearance

This study received ethical approval from the Research Ethical Committee, Faculty of Medicine, Trisakti University. Parents of all participants gave written informed consent.

RESULTS

The study involved 162 subjects, comprising 69 (42.6%) boys and 93 (57.4%) girls. There was no significant difference in mean age of boys (8.4 ± 1.6 years) and girls (8.4 ± 1.7 years). Mean scores for fine motor precision and motor strength were significantly different between boys and girls. Mean fine motor precision score in girls of 18.6 ± 4.2 was significantly higher than the mean in boys of 16.7 ± 4.3. On the other hand, mean strength score in girls (11.5 ± 3.8) was significantly lower in comparison with that in boys (12.7 ± 3.6). The means of upper limb coordination scores, bilateral coordination scores and total BOT scores did not differ between boys and girls (Table 1).

In all subjects there was a negative correlation between gender and frequency of playing games (r=-0.19; p=0.016), with girls performing games less frequently than boys. Age and fine motor precision had a significant negative correlation with frequency of outdoor play, with r=-.017; p=0.034, and r=-0.16; p=0.036, respectively, as seen in Table 2. There was no significant relationship between age and motor proficiency subsets (fine motor precision, upper limb coordination, bilateral coordination and strength) on the one hand and frequency of game playing. Gender, upper limb coordination, bilateral coordination and strength had no significant relationship with frequency of outdoor play.

In boys the BOT score had a linear correlation with outdoor play, with higher BOT score indicating higher frequency of outdoor play (r=0.28; p=0.020). Strength subsets had a significant negative correlation with watching television (r=-0.37; p=0.002).

In girls, age had a significant negative correlation with outdoor play (r=-0.26; p=0.012), while the upper limb coordination subset had a linear correlation with outdoor play,

Table 1. Distribution of children's characteristics by gender

Variables	Gender		p value
	Boys (n=69)	Girls (n=93)	
Age (years)	8.4 ± 1.6	8.4 ± 1.7	0.998
Motor proficiency subsets			
Fine motor precision score	16.7 ± 4.3	18.6 ± 4.2	0.007**
Fine motor integration	14.5 ± 3.8	14.7 ± 4.2	0.794
Bilateral coordination score	20.5 ± 2.7	19.9 ± 2.9	0.159
Balance score	7.6 ± 0.8	7.7 ± 0.6	0.182
Running speed and agility score	7.6 ± 1.5	7.5 ± 1.2	0.628
Upper limb coordination score	14.3 ± 3.9	14.1 ± 4.6	0.722
Strength score	12.7 ± 3.6	11.5 ± 3.8	0.044*
BOT[§]	64.3 ± 8.3	64.0 ± 10.4	0.880
Frequency of watching TV per week	6.6 ± 1.3	6.4 ± 1.5	0.341
Frequency of games (days/week)	3.9 ± 2.6	2.9 ± 2.5	0.013*
Frequency of outdoor play (days/week)	2.5 ± 2.6	2.2 ± 2.4	0.686

[§] BOT: Bruininks-Oseretsky Test

Table 2. Correlation between age, gender, and motor proficiency subsets with playing games, outdoor play and watching TV

Variable	Playing games		Outdoor play		Watching TV	
	r	p value	r	p value	r	p value
All subjects						
Age	0.33	0.676	- 0.17	0.034*	0.11	0.158
Gender	- 0.19	0.016*	- 0.03	0.686	- 0.08	0.341
Motor proficiency subset						
Fine motor precision	- 0.06	0.492	- 0.16	0.036*	0.03	0.746
Upper limb coordination	0.04	0.646	0.12	0.144	- 0.05	0.516
Bilateral coordination	- 0.01	0.987	0.04	0.597	- 0.07	0.410
Strength	0.01	0.892	0.05	0.529	0.04	0.629
Balance score	-0.04	0.583	-0.13	0.162	-0.05	0.510
Running speed	-0.01	0.091	0.02	0.809	-0.10	0.215
Fine motor integration	-0.12	0.416	-0.02	0.767	-0.13	0.103
Boys						
Age	0.03	0.805	- 0.03	0.794	0.09	0.437
Motor proficiency subset						
Fine motor precision	0.12	0.921	- 0.19	0.110	- 0.07	0.591
Upper limb coordination	- 0.03	0.822	- 0.15	0.212	- 0.03	0.822
Bilateral coordination	- 0.16	0.184	- 0.07	0.515	0.05	0.700
Strength	- 0.17	0.157	0.12	0.330	- 0.37	0.002*
Balance score	0.09	0.420	0.11	0.544	- 0.14	0.254
Running speed	- 0.12	0.343	0.16	0.203	- 0.15	0.208
Fine motor integration	- 0.19	0.122	- 0.15	0.239	- 0.09	0.493
BOT[§]	- 0.18	0.126	0.28	0.020*	- 0.25	0.043*
Girls						
Age	-0.06	0.542	- 0.26	0.012*	0.12	0.241
Motor proficiency subset						
Fine motor precision	0.05	0.634	- 0.09	0.357	0.11	0.285
Upper limb coordination	0.03	0.975	0.22	0.035*	-0.03	0.830
Bilateral coordination	0.05	0.613	0.13	0.220	-0.15	0.160
Strength	0.04	0.686	-0.03	0.804	0.26	0.011*
Balance score	0.05	0.136	-0.14	0.169	0.04	0.722
Running speed	-0.10	0.337	-0.12	0.267	0.14	0.167
Fine motor integration	-0.09	0.404	-0.09	0.375	0.01	0.941
BOT[§]	-0.03	0.974	0.022	0.659	0.09	0.374

[§] BOT : Bruininks-Oseretsky Test

(r=0.22; p=0.035). The strength subset had a linear correlation with watching television (r=0.26; p=0.011). There was a very clear difference in the correlation of the strength subset with television watching activity. Boys with high strength score showed a lower frequency of watching TV, whereas girls showed a higher frequency of watching TV (Table 2).

Multiple linear regression showed that in boys the strength subset was the most influential factor on TV watching activity, with higher strength score indicating lower frequency of watching television (â=-0.125; p=0.021). Age was the most influential factor on outdoor play in girls, with higher age indicating lower frequency of outdoor play (â=-0.375; p=0.016) (Table 3).

DISCUSSION

The results of this study indicate that there was no difference in BOT scores between boys and girls. Our study results were similar to those of previous studies indicating no difference in

Table 3. Regression model predicting outdoor play and TV watching

Variables	Outdoor play			Watching TV		
	β	Beta	p value	β	Beta	p value
All cases						
Age	-0.240	-0.148	0.058	-	-	-
Fine motor precision	-0.084	-0.138	0.078	-	-	-
Boys						
Strength	-	-	-	-0.125	-0.358	0.021*
BOT§	-	-	-	-0.021	-0.014	0927
Girls						
Age	-0.375	-0.246	0.016*	-	-	-
Upper limb coordination*	0.110	0.200	0.048	-	-	-

§ BOT: Bruininks-Oseretsky Test of Motor Proficiency; β = regression coefficient; Beta = standardized coefficient

BOT scores between boys and girls.[3] Taken individually, fine motor precision scores and strength scores were significantly different between boys and girls. Boys had significantly higher strength scores in comparison with girls. In contrast, girls had higher scores on fine motor precision skills in comparison with boys. Previous studies have demonstrated gender differences in motor skills, with boys performing better than girls in motor tasks of strength.[17] These results are in agreement with the study by Krombholz, who showed significant differences in motor proficiency between boys and girls, with boys scoring better on strength and girls on fine motor precision.[18]

Gender differences in motor proficiency can be explained by environmental influences, biological factors, or their interaction. Before puberty, the physical characteristics of boys and girls are similar, and environmental influences are more likely to explain gender differences in motor proficiency. The type of sports and games that boys and girls are drawn to participate in give them more opportunity to practice and refine their motor skills and may contribute to gender differences. Despite the important role of the environment in motor skill development in childhood, some biological factors may also be present for certain skills, such as throwing. For example, compared with girls, boys have more mid arm muscle tissue and a greater shoulder/ hip ratio.[19] In our study we found that girls scored higher than boys on fine motor precision (filling in shapes-circle). The study conducted by Wrotniak yielded similar results, viz. that girls sorted a greater number of shape cards.[3] In boys there was a significant positive correlation of BOT scores with outdoor play. Children who play out of doors have better gross motor development, in comparison with children with a higher weekly television viewing frequency.[20] Outdoor play also offers children opportunities to explore their community; enjoy sensory experiences with dirt, water, and sand; find or create their own places for play; collect objects and develop hobbies; and increase their liking for physical activity. Such vigorous movements and play activities can not only enhance muscle growth, but also support the growth of the child's heart and lungs as well as all other vital organs essential for normal physical development.[21] Activities such as playing outside in rain, or muddy areas give children a sense of adventure. Self-esteem is also increased when parents and teachers act as a positive audience for the child's imaginative outdoor play activities. However, our study revealed that boys who watched television more frequently had lower strength subset scores. Today children spend more time in watching television than in outdoor play. A study in the USA involving 492 fifth- and sixth-graders at six elementary schools found that most of them performed indoor activities The results showed that 96% of these children watched television regularly; 81% played computer games; 74% participated in reading; 61% played

video games; and 60% played board games indoors.[21] Many mothers are concerned with the personal safety of their children and give them opportunities for indoor play, such as watching television and playing games, thus constituting factors that prevent their children from playing outdoors. Some children may actually prefer to sit and watch events on television, instead of playing outdoors and creatively thinking of ways to entertain themselves. Outdoor play positively impacts on development of children's physical and motor skills, and are a positive stimulus for cognitive skills.

The main limitation of our study is that physical activity was assessed on the basis of self-report and did not use more objective means of assessment, such as accelerometers. We were unable to assess the BOT-2 manual dexterity subset because of techical problems in the field. Another limitation of this study was that we used a cross-sectional design, and thus were unable to determine possible causal relationships between motor proficiency and physical activity.

CONCLUSIONS

This study revealed that gender difference impacts on motor skills and physical activity in children. Higher motor proficiency increases outdoor playing activity only in boys. Girls have higher fine precision scores than boys. Primary school pupils should be given opportunities for performing outdoor playing activities to improve their motor proficiency. Therefore further studies of prospective design are necessary to determine causality between motor proficiency and physical activity in children.

ACKNOWLEDGEMENTS

We thank the primary school pupils and their parents who agreed to participate in this study. Thanks are also due to the Dean and Vice-Deans of the Faculty of Medicine, Trisakti University for providing the funding of this study.

REFERENCES

1. U.S. Department of Health and Human Services. Physical activity guidelines for Americans. Washington DC;2008. Available at: http://www.health.gov/paguidelines/guidelines/summary.aspx. Accessed April 12, 2012.
2. Pate R, Freedson P, Sallis J, Taylor W, Sirad J, Trost SG, et al. Compliance with physical activity guidelines: prevalence in a population of children and youth. Ann Epidemiol 2002;12:303–8.
3. Wrotniak BH, Epstein LH, Dorn JM, Jones KE, Kondilis VA The relationship between motor proficiency and physical activity in children. Pediatrics 2006;118:e1758-65. DOI: 10.1542/peds.2006-0742.
4. Polatajko H, Cantin N. Developmental coordination disorder (dyspraxia): an overview of the state of the art. Semin Pediatr Neurol 2006; 12:250–8.
5. Summers J, Larkin D, Dewey D. Activities of daily living in children with developmental coordination disorder: dressing, personal hygiene, and eating skill. Hum Mov Sci 2008; 27:215–29.
6. Barnett LM, Morgan PJ, van Beurden E, Beard JR. Perceived sports competence mediates the relationship between childhood motor skill proficiency and adolescent physical activity and fitness: a longitudinal assessment. Int J Behav Nutr Phys Act 2008;5:40. DOI: 10.1186/1479-5868-5-40.
7. Scott N, Alof V, Hultsch D, Meemann D. Physical fitness in children with developmental coordination disorder. Res Q Exerc Sport 2007; 78:438–50.
8. Haga M. Physical fitness in children with movement difficulties. Physiotherapy 2008;94: 253–9.
9. Bruininks RH, Bruininks BD. Bruininks-Oseretsky test of motor proficiency manual.2nd ed. Minneapolis, MN: NCS Pearson Inc; 2005.
10. Folio MR, Fewell RR. Peabody developmental motor scales-2. Austin, TX:PRO-ED; 2000.
11. Henderson SE, Sugden DA, Barnett AL. Movement assessment battery for children: examiner's manual. 2nd ed. London, United Kingdom: Pearson Assessment Inc; 2007.
12. Graf C, Koch B, Kretschmann-Kandel E, Falkowski G, Christ H, Coburger S, et al. Correlation between BMI, leisure habits and motor abilities in childhood (CHILT-project). Int J Obes Relat Metab Disord 2004;28:22–6.
13. Taylor W, Sallis J, Dowda M, Freedson P, Eason K, Pate R. Activity patterns and correlates among

youth: differences by weight status. Pediatr Exerc Sci 2002;14:418–31.
14. Kristensen PL, Moller NC, Korsholm L, Wedderkopp N, Andersen LB, Froberg K. Tracking of objectively measured physical activity from childhood to adolescence: the European youth heart study. Scand J Med Sci Sports 2008;18:171–8.
15. Barnett LM, van Beurden E, Morgan PJ, Brooks LO, Beard JR. Gender differences in motor skill proficiency from childhood to adolescence: a longitudinal study. Res Q Exerc Sport 2010;81: 162-70.
16. Roberton ET, Langendorfer S. Does the throwing "gender gap"occur in Germany? Res Q Exerc Sport 2005;76:488-93.
17. Okely A, Booth M. Mastery of fundamental movement skills among children in New South Wales: prevalence and sociodemographic distribution. J Sci Med Sport 2004;7:358–72.
18. Krombholz H. Physical performance in relation to age, sex, birth order, social class, and sports activities of preschool children. Percept Mot Skills 2006;102:477-84.
19. Harrell J, Pearce P, Markland E, Wilson K, Bradley C, McMurray R. Assessing physical activity in adolescents: common activities of children in 6th-8th grades. J Am Acad Nurse Pract 2003;15:170–8.
20. Graft C, Koch B, Kretschmann-Kandel E, Falkowski G, Christ H, Coburger S, et al. Correlation between BMI, leisure habits and motor abilities in childhood. Int J Obes 2004; 28:22-6.
21. Clements R. An investigation of the status of outdoor play. Contemp Issues Early Child 2004; 5:68-80.