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## **Association between socioeconomic status and motor development in early childhood**

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**Abstract**---Background: Motor development in early childhood undergoes great maturation and refinements due to the huge contact and interaction with the environment. Socioeconomic status (SES) as an environmental factor can affect motor development in this age period. The aim of this study was to assess the relation between SES and motor development. Study Design: This study was an observational cross-sectional study and it conducted in nurseries and elementary schools at Cairo governorate, Egypt. Subjects & methods: Two hundreds and seventy six normal children from both sexes aged 4-7 years old participated in this study. Motor development was assessed by the short form of Bruininks-Oseretsky Test 2 of Motor Proficiency (BOT-2 SF). The SES scale was used to measure SES of children's families. IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows was used for all statistical analyses. Results: The results of this study revealed non-significant association of SES and motor development ( $r = 0.106$ ,  $p = 0.078$ ).

**Keywords**---motor development, socioeconomic status, SES scale.

### **Introduction**

Motor development includes the changes in motor behavior from fetal life till adulthood and these changes are related to age (Hopkins et al., 2017). Moreover, motor development is a continuous process which passes through hall marks

which called motor milestones (Haywood et al., 2012). Major factors that can influence motor development are biological and environmental factors however the environmental factors had the greater effect (Pereira et al., 2016). Socioeconomic status (SES) is one of the common environmental risks that can affect child motor development in early childhood (Venetsanou & Kambas, 2009). Although several studies reported the positive relation between SES and motor development, other studies reported no relation. Otherwise few studies reported negative relation. This study aimed to assess the relationship between SES and motor development in early childhood.

## **Materials and Methods**

### **Ethical Considerations**

The study was approved by the Ethics Committee of Faculty of Physical Therapy, Cairo University (No: P.T.REC/012/001703). This work was carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

### **Trial Design**

This study is observational cross-sectional. It was conducted at selected nurseries and elementary schools at Cairo governorate, Egypt. Assuming that the effect size of SES on motor development in early childhood was 0.19, the estimated minimum required sample size was 245 participants. The sample size was calculated through G. Power software version 3.1.9.4.

### **Participants**

The study was conducted in the period since October, 2020 to October 2021. This study was conducted on 276 normal children from both sexes aged 4-7 years old. Inclusion criteria: the participated children were free of any sensory or motor problems, and they were from various SES levels. Exclusion criteria: the excluded children had visual or auditory deficit, convulsions or epilepsy, Teratogenic defects, musculoskeletal or neuromuscular surgery, mental deficits, nerve, muscle or chronic diseases. The short form of Bruininks-Oseretsky test-2 for Motor Proficiency (BOT-2 SF) was used to measure motor development of all participated children (Bruininks & Bruininks, 2005), while SES was measured by SES scale of Fahmy et al., (2015).

The BOT-2 SF had 14 items representing the 8 subtests of the total composite scale. Seven items of the 14 were available in 2 trials, and the higher trial score was chosen during calculation of the total score. Each child actively did the 14 items and after the completion of testing, raw scores are transformed into point scores, then the point scores were summed to get the total point score in test sheet. The total point score of each child was converted to standard score; in order to get uniformity of scores, eliminate the effect of age and to allow proper comparison between scores as well. The 14 items of BOT-2 SF are; drawing lines through paths – crooked, folding paper, copying square , copying star , transferring pennies , jumping in place - same sides synchronized , tapping feet

and fingers – same sides synchronized , walking forward on a line, standing on one leg on a balance beam – eyes open, one-legged stationary hop , dropping and catching a ball – both hands, dribbling a ball – alternating hands, knee push-ups, and sit-ups.

The SES scale had 10 items with total score equals 48. The score was then converted to low, medium or high SES according to the score scale. The score was then converted to low, medium or high SES according to the score scale. Direct interviews with parents were done to fill in the scale.

### Statistical Analysis

Data were statistically described in terms of mean  $\pm$  standard deviation ( $\pm$  SD), median and range, or frequencies (number of cases) and percentages when appropriate. Numerical data were tested for the normal assumption using Kolmogorov Smirnov test. The comparison versus other groups was done using Kruskal Wallis test. Chi-square values were determined to measure the association of categorical variable (SES levels). Correlation between various variables was done using Spearman rank correlation equation. Two-sided p values less than 0.05 was considered statistically significant. IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows was used for all statistical analyses.

### Results

#### General Characteristics of subjects

The sex distribution as well as mean  $\pm$ SD of age of the study participants demonstrated in table no. 1.

Participants' demographic data	Sex		Age (years)
	No.	%	$\bar{X} \pm SD$
Boys	156	56.5	5.26 $\pm$ 1.12
Girls	120	43.5	
$\bar{X}$ : Mean	No. : Number		
SD : Standard Deviation	% : Percentage		

#### Motor development scores of various SES levels

The mean  $\pm$  SD values of motor development scores of study participants according to their SES level demonstrated in table no. 2. The statistical analysis by chi square-test revealed a significant differences in motor development scores (P= 0.001) of study participants from different SES levels as shown in table no. 2 and Figure no. 1.

### Association between motor development and SES levels

The association between motor development and SES of the study participants was non-significant ( $r = 0.106$ ,  $p = 0.078$ ) as shown in table no. 3 and Figure no. 2.

Table 2  
Motor development scores of various SES levels, and chi-square values

SES	No.	Mean $\pm$ SD	Median	Min	Max	Chi Square	P Value
Low	7	54.7 $\pm$ 15.5	52.0	35	76	13.01	0.001
Medium	216	41.7 $\pm$ 7.8	40.0	24	64		
High	53	45.3 $\pm$ 9.2	45.0	21	67		

SES: socioeconomic status  
No.: number of children  
SD: standard deviation

Min: minimum value  
Max: maximum value  
P value: Probability value

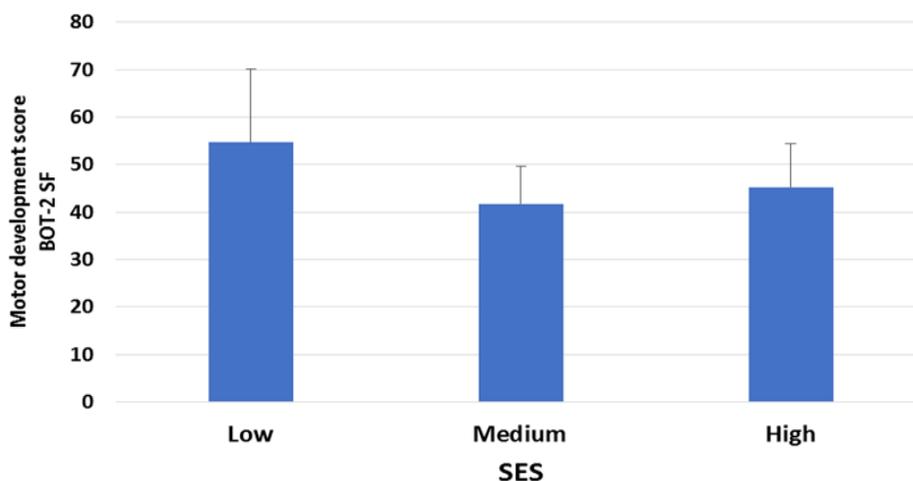


Figure no. 1. Motor development scores of various SES levels

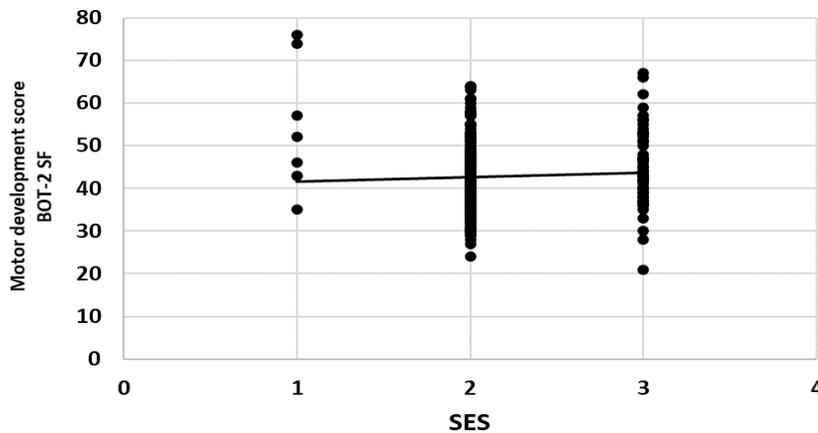
Table no. 3  
Association between motor development and SES levels

SES	Motor development				
	No.	R	p value	Sig.	Relation
	276	0.106	0.078	NS	Proportionate

SES: socioeconomic status  
No.: number of children  
p value: Probability value

R: Spearman correlation coefficient  
Sig.: Significance  
NS: statistically insignificant

Figure no. 2  
Association between motor development and SES levels



## Discussion

Early childhood is a very important period in development and refinement of motor skills due to more exposure to environmental stimuli like school, sport and other activities (Honrubia-montesinos et al., 2021). Many authors reported an increase of numbers of motor delays in early childhood period (Roth et al., 2010; Kwon & O'Neill, 2020). Results of this study showed non-significant relation between SES and motor development in early childhood. These findings came in agreement with Lee et al., (2012) who reported non-significant association between SES and motor development in infancy and early childhood.

In 2011, Puciato et al., found mixed results in their study. They reported non-significant association between SES and motor development in middle childhood (8-12 years old). However, they found in the same study significant positive relation between SES and motor development in late childhood (13-16 years old). Their results supported that the effect of SES on motor development differs according to age. They reported that SES affects only motor development in late childhood and adolescence. So, age of children may be a mediating factor between SES and motor development. By other words, SES may affect child's motor development only at middle and late childhood.

Some authors also stated the cross cultural differences as an explanation of different association results between SES and motor development. Kwon and O'Neill, (2020) and Africa et al., (2021) explained the effect of the culture of country or region as a mediating factor between SES and motor development. This means that the socio-cultural environment of high social classes in some countries support high physical activity and balanced diet for their children which lead to more advancement in motor development. On the other hand, other countries; mainly developed countries, the culture or traditions of high social classes support more sedentary behaviors.

However there were many studies <sup>(8)</sup> <sup>(11)</sup> which reported negative or inverse association between SES and motor development. Africa et al., (2021) found inverse relation between SES and gross motor development in locomotor subtests, as well as non-significant relation between SES and object control subtest of gross motor skills. They only assessed gross motor development for grade one school students.

So, our findings partly came in agreement with findings of Africa et al., (2021). Their sample included only school age children; those in grade one. And they explained their results mainly according to the socio-cultural environment differences of the South African society. Kwon and O'Neill, (2020) also reported significant inverse association between SES and gross motor development in preschool United States (US) children. They found children with low SES have significant higher gross motor scores than those with higher SES. Their sample was national representative sample of US preschool children. They also explained these results through sedentary behavior of high social classes in US.

So, increased comfortable circumstances as well as decreased opportunities for motor activities may be a characteristic of high SES. Africa et al., (2021) reported increased body weight and percentage of body fat in preschool children from high SES than those with lower SES. This may be due to sedentary life style at which decreased level of physical activity and increased availability of food. Also, Kwon and O'Neill, (2020) stated that there was an association between increasing prosperity and missed opportunities for motor activities in preschool children. Nevertheless, positive association between SES and motor development is still the secular trend of results in this field.

Chowdhury et al., (2010) reported significant positive association between SES and motor development in early and middle childhood. They also assessed the effect of nutritional status on motor development and concluded positive association too. They assumed that higher SES may improve nutritional status which in turn associated with improved scores of motor development. In high SES families, there is high income and good awareness of child care and upbringing which lead to provide healthy nutrition for their children.

However, there're some studies reported non-significant association between nutritional status and motor development in children like Ocansey et al., (2019) and Bliznashka et al., (2021). So, we may not state the nutritional status as mediator between SES and motor development. They also recruited children from wide age range; 5-12 years old, this study included different age periods; early and middle childhood. Each age period has specific characteristics differ from other periods, so separation of results may show some differences or draw other explanations, especially when considering the findings of Puciato et al., (2011), who suggested different impacts of SES with different ages.

Furthermore, Gottschling-Lang et al., (2013), also reported significant positive correlation between SES and fine motor development, while the gross motor development scores were insignificantly correlated with SES in preschool children. The results of gross motor development came in agreement with the current study .In the study of Gottschling-Lang et al., (2013) the Dortmund

Developmental Screening scale for Preschools (Dortmunder Entwicklungs Screening fur den Kindergarten 3–6) was used to detect developmental delay. However it's a screening tool rather than a test for motor development. They also didn't provide clear explanation of their SES results.

Moreover, Morley et al., (2015) reported significant positive association between SES and motor development in United Kingdom (UK) early childhood children. They supposed that more stimulation at home is provided for high SES children. This includes interactive and learning toys as well as cognitive stimulation through effective parent-child interaction. Nevertheless, Puciato et al., (2011) reported the importance of physical activity for motor development rather than living condition.

As a further matter, Ferreira et al., (2018) found a positive association between SES and motor development in early and middle childhood. They also reported that this association was directly mediated by age; this means that SES is highly associated with motor development in older children and vice versa. They suggested the availability of toys in the home and participation in physical experiences in school as explanations for their findings.

From all previous findings, high SES families may restrict the physical activity and sports of their children only to school or kinder gardens, including extracurricular activities, private sports' clubs or private physical education lessons. Sport activities; either private lessons or private sports 'clubs, are usually present at summer vacation. This could cause more restricted opportunities for physical or motor activity for high SES children. On the other hand, low SES families and some medium SES families provide more opportunities for their children to engage in unstructured physical activities like active transportation to and from school or outdoor activities with their neighbors or peers in public areas or young's activity centers. The previous premises came in agreement with Puciato et al., (2011), Tomaz et al., (2020) and Gosselin et al., (2021).

According to our findings, it seems to be a balance between the high level of spontaneous regular physical activity of children from lower social classes and the sport or physical education activities of children from higher classes .Development of motor abilities in early childhood may be more related to the amount of physical activity of children than their living conditions. This explanation coincides with Puciato et al., (2011).

## **Conclusion**

The non-significant association between SES and motor development didn't coincide with the secular trend of positive correlation results in previous studies. Future research is needed to assess further predicted mediating or moderating factors between SES and motor development. Also further explanation is needed for the different results across populations.

### Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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