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MASTERY OF GROSS MOTOR SKILLS AMONG PRESCHOOL OBESE CHILDREN

NAFISEH KHALAJ[1, 2], SAIDON AMRI[1]

Abstract
Purpose. Gross motor skills are basis for almost all physical activities. Proper gross motor development among four to six years old children is critical and essential. The aim of this study was to investigate the gross motor skill development of obese children.
Method. Participants were obese (n=40) and normal-weight children (n=40) aged four to six years at kindergartens. Gross motor skills were assessed by using Test of Gross Motor Development second edition. The test was used to assess 12 gross motor skills including six object control and sixlocomotor skills.
Results. The one way ANOVA was used in this study. The results revealed that there was a significant difference at the p<.05 level in GMQ between obese and normal weight children [F (1, 78) = 544.776, p=.000].
Conclusion: Obese children aged four to six years old had poorer gross motor skill performance compare to their normal weight peers.
Key words: preschool children, childhood obesity, gross motor skill.

Introduction

In recent years, the prevalence of childhood obesity has significantly increased(Lob-Corzilius. 2007; Wang ,Lobstein. 2006).It is a growing problem because of its medical complications and psychosocial consequences; especially during childhood (Daniels. 2009; Giugliano ,Carneiro. 2004; Nader, 'Brien, Houts et al. 2006). In addition to medical and psychosocial problems, excess body weight in children is associated with poorer motor development and gross motor skills performance (Graf, Koch, Kretschmann-Kanddel et al. 2004). Mastery of gross motor skills among children is essential to have successful participation in sport, games, and leisure activities (Okely, Booth, Chey. 2004).

Motor development can be defined as development of human fundamental movement patterns and specialized skills and it encompasses human movement abilities and motions that take place through lifespan (Payne ,Isaacs. 2005).

Motor development is classified intotwo types including fine and gross motor development. Fine motor development can be defined as development of precise movements, that use the small muscles to control small movements of the hands, wrists, fingers, feet, toes, lips, and tongue (Payne & Isaacs , 2005; Malina, Bouchard, & Bar-Or, 2004; Gallahue&Ozmun, 1998). Gross motor development can be defined as development of movements that use the large muscles of the body (Gallahue ,Ozmun. 1998), which enables functions such as walking, kicking and throwing.

Early childhood is a critical period to children's development (Hardy, King, Farrell et al. 2010), and considered asa period of rapid changes in all areas of child development, such as gross motor skills. During this period, children's abilities develop noticeably and at the end of this period they can use these abilities to achieve their goals (Shala. 2009). Children acquire new gross motor skills most successfully during preschool and elementary school years (Agnes ,Daniel. 2009); and are able to master these skills with greater ease during this period than any other point in their life (Olrich. 2002).

Gross motor skills provide the infrastructure for learning more complex games, sports, and dance skills in later life (Branta, Haubenstricker, Seefeldt. 1984). The proficiency of gross motor skills is a prerequisite for children to experience success and enjoyment in organized and unorganized movement activities (Woodard ,Surburg. 2001).

In addition, this period is a developmental period during which the majority of children achieve the basic repertoire of locomotor and object control skills (Williams, Pfeiffer, Dowda, Jeter, Jones & Pate, 2009). By this age children acquire some degree of self-consciousness about their gross motor activities which leads to increased feeling of success when they master a new skill (Miller-Keane ,O'Toole. 2005). Failure to master these skills leads to difficulties for children to participate in physical activities and advanced movements, and to achieve adult physical activity levels recommended for health maintenance (Beurden, Zask, Barnett et al. 2002).

Proper development of gross motor skills is considered as an important factor in making sure that children are prepared with the competencies to incorporate and maintain regular physical activities during lifespan (Taggart ,Keegan. 1997).Few studies examined the gross motor development of preschool

[1]Department of Sport Studies, Faculty of Education, Universiti Putra Malaysia, Serdang, Selangor, MALAYSIA
[2] Department of Biomedical Engineering, Faculty of Engineering, University of Malaya 50603, Kuala Lumpur, MALAYSIA
Email: nafiseh8261@hotmail.com

obese children; however, they used different instrument to assess these skills. In addition, more studies are needed to confirm the previous findings. Thus, the purpose of this study was to investigate the gross motor skills performance in preschool obese children by using TGMD-2.

Method

The study was conducted in Qazvin, Iran. Eight kindergartens were randomly selected. Principals of all kindergartens agreed to participate in our study. Parents or guardian of the children were informed about the study, in the case they did not agree, their children were excluded from participation. Finally, a total of 80 children enrolled into this study.

The test of Gross motor development-second edition was used to evaluate gross motor development (Ulrich. 2000).TGMD-2 is a norm and criterion reference instrument which provides a reliable measurement of gross motor development. It evaluate 12 gross motor skills including six locomotor skills (i.e. run, gallop, hop, leap, horizontal jump and slide) and six object control skills (i.e. striking a stationary ball, stationary dribble, catch, kick, overhand throw, and underhand roll) for children aged between 3 and 10.92 (10 years and 11 months) years.

According to TGMD-2 manual, each skill has performance criteria to describe performance quality and mature pattern of the skills, and varied in number from three to five among different motor skills. If the child performed the criterion correctly, a score of one was recorded and if performed incorrectly zero was recorded (Ulrich. 2000). After assessment, the raw scores of each gross motor skill were obtained by summing the scores of the criterion of the two trials.

The raw score of two trials for each skill range from 6 to 10 points. The total raw scores for each of the locomotor and object control skills are obtained separately by summing the scores of the six skills of the two trials which would range from 0 to 48 points. Raw scores would be used to find the age equivalent for both locomotor and object control skills. Also, the two-subset raw scores would be used to find gross motor quotient (GMQ). Raw scores of locomotor and object control skills would be converted to standard scores; and the quantity resulted from summing standard scores could be converted to gross motor quotient (GMQ).

Data collection

The testing period was January and February 2010. All the measurements were conducted in the morning by the principal investigator. Weight and height were measured to calculate body mass index (BMI). All participants were weighed by using the same scale to avoid bias; and weight was measured to the nearest 0.5 kg.

The height of the participants was measured with stadiometer. The height and weight measurement was also carried out with bare foot. After measuring height and weight, BMI was calculated by dividing weight by height squared (kg/m2). The BMI was classified according to the BMI scale adapted by Cole et al in 2000.

Data collection was started by verbal description and showing the participants how to perform each gross motor skill.

The demonstrations were only provided once to avoid teaching. Each participant was asked to perform each skill twice.To avoid bias and injuries during assessment, in each centre participants were put in groups that had maximum 10 members.After 5-minute warm up exercises, the evaluation was started. Each participant was asked to perform each skill twice. The focus of observation was on the presence or absence of the behavioural component of the skill, which are in the TGMD-2 manual. If the child performed the skill incorrectly such as jogged instead of running or weakly throw the ball at the wall, they were asked to repeat the trial with increasing speed or force.

The performance of participants was recorded by a video camera for later analysis. During the object control skills performance, video camerawas fixed in a proper position and angle to record the whole movement. Throughout the locomotor skills, the camera position was changed when it was required to record the entire performance.

Statistical analysis

Data analysis included descriptive analysis and one-way ANOVA. Mean and standard deviation were calculated for all variables. One-way ANOVA was performed to determine the difference in GMQ between obese and normal weight children. All analysis was performed using SPSS (version 17.00). Results were considered significant at level of <0.05.

Results

Descriptive analysis was used to calculate mean and standard deviation for all the variables. Anthropometrics data for the entire participants is shown in table 1. The numbers of participants were 80 including 40 obese (50% female, 50% male) and 40 normal weight (50% female, 50% male). The age is presented in year, and the average age for all the participants is 4 years and 11 months, height is 1.09 meter, weight is 21.16 kg, and BMI is 17.53(kg/m^2).

Table 1. Anthropometric data

	Normal weight			Obese		
	Minimum	Maximum	Mean (SD)	Minimum	Maximum	Mean (SD)
Weight (Kg)	12	24	17.3 (0.4)	21	31.5	25 (0.4)
Height (m)	0.96	1.23	1.09 (0.01)	1.00	1.21	1.1 (0.01)
BMI (kg/m^2)	11.36	16.74	14.39 (0.21)	19.19	23.15	20.67 (0.18)
Age (year)	4.08	6	4.88 (0.07)	4.00	6.00	4.85 (0.09)

Table 2 presents raw scores of locomotor and object control skills, and GMQ data for all the participants. This table provides information on range (maximum and minimum), mean and standard deviation of the mentioned variables.

Table 2.Raw scores and GMQ data

	Normal weight			Obese		
	Minimum	Maximum	Mean (SD)	Minimum	Maximum	Mean (SD)
Raw score-locomotor	26	37	31.78 (0.383)	19	32	23.78 (0.57)
Raw score-object control	22	34	27.55 (0.464)	16	29	20.78 (0.519)
GMQ	97	106	23.78 (0.57)	79	91	85.53 (0.525)

One-way ANOVA was used to find the difference in gross motor quotient (GMQ) between obese children and their normal weight peers. The result of one-way ANOVA is presented in table 3. The result demonstrated that there is a significant difference in score of GMQ, between obese children and their normal weight peers, [F (1, 78) = 544.776, p=.000]

Table 3. Result of one-way ANOVA for GMQ

		Normal weight	Obese	F	p
GMQ	Mean (SD)	100.45(2.31)	85.53(3.32)	9.77	.002

The mean and standard deviation for age equivalent of object control and locomotor skills of all the participants were calculated according to their weight status (obese and normal weight). The age is presented in year. Figure 1 presents the chronological age and age equivalent for locomotor and objects control skills. Chronological ages of all the participants are presented in order to show the amount of difference that exists between age equivalent and chronological age.

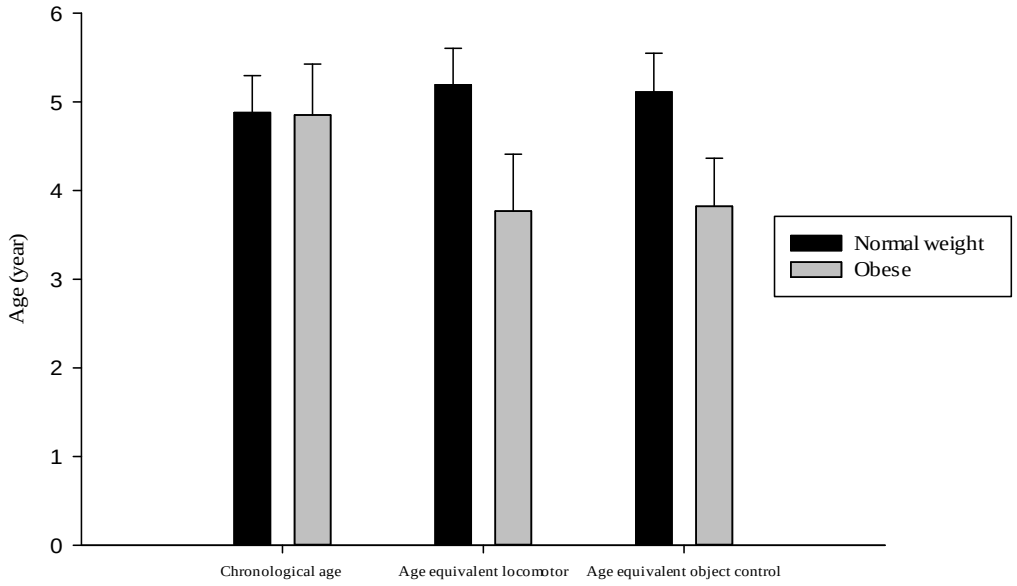

Figure 1.Chronological age and Age Equivalent of all the participants

Discussion

Early childhood is a critical period for development of gross motor skills. Preschool children are in nature curious, and love to play and explore the surrounding environment; thus, they learn motor skills very easily (Cools, Martelaer, Samaey et al. 2008). At this period, proper gross motor development is essential for children to move, stabilize their body, maintain balance and control objects while exploring their surrounding environment. Deficits in the gross motor skills reflect in low proficiency in more refined motor tasks which need the combination of these skills to obtain more highly structured skills (Catenassi, Marques, Bastos et al. 2007a). Therefore, proper gross motor development during childhood are important for the execution of many motor tasks (Doty, McEven, Parker et al. 1999).

This study investigated the gross motor skill proficiency of preschool obese children aged between four and six years. In this study, age equivalent and GMQ were used to assess the gross motor skill proficiency of participants. Findings of this study revealed that there is a significant difference in gross motor skill performance between obese and normal weight children; obese children had poorer gross motor skill compare to their normal weight peers.The results of GMQ (Table 2) which was used to describe overall gross motor skill performance indicated that normal weight children performed better in gross motor skills and achieved higher scores of GMQ(both locomotor and object control skills) compare to obese children.

Although few previous studies just considered gross motor skill performance of one gender, in this study gross motor skills of both genders were evaluated. However, differences in gross motor skills were not considered according togender, and overall performance of participants was evaluated.

In recent years, the assessment of children's gross motor skill performance has significantly increased, particularly the relationship between childhood obesity and gross motor development. Evidence that obese children have poorer gross motor skill performance compare to their normal weight peers were reported in few studies (Castetbon, Andreyeva. 2012;D'Hondt, Deforche, De Bourdeaudhuij et al. 2009; Mond, Stich, Hay et al. 2007).

Their findings indicated that there is a negative association between excessive weight and

gross motor development, which was in line with our finding and confirmed them. A recent study assessed motor skills among obese young children, and reported that motor skills are adversely associated with childhood obesity only for skills most directly related to body weight, such as jumping and hopping(Castetbon ,Andreyeva. 2012).In addition, our findings illustrated that both locomotor and object control skills of obese children were impaired(figure 1). In contrast to our findings, Catenassi and colleagues in 2007 reported that gross motor skill performance of children aged between four and six years were not related to BMI.

Over the last decade, sedentary behaviors have increased and the level of physical activity has decreased specially among obese children. Obese and overweight children present lack of physical activity and this is linked to insufficient motor experience and development of gross motor skills(Cliff, Okely, Morgan et al. 2011). Graf and colleagues (2004) reported that children who are more inactive have poorer gross motor development and endurance performance compare with more physically active children. This poor performance of gross motor skill in obese children could be the result of insufficient level of physical activity and sedentary lifestyle.

Level of physical activity might be the main reason underlying poorer gross motor skills performance by obese children. Interestingly, children with better-developed motor skills are more physically active than children with less-developed motor skills (H. Williams, Pfeiffer, O'Neill et al. 2008). Thus, future studies need to attempt to find the relationship between physical activity and development of gross motor skills among preschool obese children. Also,researchers should attempt to find new and appropriate exercise programs for obese children to improve their gross motor skills and prevent motor development delays.

Conclusion

Gross motor skills are the foundations of sports and physical activities. In fact, the focus on gross motor development has implications for the development of highly skilled sport people. Childhood obesity is one of the factors that negatively influence the development and performance of gross motor skills, thus it should be considered as a serious problem.

It is essential to identify strengths and weakness in gross motor performance as early as possible. The earlier the movement deficit is identified, and the longer an appropriate motor program is carried out, the better the result may be. Findings of this study clearly show that gross motor development of preschool children is related to obesity.Thus, obese children need plenty of opportunities to practice and refine their gross motor skills. Improving motor skills during childhood is a schedule to influence young people's present and future physical activity.

References

Agnes, W.Y.P., Daniel, T.P.F., 2009, Fundamental motor skill proficiency of Hong Kong children aged 6–9 years. Research in Sports Medicine, 17 125-144.

Beurden, E.V., et al., 2002. Fundamental movement skills- how do primary school children perform? the move it grove it program in rural Australia. science and medicine in sport, 5(3), 244-252.

Branta, C., Haubenstricker, J., Seefeldt, V., 1984, Age changes in motor skills during childhood and adolescence. Exercise and Sport Sciences Reviews, 12(4), 467-520.

Castetbon, K., Andreyeva, T., 2012, Obesity and motor skills among 4 to 6-year-old children in the united states: nationally-representative surveys. BMC pediatrics, 12(1), 28.

Catenassi, F.Z., et al., 2007a, Relationship between body mass index and gross motor skill in four to six Year-old children. Rev Bras Med Esporte, 13(4), 203-206.

Catenassi, F.Z., et al., 2007b, Relationship between body mass index and gross motor skill in four to six year-old children. Revista Brasileira de Medicina do Esporte, 13(4), 227-230.

Cliff, D.P., et al., 2011. Movement skills and physical activity in obese children: randomized controlled trial. Faculty of Education-Papers, 90-100.

Cole, T.J., et al., 2000, Establishing a standard definition for child OVERWEIGHT AND OBESITY WORLDWIDE: INTERNATIONAL SURVEY. BMJ, 320, 1-6.

Cools, W., et al., 2008, Movement skill assessment of typically developing preschool children: A review of seven movement skill assessment tools. Journal of Sports Science and Medicine 8, 154-168.

D'hondt, E., et al., 2009, Relationship between motor skill and body mass index in 5-to 10-year-old children. Adapted Physical Activity Quarterly, 26(1), 21-37.

Daniels, S., 2009, Review: complications of obesity in children and adolescents. International journal of obesity, 33, 60-65.

Doty, A., et al., 1999, Effects of testing context on ball skill performance in 5 year old children with and without developmental delay. Physical Therapy, 79, 818–826.

Gallahue, D.L., Ozmun, J. C., 1998, Motor Development Infants, Children, Adolescents, Adults (fourth ed.): McGraw-Hill.

Giugliano, R., Carneiro, E.C., 2004, Factors associated with obesity in school children. Jornal de Pediatria, 8, 17-22.

Graf, C., et al., 2004, Correlation between BMI, leisure habits and motor abilities in childhood. International Journal of Obesity, 28, 22-26.

Hardy, L.L., et al., 2010, Fundamental movement skills among Australian preschool children. Journal of Science and Medicine in Sport, 13(5), 503-508.

Lob-Corzilius, T., 2007. Overweight and obesity in childhood: A special challenge for public health. International journal of hygiene and environmental health, 210(5), 585-589.

Malina, R.M., Bouchard, C., Bar-Or, O., 2004, Growth, Maturation, and Physical Activity (2nd ed.).

Miller-Keane, O'toole, M., 2005. Miller-Keane Encyclopedia & Dictionary of Medicine, Nursing and Allied Health (7th ed.): Elsevier Science.

Mond, J., et al., 2007, Associations between obesity and developmental functioning in pre-school children: a population-based study. International Journal of Obesity, 31(7), 1068-1073.

Nader, P.R., et al., 2006. Identifying Risk for Obesity in Early Childhood. PEDIATRICS, 118(3), 594-601.

Okely, A.D., BOOTH, M.L., CHEY, T., 2004, Relationships between body composition and fundamental movement skills among children and adolescents. Research Quarterly for Exercise and Sport, 75, 238–248.

Olrich, T.W., 2002, Assessing fundamental motor skills in the elementary school setting: Issues and solutions. JOPERD--The Journal of Physical Education, Recreation & Dance, 73(7), 26-30.

Payne, V.G., Isaacs, L.D., 2005. Human Motor Development (6th ed.): William Glass

Shala, M., 2009. Assessing gross motor skills of Kosovar preschool children. Early Child Development and Care 179(7), 969-976.

Taggart, A., Keegan, L., 1997, Developing fundamental movement skills in outdoor settings: Three case studies of children playing. The ACHPER Healthy Lifestyles Journal, 44(4), 11-17.

Ulrich, D.A., 2000. Test of Gross Motor Development second edition. Austin,TX: 21. PRO-ED.

Wang, Y., Lobstein, T., 2006, Worldwide trends in childhood overweight and obesity. International Journal of Pediatric Obesity, 1(1), 11-25.

Williams, H., et al., 200,. Motor skill performance and physical activity in preschool children. Obesity journal, 16(6), 1421-1426.

Williams, H.G., et al., 2009, A field-based testing protocol for assessing gross motor skills in preschool children: The children's activity and movement in preschool study motor skills protocol. Measurement in Physical Education and Exercise Science, 13, 151-165.

Woodard, R.L., Surburg, P.R., 2001, The performance of fundamental movement skills by elementary school children with learning disabilities. Physical Educator, 58(4), 198-205.