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Effect of Body Mass Index on Gross Motor Development in Normal Children

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ABSTRACT

Background: The motor developmental sequence may be delayed as a consequence to childhood obesity. **Purpose:** The purpose of the study was to investigate the effect of different BMI in Peabody Developmental Motor Scales-Second Edition (PDMS-2). **Methods:** 75 children with mean age 15 ± 2.1 months assigned in 3 groups. Group A: normal weight <85th percentile for weight. The overweight. Group B: overweight ≥ 90th percentile for weight. Group C: Obese ≥95th percentile for weight.The Peabody developmental screening scale (PDMS-2) was used to assess infant development. A pediatric electronic body fat analyzer (Inbody 230), was used to weigh the infants and calculate the BMI. **Results:** Statistical analysis revealed that there was significant increase in Peabody developmental screening scale in favor to group A in compared to group B and C. while there was no significant difference between group B and group C. **Conclusion:** Overweight and obese children are more likely than their normal-weight peers to have motor developmental delays. Preventing obesity during infancy may facilitate reducing developmental delays in young children.

Key words: Child obesity, Motor development, Body Mass Index

Introduction

The American Medical Association categorized obesity as a disease. It may have an undesirable effect on health due to excess body fat accumulation to the extent (AMA, 2013). Daily physical activity minimum 60 minutes are recommended for children, but inappropriately, these suggestions are not being met (Hills *et al*., 2011).

Alterations in motor skills and motor planning can prevent efforts to improve physical activity for children with overweight and obese. There is verification that obesity has a negative influence on the cognitive processing required to effectively plan movements. Children with obese and adolescents accomplish worse on tasks of global executive functioning, visuospatial organization, and tasks of executive function involving planning and mental flexibility (Boeka and Lokken, 2008). A variety of activities has been revealed to increase executive functioning required for motor planning (Diamond and Lee, 2011). Furthermore to motor skills, motor planning are influenced by obesity, specifically skills correlated to walking (Smith *et al.,* 2011).

Children with overweight and obese involve in restricted physical activity thus increasing probabilities for poor motor planning. Deficiencies in these parts of cognitive processing deteriorate the capability of plan movements causing poor motor planning and reduced motor performance on tasks. For instance, children with overweight and obese have higher rates of falls related to children with normal-weight (Bazelmans *et al*., 2004). Though research recommended that there is an association between motor planning troubles and obesity, scarce studies evaluated how motor planning influences children's motor performance and motor skills. In contrast to their normal-weight complements, children with overweight and obese walk more slowly, spend less time supporting their weight with one leg, take shorter steps, keep both feet on the ground for longer periods of time, and walk with their feet farther apart (Deforche *et al*., 2009).

The researchers established that there are larger joint powers in weight acceptance of the gait in the knee and hip joints mechanics (Shultz *et al*., 2010), greater peak plantar pressures under the feet during gait (Yan *et al*., 2013), and a smaller amount of knee flexion at the heal strike (McMillan *et al*.,

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2010). Additional weight also creates it obscure to accelerate the center of gravity during gait owing to the amount of mechanical work needed and the metabolic cost (Peyrot *et al*., 20100). Consequently, the purposes of this study were to compare the motor development in overweight/obese children versus normal weight peers. As well as to investigate the association of anthropometric variables (BMI, and body weight) with motor development in this age interval.

Methods

Study Design

The study was designed as a cross-sectional design. Ethical approval was obtained from the institutional review board at Faculty of physical therapy, Cairo University before study commencement. The study was followed the Guidelines of Declaration of Helsinki on the conduct of human research. The study was conducted between June 2015 and August 2016.

Participants

A convenient sample of seventy-five infants (37 girls and 38 boys) were participated in this study. They were enrolled and assessed for their eligibility to participate in the study. To be included in the study, their ages ranged from 14 to 16 months (15 ± 2.1) months. They were classified into three groups. Each group contains 25 infants with equal size sample for all groups. The normal-weight peers group **(A)** included infants with BMI <85th percentile for weight. The overweight group **(B)** included infants with BMI ≥ 90th percentile for weight. The obese group **(C)** included infants with BMI ≥95th percentile for weight. These children's were classified on the basis of the World Health Organization (WHO, 2006) Child Growth Standards from 0 to 5 years, according to the BMI-for-age cut-off points relative to age **(**World Health Organization Reference Study Group, 2006**).** A pediatric electronic body fat analyzer (Inbody 230), was used to weigh the infants and calculate the BMI. The children were excluded if they had; preterm and low birth weight infants; pregnancy and delivery complications, motor deficit, signs of malnutrition or illness that interfere with growth and development, and some infectious process (fever, influenza, diarrhea, ear infections, etc.) in the past 15 days. Informed consent was obtained from each parents after explaining the nature, purpose, and benefits of the study, informing them of their right to refuse or withdraw at any time, and about the confidentiality of any obtained information. No children dropped out of the study after classification groups.

Outcome Measures

The primary outcome measure was the Peabody developmental screening scale (PDMS-2) that assess infant development. The Peabody Developmental Motor Scales-Second Edition (PDMS-2) is composed of six subtests that measure interrelated abilities in early motor development. The scale has five subtests: Reflexes, Stationary, Locomotion, object manipulation, grasping and visual motor integration. In this study, the locomotion subtest of the gross motor skills was measured and assessed by direct observation and interaction with the child. Scaled scores were derived from the subtest total raw scores and the composite scores were derived from sums of the subtest scaled scores. The total administration time lasted between 50 and 90 min, depending on infant abilities. Two researchers were trained for the application of tests, and inter-rater reliability was established (ICC = 0.98 − 0.99).

Statistical analysis

Data was analyzed using the Statistical Package for Social Sciences version 20 (SPSS Inc., Chicago,IL, USA). Prior to final analysis, the data was screened for normality assumption and presence of extreme scores. This exploration was done as a pre-requisite for parametric calculation of the analysis of difference and analysis of relationship measures. Descriptive analysis using histograms with the normal distribution curve showed that the data was normally distributed and does not violate the parametric assumption for the measured dependent variable. Normality test of data using Shapiro-

Wilk test was used, which reflected that the data was normally distributed for the dependent variable (p>0.05). All these findings allowed the researchers to conduct parametric analysis. So, One way analysis of variance (ANOVA) test was used for analysis of the Peabody developmental screening scale. If the One way ANOVA test showed significant results, Tukey's test was used to determine the difference among groups. The level of significance was set at 0.05 for all statistical results.

Results

As indicated by the One Way Analysis of Variance (ANOVA), there were no significant differences (p>0.05) in the mean values of ag among the three tested groups (Table1).

Table 1: Descriptive statistics and One Way Analysis of Variance (ANOVA) for the mean age for the three tested groups.

Variables	Group (A)	Group (B)	Group (C)	P-value
Age (months)	15±2.1	15±2.1	15±2.1	0.562

As indicated by the one-way ANOVA, there was a statistically significant difference in PDMS among the three groups (p<0.05). A Tukey multiple comparison tests (Post hoc tests) revealed that there was a statistically significant increase in the PDMS in the group A compared with the group B and group C (p<0.05). While, there was no statistically significant difference in the group B compared with the group C (p>0.05) (table 2).

Table 2: Descriptive statistics (mean±SD) and One-way ANOVA for the PDMS among the three groups

Descriptive statistics for the PDMS			
	Group A	**Group B**	**Group C**
PDMS	18.51±1.3	8.67±4.05	5.97±2.56
One way ANOVA for the PDMS			
F-value		**P-value**	
26.375		0.0001*	
Tukey multiple comparison tests (Post hoc tests) for the PDMS			
Group A	**vs.**	**Group B**	*0.001
Group A	**vs.**	**Group C**	*0.0001
Group B	**vs.**	**Group C**	0.383

Significant at alpha level <0.05

Discussion

The motor developmental sequence may be delayed as a consequence to childhood obesity. So, the purpose of the study was to investigate the effect of different BMI in Peabody Developmental Motor Scales-Second Edition (PDMS-2). This study showed that there was significant increase in Peabody developmental screening scale in favor to group A in compared to group B and C. while there was no significant difference between group B and group C. This reflected that the body mass index in childhood affected on the gross motor development. In line with the aforementioned studies, Castetbon and Andreyeva, (2012**)** revealed that gross motor development was lower in the BMI group. Schmidt Morgen *et al*. (2014) proposed that body weight and motor milestones are largely independent of one another.

As well as Castetbon and Andreyeva, (2012) confirmed that the link between gross motor skills and BMI diverse with the type of skills, with some differences perceived across sex and age intervals. They detected that only gross motor skills with relatively high energy expenditure (hopping and jumping distance) were inversely related with obesity, nevertheless most motor skills were not reduced in overweight children of 4-5 and 5–6 years of age. In the present study, the gross motor skills assessed by the PDMS2 test. This study doesn't determine whether a specific ability was diminished by overweight when the ages come to be dissimilar.

Overweight/obese children had low gross motor performance owing to biomechanical problems and morphological restraints on tasks concerning variations in the center of mass (Chivers *et al*., 2013). Gentier *et al*., (2013) revealed that overweight children were sluggish than normal-weight peers in executive functions and decision-making to design and control movement. They recommended that infant obesity is similarly linked with both diminished fine motor development and perceptual-motor function.

The previous studies assessed older children than children contributed in the current study, making it difficult to compare the results. Slining *et al*. (2010) estimated motor development, in a comparable age range using the BSID-II development scale, which resembles to the 2nd version of the Bayley test. In this study confounding variables were controlled (gender, age, mother's age, weight and educational level). They found that there was a link between BMI and motor development in infants with a low socioeconomic status.

As that inconsistency is a unusual characteristic of motor development, that be able to be influenced by numerous issues as socioeconomic status (Grantham-McGregor *et al*., 2007) and age (Chivers *et al.,* 2013), furthermost of the sample established medium socioeconomic status in the current study that diminished the effect of this issue on motor development. This study is one of the studies that deals with the effect of BMI on gross motor development in this age. So, regardless some limitations in this study, this was the first study that was rigorous controlled to minimize bias.

Conclusion

Overweight and obese children are more likely than their normal-weight peers to have motor developmental delays. Preventing obesity during infancy may facilitate reducing developmental delays in young children.

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