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FAMILY AND CHILD CORRELATES OF MOTOR DEVELOPMENT OF TODDLERS IN INDIA

Balasubramanian Sundaram¹, Y. S. Siddegowda²

¹Department of Health Rehabilitation Sciences, College of Applied Medical Sciences for Boys, Shaqra, Shaqra University, Kingdom of Saudi Arabia

²Department of Studies in Social Work, Manasagangotri, University of Mysore, Mysore, Karnataka, India

E-mail of Corresponding Author: sbala_2001@rediffmail.com

ABSTRACT

Purpose: To analyze the family- related and child- related factors that are related to the motor development of toddlers and to determine the most significant factors among them.

Methods: Fifty urban and fifty rural families with children aged one to three years old were recruited through multi-stage cluster random sampling from Bangalore urban and Bangalore rural districts respectively. Suitable and valid measurement tools were used to assess the family-related and child-related factors. The gross motor and fine motor development of toddlers were measured by using Psychosocial Development Screening Test. A multiple logistic regression analysis was done to identify the factors influencing the motor development of toddlers.

Results and Interpretation: The toddlers brought up in a non – stimulating home environment had 4.25 times and 4.75 times delayed gross motor and fine motor development respectively, than those brought up in a stimulating home environment. The toddlers brought up by authoritative parents had 0.54 times normal gross motor development compared to those brought up by authoritarian and permissive parents.

Conclusion: A stimulating home environment and authoritative parenting style are significant correlates of gross motor development of toddlers, whereas only the stimulating home environment is significantly correlated with fine motor development of toddlers in India.

Keywords: Gross Motor Development, Fine Motor Development, Home Environment

INTRODUCTION

During toddlerhood, though remarkable advances occur in language and cognitive development the progress is obvious in all the developmental domains including motor development.¹ Motor development refers to changes in motor behavior that are related to age and assists the children to control their body movements. It emerges from infants' initial impulsive waving and kicking movements to the adaptive control of reaching, locomotion, and complex sport skills.² The term 'motor behavior' describes all movements of the body and can be classified into gross motor and fine motor behavior. When performing gross

motor skills such as standing, walking, jumping, running, jogging, and throwing a ball children use large muscles of their legs and arms or the entire body, whereas during fine motor behaviors such as the eye movements to follow objects and movements of fingers to grasp and manipulate objects, the small muscles of eyes and fingers are involved respectively.³

Unlike newborns, toddlers' bodies have a more cylindrical shape, and they have a larger ratio of muscle mass to body fat, predominantly in the legs. These changes in weight, size, percentage of body fat, and muscle strength endow with

perceptual/motor challenges to toddlers as they practice a variety of motor actions.⁴

During the toddler years, the gross motor skills develop rapidly. By 18 months, most children walk without assistance and soon, they learn to walk faster with a few falls. Around 2 years old, they walk steadily with an adult-like heel-toe progression. By 36 months, they will develop their balance and can stand on one foot momentarily. Toddlers delight in their new-found skills and often can be seen experimenting with them. As any person who has cared for a toddler can attest, they climb, they jump, and they run. Supervision is essential for preventing injury because toddlers sometimes test their skills beyond their abilities in an attempt to learn and do more.¹

Increasing fine motor abilities during toddlerhood result from refinements in reaching, grasping, and manipulating small objects. The average 18-month-old can make a tower of four blocks. Just one year later, with practice and improved control, he or she can stack eight blocks. Most 18-month olds have developed an interest in crayons and, if given the opportunity, will hold the crayon in a fist and scribble spontaneously on paper (or anywhere else). After one and half years, toddler will develop the control and sophistication to pick up a crayon by placing the thumb at the left and fingers at the right of the shaft and make a circle; by age three, the child even may begin to draw a primitive stick figure.¹

Family is the first environment with which children interact from birth and is significantly important in providing children with stimulation, support, and nurturance.⁵ The toddlers select an optimal movement required for a new motor ability after exploring a variety of movement options and this process needs an interaction between multiple elements of toddler, and the environment, and the task.⁶ Thus the physical condition of the home and provision of toys encourage the toddlers to practice a variety of

sensory experiences and to be able to develop gross and fine motor skills.⁷

Parenting styles are the collection of parents' behaviors which create an atmosphere of parent-child interactions across situations.⁸ Baumrind outlined three typologies of parenting styles known as authoritative, authoritarian, and permissive parenting. Authoritative parenting offers a balance between high nurturance and high control, allowing the child room to exercise autonomy. Authoritarian parenting restricts autonomy through high coercive control and low nurturance and support. Permissive parenting is high in nurturance and support while being low in control, allowing an excess of autonomy without engendering responsibility.^{9,10} Each style has a different influence to each child development areas. The socioeconomic status (SES) of the family and family relationship also influence the children's development, for those with high economical status and good family relationship had better development than those in low economic status and poor family relationship.^{6,11}

A greater part of the Indian population lives in villages.¹² The toddlers get fewer opportunities to develop their full prospective as their mothers lack knowledge regarding scientific child care, stimulatory activities and conducive environment which are essential for hale and hearty development.¹³ The parents' educational levels have an important impact on children's achievement,¹⁴ and higher levels of adult education have a positive bearing on both the educational future and the income level of the children in a family.¹⁵

Being early in the birth order may be rewarding for child development, because a child that is early in the birth order lives in a smaller family for a longer time and hence may get a larger share of the family resources when young than its younger siblings. The dilution may not be limited to quantity of resources but may also occur for the quality of the investments received by a child.¹⁶⁻¹⁹

Even though all the above factors are related to the motor development of toddlers, the decisive factors among them are yet to be identified. Therefore, this study was conducted to determine the most significant factors among the family-related (parental literacy status, location of residence, home environment, preferred parenting style, family type, family's economic status and maternal employment) and child-related factors (number of siblings and order of birth) that are associated with the motor development of toddlers through a suitable regression analysis.

METHODS

In this explanatory cross-sectional study, a multi-stage cluster random sampling technique was used for data collection. All the taluks of Bangalore urban (Bangalore North, Bangalore South, Bangalore East and Anekal) and Bangalore rural (Nelamangala, Dodballpura, Devanahalli, Hosakote) districts were included for the study. By using computer generated random numbers, three villages were randomly selected from each taluk in Bangalore rural district, and then hundred households were randomly selected from each village. In the similar way three towns were selected from the Bangalore urban district and from each town hundred households were randomly selected.

A preliminary survey was conducted during February and March of year 2008 to identify the families with children aged one to three years. Then based on the literacy status of the parents the households were categorized as families with both the parents literates, families with both the parents illiterates and families with one of the parents literate or illiterate. The families with one of the parents literate or illiterate were not included in the study.

In Bangalore urban district, 367 families were identified with children aged between one and three years, among them in 207 families both the parents were literates, in 127 families both the parents were illiterates, and in 33 families one of

the parents were literate or illiterate, who did not participate in the study. Among 207 families with both the parents literates, 146 met the selection criteria and 98 were willing to participate in the study and from these 98 families 25 families were selected randomly by using computer generated random numbers to form the Urban Literate group. Among 127 families with both the parents illiterates, 99 fulfilled the selection criteria and 82 were willing to participate in the study and from these 82 families 25 families were randomly selected by using computer generated random numbers to form the Urban Illiterate group.

In Bangalore rural district, 312 families were identified with children aged between 1 and 3 years, among them in 156 families both the parents were literates, in 133 families both the parents were illiterates, and in 23 families one of the parents were literate or illiterate, who did not participate in the study. Among 156 families with both the parents literates, 130 families met the selection criteria and 108 were willing to participate in the study and from these 108 families 25 families were selected randomly by using computer generated random numbers to form the Rural Literate group. Among 133 families with both the parents illiterates, 110 families fulfilled the selection criteria and 103 were willing to participate in the study and from these 103 families 25 families were randomly selected by using computer generated random numbers to form the Rural Illiterate group. Thus totally four groups were formed.

Participants:

From these four groups, at least one of the parents with their children aged between one and three years old had participated in the study. If there were more than one child in that age group in the same family, one of the children was selected randomly by using lottery method. After being approved by the Institution's Review Committee, an informed written consent was obtained from all the participants (parents) who

were willing to participate in the study after explaining the purpose and procedure of the study. After completing the preliminary assessment, the information regarding parenting style, observation of family environment and screening of the target child's motor development was done from those families who were ready to devote time (one and half to two hours) during the first visit itself. From the remaining families, an appointment was received based on their convenience to collect the whole data. The phone number was also received during the first visit to remind them about the appointment prior day and to ensure the presence of primary caretaker during the subsequent visits.

Selection Criteria:

The toddlers from both the genders, born in term with normal birth weight (2.5 to 3.5 kg) and appropriate for gestational age, and having age appropriate anthropometric measurements such as height, weight and head circumference were included in the study and the toddlers with a history of any congenital anomalies, neonatal seizures, perinatal asphyxia, neonatal hypoglycemia, intracranial hemorrhage, neonatal hyperbilirubinaemia (bilirubin > 20mg/dl and untreated), hypothermia, neonatal infections and septicaemia were excluded from the study and if the parents were not sure about the above features or no medical reports were available, the parents were asked whether the child was admitted in the Neonatal Intensive Care Unit (NICU), as admission of a newborn in NICU may be due to any of the above mentioned causes.

Assessment Tools

The literacy status of the parents was assessed by using the UNESCO's operational definition of literacy.²⁰ To assess the parenting style, Parenting Style Questionnaire [PSQ]²¹ was used. The illiterate parents answered the questions in PSQ by schedule method. The Infant/Toddler HOME Inventory²² was used to observe the home

environment of the toddlers and the gross motor and fine motor development of the toddlers were assessed by using the Psychosocial Development Screening Test [PDST].²³⁻²⁵

DATA ANALYSIS AND RESULTS

The data analysis was performed by using the statistical software SPSS 16 (Inc., Chicago, IL) for windows. Descriptive statistics were calculated for all the basic characteristics like age, gender, height, weight, and head circumference. One way ANOVA and chi-square test were used to determine the homogeneity of the four groups, which revealed that all the four groups were homogenous in terms of age, gender, height, weight, and head circumference at $p > 0.05$ (Table 1). The descriptive analysis for family-related factors (home environment, preferred parenting style, family type, economic status, maternal employment), and child-related factors (order of birth, and number of siblings) is displayed in Table 2.

Kruskal – Wallis test showed a statistically significant ($p < 0.0001$) difference between the groups in home environment at 0.05 level. The post-hoc analysis performed by using Mann Whitney U test revealed a statistically significant ($p < 0.0001$) difference in home environment between all the unique pairs, except between Urban Literate and Rural Literate, and Urban Illiterate and Rural Illiterate groups at $p < 0.0125$ (Figure 1).

A statistically significant difference between the groups was obtained in both gross motor ($p = 0.0001$) and fine motor ($p = 0.0010$) development of toddlers at 0.05 level as tested by chi-square test (Figure 2 & 3). A multiple logistic regression analysis was done to identify the most significant factors associated with the language and cognitive development of toddlers. The explanatory variables were selected for the models based on a significant Wald chi-square statistic at $p < 0.5$ in univariate analyses and also based on the existing body of evidence. Three

regression models were built for gross motor and fine motor development as measured by PDST. In the first model, parental literacy status and locality of residence were included, in the second model other family- related factors such as home environment, preferred parenting style, family type, family's economical status, maternal employment, and a child- related factor, order of birth were included, whereas in the final model all the above variables included in the first and second models were included. The model fitness was examined by using Hosmer Lemeshow test at $p > 0.05$.

The results suggest that only the parental literacy status (with literates as reference category) showed a statistically significant adjusted odds ratio (Adj. OR: 0.15; CI: 0.06, 0.36) at $p < 0.05$ in model 1 for gross motor development. In both model 2 (Adj. OR: 3.34; CI: 1.38, 7.02) and model 3 (Adj. OR: 4.25; CI: 1.45, 9.59) the home environment (with a stimulating home environment as reference category) showed a statistical significance at $p < 0.05$; similarly in both model 2 (Adj. OR: 0.26; CI: 0.01, 0.74) and model 3 (Adj. OR: 0.54; CI: 0.11, 0.79) preferred parenting style (with authoritarian and permissive parenting styles as reference categories) showed a statistical significance at $p < 0.05$; whereas other variables did not reveal a statistical significance for gross motor development in both model 2 and model 3 (Table 3).

For fine motor development also only the parental literacy status (with literates as reference category) showed a statistically significant adjusted odds ratio (Adj. OR: 0.21; CI: 0.09, 0.51) at $p < 0.05$ in model 1. The home environment (with a stimulating home environment as reference category) showed a statistical significance in both model 2 (Adj. OR: 3.73; CI: 1.20, 9.07) and model 3 (Adj. OR: 4.75; CI: 1.70, 9.47) at $p < 0.05$, whereas other factors did not show such difference for fine motor development in both these models (Table 4).

DISCUSSION

The findings of the present study suggest the factors constantly influencing gross motor development are home environment and preferred parenting style. The toddlers from a non-stimulating home environment had 4.25 times delayed gross motor development than those from a stimulating home environment and the toddlers brought up by Authoritative parents had 0.54 times normal gross motor development than those by Authoritarian and Permissive parents. The fine motor development of toddlers was constantly influenced by home environment alone, where toddlers from a non-stimulating home environment had 4.75 times delayed fine motor development than those from a stimulating home environment.

In recent times, there has been increasing interest among researchers on the quality of home environments and their impact on child development.^{26,27} Bradley and colleagues found that measures of particular aspects of the child's home environment, such as parental response, and availability of stimulating play materials were strongly related to children's developmental status.²⁸ The definite interaction of two features of the home environment, availability of toys and amount of maternal involvement were examined in 6 months old children and found that higher locomotor, eye-hand coordination and critical developmental quotients were associated with the additive combination of more optimal play materials and high level of maternal involvement. When examining the independent contribution of the factors, appropriate play materials were associated more favorably with eye-hand coordination.²⁹ These findings are in accord with the results of the present study.

The results of the present study are partially consistent with the findings of a previous study conducted by Kapur M and colleagues, where they had assessed the psychosocial development of pre-school children in South India and concluded the psychosocial development in terms

of gross motor, fine motor, conceptual readiness, language and personal – social skills were closely associated with the stimulating child rearing practices rather than the macro-environmental factors such as residence, parental education and home. They also observed there were some significant urban/rural differences in performances favoring urban children which could be attributed partly to the differences in child rearing practices.³⁰

A cross-sectional study conducted by Malik and colleagues in Raja bazaar, an urban slum in Central Delhi, examined the psychosocial development of 202 infants by using PDST and correlated with the socio-demographic factors and revealed that literacy of parents especially mothers was not significantly influencing the development of the infants living in urban slums which is in agreement with the findings of this study.³¹

The resources of a family can be invested into the development of the child, whether to improve the physical environment for learning or to procure materials and services that stimulate positive development. Bradley and Corwyn, and Berger and colleagues found a link between low income, the material quality of the child's home environment and child behavioral outcomes for relatively contemporary cohorts of children in North America. Alternatively, low family income may create an emotional impact on parent-child interactions, for example, greater parental stress or depression.^{32,33} A strong association exists between high quality of family context and high socioeconomic status and between low quality of family context and low socioeconomic status.^{34,35}

The economic status of the family is not directly associated with the gross and fine motor development of the toddlers as revealed from the results of the present study, even though there is an association between the quality of family context and socioeconomic status of the family.

Older siblings influenced the onset of their younger siblings' motor milestones. In some

families, younger siblings crawled and walked earlier than their older siblings did, suggesting the onset of younger siblings' motor milestones may be facilitated by imitating or modeling their own older siblings.³⁶⁻³⁸ In contrast, in other families, older siblings crawled and walked significantly earlier, suggesting a delay in the onset of younger siblings' motor milestones. In these cases, parental 'resources' may have been split between the two siblings, creating a disparity between the amount of attention available to the older sibling prior to the birth of the younger sibling and the amount of attention available for two children.³⁹ The present study found 0.49 times and 0.44 times normal development for gross motor domain and fine motor domain respectively among the older siblings compared to their younger siblings, though they are not statistically significant.

Limitations

In this study during the assessment of the toddlers, in many of the households only mother was present and she was the informant and there was no opportunity to obtain the required information from father, which was not practically possible as they went for job. Also this study did not analyze the effects of single parent and the average time spent by the fathers with their toddlers.

Implications for practice

The clinicians especially Pediatricians, Physiotherapists, Occupational therapists, Clinical Psychologists and Social workers who are involved in the developmental evaluation and intervention should consider the family- related factors (parenting style and home environment) as they play an important role in the development of children especially during the toddlerhood.

Implications for research

A multicentre cross-sectional study by including the other parts of the state and country is

warranted with the objectives of the present study. Also a prospective longitudinal study is warranted to determine how these family factors exposed by the children during their toddlerhood create an impact in gross motor and fine motor development during their early childhood, late childhood, and adolescent periods.

CONCLUSION

From the findings of this study, it is evident that the family- related factors such as; a stimulating home environment and authoritative parenting style are significant correlates of gross motor development of toddlers, whereas a stimulating home environment alone is significantly related with fine motor development of toddlers in India. It is also apparent that the child- related factors are not significantly related to the motor development of toddlers in India.

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Table 1. Summary of basic characteristics

Characteristic	Urban Literate N = 25	Urban Illiterate N = 25	Rural Literate N = 25	Rural Illiterate N = 25	<i>p</i> value
Age (Months)					
Mean ± SD	24.7 ± 6.60	25.2 ± 6.35	23.7 ± 5.23	22.2 ± 5.31	
Median	24.0	24.0	23.0	21.0	
Min, Max	15, 36	16, 36	16, 35	15, 34	0.2873 ^a
Gender - n(%)					
Male	13 (52.0)	13 (52.0)	15 (60.0)	13 (52.0)	
Female	12 (48.0)	12 (48.0)	10 (40.0)	12 (48.0)	0.9225 ^b
Height (cm)					
Mean ± SD	87.02 ± 5.62	86.18 ± 5.05	85.52 ± 4.46	84.54 ± 4.53	
Median	88.00	85.00	85.00	83.00	
Min, Max	79.0, 95.0	78.2, 94.0	79.0, 94.0	78.0, 94.0	0.3412 ^a
Weight (Kg)					
Mean ± SD	12.48 ± 1.25	12.00 ± 1.09	11.76 ± 0.83		
Median	13.00	2.00	11.50		
Min, Max	10.5, 14.0	10.0, 14.0	10.5, 13.5		0.0578 ^a
Head Circumference (cm)					
Mean ± SD	48.04 ± 0.99	47.74 ± 0.97	47.70 ± 0.83	47.62 ± 0.94	
Median	48.00	47.70	48.00	47.50	
Min, Max	46.0, 49.5	45.6, 49.5	46.0, 49.0	46.0, 49.5	0.4230 ^a

SD: Standard deviation; Min, Max: Minimum and Maximum.

^a *p* values were calculated using ANOVA; ^b *p* value was calculated using chi-square test

Table 2. Description of family- and child- related factors

Factors	Urban Literate N = 25	Urban Illiterate N = 25	Rural Literate N = 25	Rural Illiterate N = 25
<i>Family- related factors</i>				
Home environment				
Mean ± SD	30.0 ± 8.90	17.3 ± 6.74	29.5 ± 6.81	13.4 ± 6.38
Median	31.0	18.0	28.0	12.0
Min, Max	15, 40	8, 27	17, 42	5, 27
Preferred parenting style – n (%)				
Authoritative	2 (8)	0 (0)	2 (8)	2 (8)
Authoritarian	5 (20)	3 (12)	3 (12)	17 (68)
Permissive	18 (72)	22 (88)	20 (80)	6 (24)
Family type – n (%)				
Joint family	3 (12.0)	1 (4.0)	3 (12.0)	9 (36.0)
Nuclear family	22 (88.0)	24 (96.0)	22 (88.0)	16 (64.0)
Economic status (INR) – n (%)				
Low	0 (0.0)	18 (72.0)	0 (0.0)	17 (68.0)
Lower Middle	8 (32.0)	7 (28.0)	7 (28.0)	8 (32.0)
Upper Middle	5 (20.0)	0 (0.0)	13 (52.0)	0 (0.0)
High	12 (48.0)	0 (0.0)	5 (20.0)	0 (0.0)
Maternal employment – n (%)				
Employed	7 (28.0)	1 (4.0)	2 (8.0)	6 (24.0)
Non-employed	18 (72.0)	24 (96.0)	23 (92.0)	19 (76.0)
<i>Child- related factors</i>				
Order of birth – n (%)				
First	8 (32.0)	4 (16.0)	5 (20.0)	0 (0.0)
Second	11 (44.0)	14 (56.0)	10 (40.0)	4 (16.0)
Third	6 (24.0)	6 (24.0)	9 (36.0)	18 (72.0)
Fourth	0 (0.0)	1 (4.0)	1 (4.0)	3 (12.0)
Number of Siblings – n (%)				
0	8 (32.0)	4 (16.0)	5 (20.0)	0 (0.0)
1	11 (44.0)	14 (56.0)	10 (40.0)	4 (16.0)
2	6 (24.0)	6 (24.0)	9 (36.0)	18 (72.0)
3	0 (0.0)	1 (4.0)	1 (4.0)	3 (12.0)

Low: ≤ Rs. 10000; Lower Middle: Rs. 11000 – 20000; Upper Middle: Rs. 21000 – 30000; High: ≥ Rs. 31000

Table 3. Multiple logistic regression of factors associated with gross motor development of toddlers

Factors	Model 1 Adj OR (CI)	Model 2 Adj OR (CI)	Model 3 Adj OR (CI)
Parental Literacy Status (1)	0.15 (0.06, 0.36)*		1.05 (0.18, 5.99)
Location of Residence (2)	1.22 (0.51, 2.94)		3.9 (1.04, 14.74)
Home Environment (3)		3.34 (1.38, 7.02)*	4.25 (1.45, 9.59)*
Preferred Parenting Style (4)		0.26 (0.01, 0.74)*	0.54 (0.11, 0.79)*
Family Type (5)		0.34 (0.05, 2.28)	0.40 (0.05, 2.98)
Economic Status (6)		3.35 (0.93, 12.10)	3.0 (0.51, 17.18)
Maternal Employment (7)		1.05 (0.28, 3.97)	1.72 (0.39, 7.61)
Order of Birth (8)		0.63 (0.15, 2.62)	0.49 (0.10, 2.28)
Model Fit	<i>p</i> = 0.887	<i>p</i> = 0.374	<i>p</i> = 0.477

* Statistically Significant at $p < 0.05$; Adj OR: Adjusted Odds Ratio; CI: Confidence Interval; Number inside the parentheses after the variable are reference categories. 1. Literates, 2. Urban, 3. Stimulating home environment, 4. Authoritarian and Permissive, 5. Joint family, 6. Low, 7. Not employed, 8. First born.

Table 4. Multiple logistic regression of factors associated with fine motor development of toddlers

Factors	Model 1 Adj OR (CI)	Model 2 Adj OR (CI)	Model 3 Adj OR (CI)
Parental Literacy Status (1)	0.21 (0.09, 0.51)*		1.20 (0.25, 5.82)
Location of Residence (2)	0.69 (0.30, 1.61)		0.93 (0.32, 2.71)
Home Environment (3)		3.73 (1.20, 9.07)*	4.75 (1.70, 9.47)*
Preferred Parenting Style (4)		0.70 (0.23, 2.14)	0.71 (0.22, 2.24)
Family Type (5)		1.67 (0.38, 7.34)	1.69 (0.37, 7.61)
Economic Status (6)		1.26 (0.39, 4.04)	1.44 (0.29, 7.22)
Maternal Employment (7)		0.96 (0.29, 3.15)	0.89 (0.24, 3.26)
Order of Birth (8)		0.44 (0.11, 1.73)	0.44 (0.11, 1.77)
Model Fit	<i>p</i> = 0.245	<i>p</i> = 0.611	<i>p</i> = 0.640

* Statistically Significant at $p < 0.05$; Adj OR: Adjusted Odds Ratio; CI: Confidence Interval; Number inside the parentheses after the variable are reference categories. 1. Literates, 2. Urban, 3. Stimulating home environment, 4. Authoritarian and Permissive, 5. Joint family, 6. Low, 7. Not employed, 8. First born.

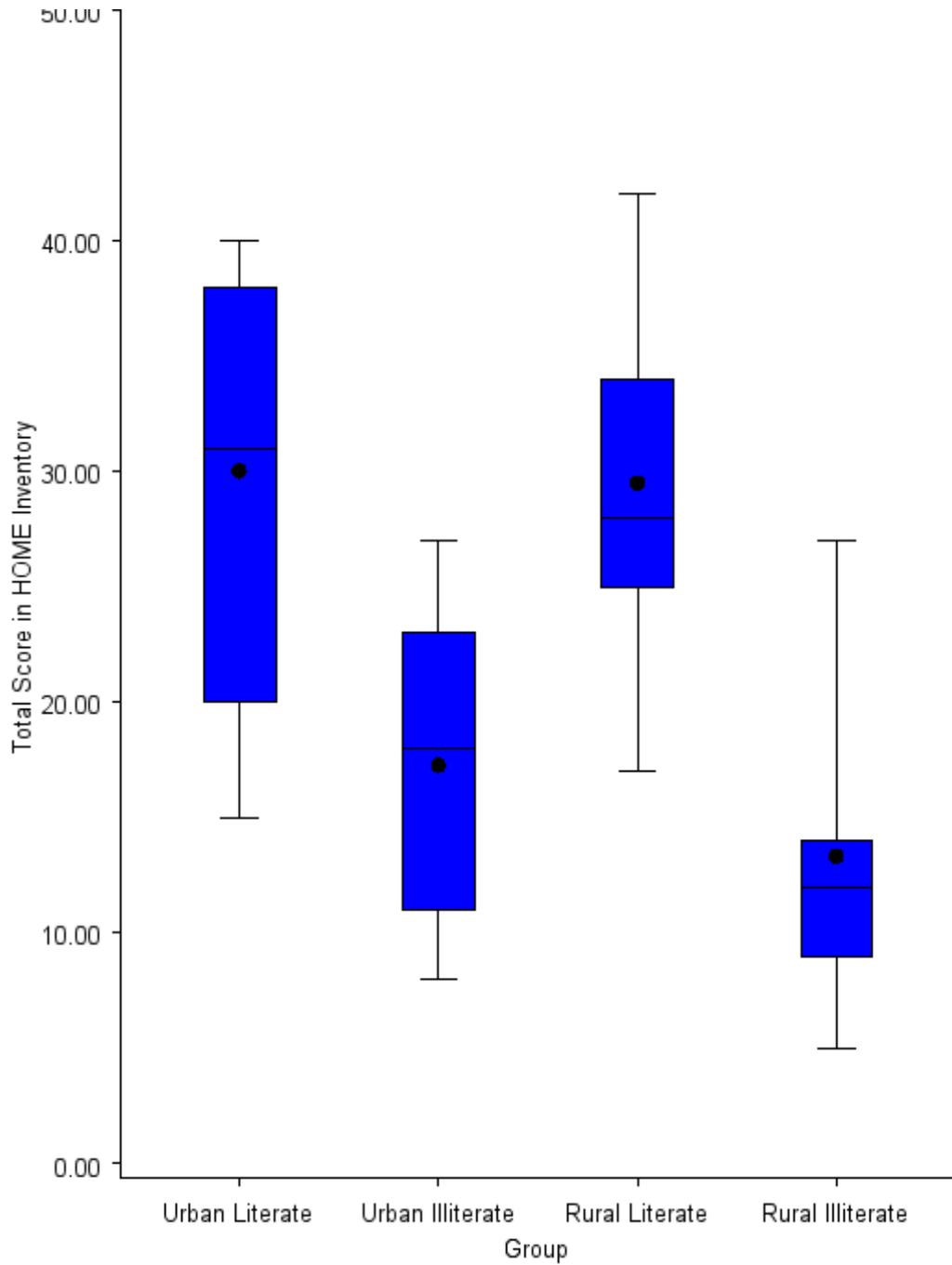


Figure 1. Home environment between the groups

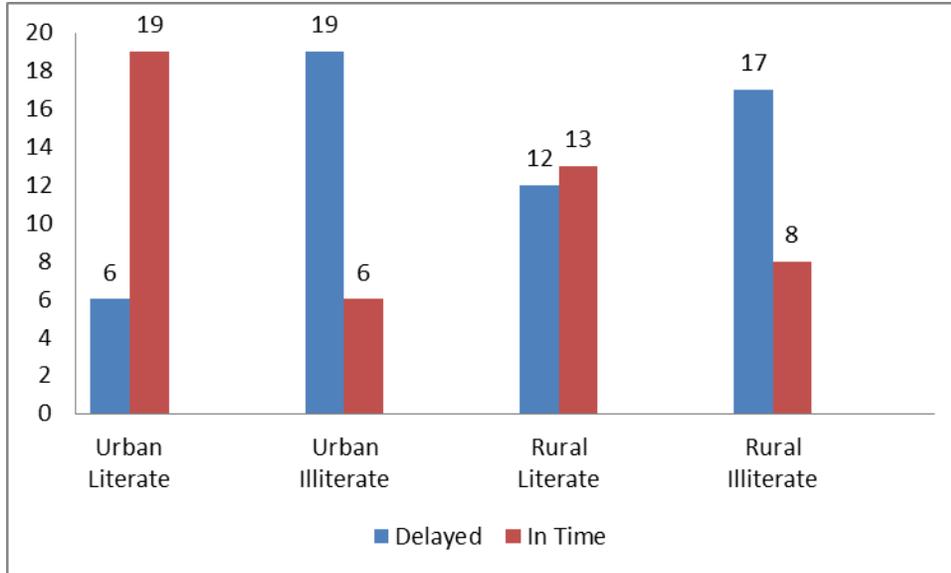


Figure 2. Number of children with delayed and in time development of gross motor skills in each group

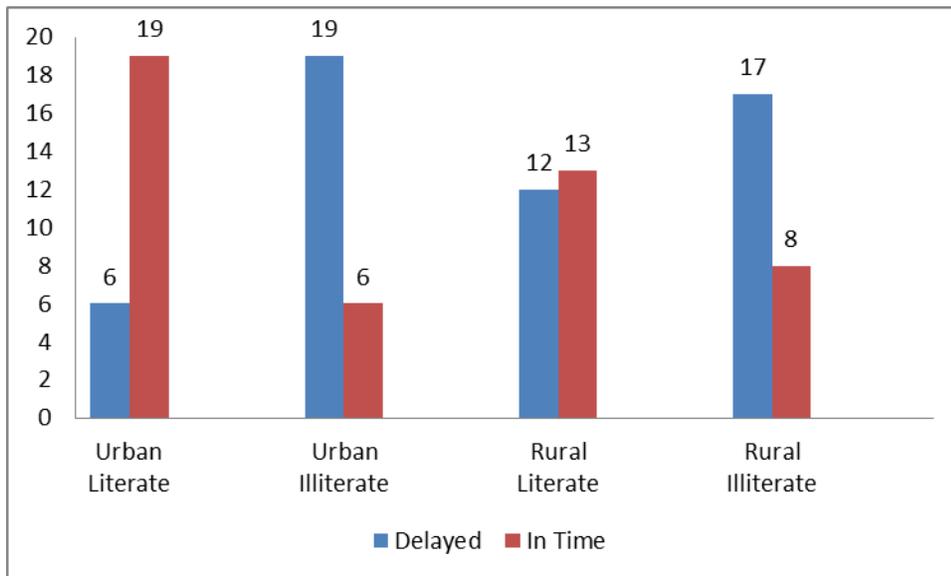


Figure 3. Number of children with delayed and in time development of fine motor skills in each group