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Evaluation of motor skills in high risk infants based on Peabody Developmental Motor Scales (PDMS-2)

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Abstract

Background and Objective: Achievement of motor skills is an important part of childhood development. There are some scales that commonly used for preschool-aged children including Peabody Developmental Motor Scales, 2nd edition (PDMS-2). A cross sectional study designed to compare motor skills of high risk and normal infants of 3 to 6 months of age.

Methods: In this case control study, 45 high risk infants 3-6 month of age were compared with 45 normal cases that matched for age and sex, for evaluation of motor development by PDMS-2. Subjects were selected by cluster sampling from different health centers of Tehran. Data about gross, fine and total scores were analyzed using SPSS software version 13.

Results: There was a significant difference between gross, fine and total motor scores in normal and high risk infants with perinatal risk factors ($p<0.05$).

Conclusion: Fine, gross and total motor scores in normal and high risk infants of 3- 6 months old are significantly different. It is recommended to evaluate movement development by PDMS-2 in mentioned infants and starting rehabilitation as soon as possible.

Keywords: High risk, Infants, Motor skills, PDMS-2

Introduction

Nervous system grows during primary years of childhood period and motor skills continuously form throughout these years. Identification of children with disorders in motor skills is crucial in order to screening, etiology, diagnosis and proper management (1). Throughout this process, various types of measures are used, including discriminative and evaluative measures. Discriminative and evaluative measures of motor development and function that are commonly used for preschool-aged children including the Bayley Scales of Infant Development II, Peabody Developmental Motor Scales, 2nd edition, Toddler and Infant Motor Evaluation, Pediatric Evaluation of Disability Inventory, and Gross Motor Function Measure. Selecting an appropriate measure is a crucial part of the examination process and should be geared toward the purpose of testing and characteristics of the child. Evidence of reliability and validity are important considerations for selection of a measure (1,2).

Peabody Developmental Motor Scales-Second Edition (PDMS-2) is an early childhood motor development program that provides both in-depth assessment and training or remediation of gross and fine motor skills. The assessment is composed of six subtests that measure interrelated motor abilities that develop early in life. It is designed to assess the motor skills of children from birth through 5 years of age. Reliability and validity have been determined empirically (1-3).

Some investigations showed some agents in pregnancy or after that may have adverse effects

on the child's mental and motor abilities (3,4). The process of motor development does not happen overnight. Like many things, learning about the body and making it move takes time. Motor development is the process of learning how to use muscles in the body to move. The progression of acquiring motor skills goes from simple to complex (1,4). Motor development happens in a predictable sequence of events for most children, but each child varies in age when each skill is mastered (5,6). Accurate and diagnostic measures are central to early identification and intervention with infants who are at risk for developmental delays or disabilities. Preterm infants are known to have low gross motor and fine motor skills. In preterm infants, low eye-hand coordination/fine motor scores are likely to be due to their extreme prematurity (7).

Infants born preterm are at increased risk of developing cognitive and motor impairments compared with infants born at term. Infants at high biologic risk and infants with developmental delays are less attentive, less active, and less skilled in motor tasks during the first 0-24 months of life, suggesting an association between biologic risk and behavior and developmental delay and behavior (4). Motor development is more affected by premature birth than other developmental domains; however few studies have specifically investigated the development of gross and fine motor skills in this population (5,8).

This study designed to compare motor skills of high risk and normal infants of 3 to 6 months of age.

Methods

In this cross-sectional study, infants with 3-6 month of age that were referred to Tehran health centers enrolled, during February to December of 2009. The health centers were selected by cluster sampling from 3 health centers of southern and western region of Tehran.

Infants were divided into two groups, each with 45 samples matched for age and gender; case group including infants with perinatal (labor and postnatal period) problems as high risk group and control group including healthy infants who were between 3 to 6 month old.

Data about perinatal problems were found from parents and medical records. Labor problems were defined as mild hypoxia (ischemic hypoxic encephalopathy grade 1 that inadequate oxygenation at birth leads to nervous system manifestation including hyperalertness, dilated pupils and normal muscle tone without seizure) and prematurity (gestational age less than 37 weeks). Low birth weight or LBW (birth weight less than 2500 gram), Cyanosis, neonatal seizure and icter were considered as postnatal risk factors. Exclusion criteria were drowsiness, irritability and hungriness. Cases with severe hypoxia at birth (positive history of cardiopulmonary resuscitation), kernicterus, very LBW (lower than 1500 gram), gestational age lower than 34 weeks and those who needed ventilator assistant were excluded.

The PDMS-2 is a reliable and valid tool for assessment of gross and fine motor skills in infants (9). It is composed of six subtests as follows:

Reflexes: This 8-item subtest measures a child's ability to automatically react to environmental events. Because reflexes typically become integrated by the time a child is 12 months old, this subtest is only given to children birth through 11 months.

Stationary: This 30-item subtest measures a child's ability to sustain control of his or her body within its center of gravity and retain equilibrium.

Locomotion: This 89-item subtest measures a child's ability to move from one place to another. The actions measured include crawling, walking, running, hopping, and jumping forward.

***Object Manipulation*:** This 24-item subtest measures a child's ability to manipulate balls. Examples of the actions measured include catching, throwing, and kicking. Because these skills are not apparent until a child has reached the age of 11 months, this subtest is only given to children aged 12 months and older.

***Grasping*:** This 26-item subtest measures a child's ability to use his or her hands. It begins with the ability to hold an object with one hand and progresses up to actions involving the controlled use of the fingers of both hands.

***Visual-motor integration*:** This 72-item subtest measures a child's ability to use his or her visual perceptual skills to perform complex eye-hand coordination tasks such as reaching and grasping for an object, building with blocks, and copying designs.

Gross motor quotient is a combination of the results of the subtests that measure the use of the large muscle systems including reflexes (11 months only), stationary (all ages), locomotion (all ages) and object manipulation (12 months and older).

Fine motor quotient is a combination of the results of the subtests that measure the use of the small muscle systems including grasping (all ages) and visual-motor integration (all ages).

Total motor quotient is a combination of the re-

sults of the gross and fine motor subtests and is the best estimate of overall motor abilities (9).

This study was approved by ethics committee of Iran University of Medical Sciences. Informed consent was obtained from infants' parents before enrollment in the study.

Data were analyzed through SPSS software version 13 for descriptive and analytical statistics including independent sample t-test and univariate analysis of variance.

Results

A total 90 infants of 3-6 months were studied. Mean (SD) age was 4.56±1.092 months. Fifty (56%) cases were female and 40(44%) cases were male. There were 45 infant as high risk and 45 healthy cases as control groups. In high risk group infants, 22(49%) cases had labor problems and 23(51%) cases had postnatal risk factors which are shown in Table 1.

Table 1. Problems in high risk infants

variable	Number (%)
Labor problems	
Birth hypoxia	12 (27%)
Prematurity	10 (22%)
Postnatal risk	
Low birth weight	13 (29%)
Icter	4 (10%)
Seizure	3 (6%)
Cyanosis	3 (6%)

Mean fine motor, gross motor and their subtype scores were evaluated in two groups and compared with each other.

There was a significant difference between normal and high risk infants for gross motor development including reflex, locomotion and stationary scores with p values of 0.011, 0.005 and 0.01, respectively; and fine motor development including grasping and visual motor scores with p values of 0.006 and 0.007, respectively. Comparison of summations and quotients of gross and fine motor scores are shown in Table 2.

There was no significant relationship between gender and motor skills in each age group of infants.

Discussion

Some previous studies have evaluated effects of perinatal risk factors such as mother and labor problems, prematurity or low birth weight on motor skills of infants (4, 10-12).

The present study showed that there was a significant relationship between high risk infants (with perinatal risk factors) and normal cases in motor skills (gross, fine and total).

In our study, 22% of cases had history of prematurity with lower scores in motor skills. Goyen and et al (5) detected 58 infants born less than 29 weeks gestation and/or 1000 g without disabilities at 12 months. Gross and fine motor skills at 18 months, 3 and 5 years using the Peabody Developmental Motor Scales studied. The HOME scale provided information of the home environment as a stimulus for development. A large proportion (54% at 18 months, 47% at 3 years and 64% at 5 years) of children continued to have fine motor deficits from 18 months to 5 years. The proportion of infants with gross motor deficits significantly increased over this period (14%, 33% and 81%, $p<0.001$). In multivariate analyses, gross motor development was positively influenced by the quality of the home environment. A large proportion of high-risk infants continued to have fine motor deficits, reflecting an underlying problem with fine motor skills.

In our study there was 29% low birth weight cases with lower scores in motor skills than nor-

Table 2. Comparison of Peabody developmental motor scales in high risk and normal groups

variable	group	N	Mean	SD	P value	95% Confidence interval of the difference	
						Lower	Upper
Gross motor score(summation)	Normal	45	29.73	3.974	.007	.720	4.302
	High risk	45	27.22	4.557			
Fine motor score (summation)	Normal	45	19.71	2.599	.005	.523	2.765
	High risk	45	18.07	2.750			
Total score	Normal	45	49.44	6.479	.005	1.279	7.032
	High risk	45	45.29	7.232			
Quotient gross	Normal	45	99.36	8.590	.008	1.409	9.125
	High risk	45	94.09	9.788			
Quotient fine	Normal	45	99.13	7.797	.005	1.570	8.296
	High risk	45	94.20	8.251			
Quotient total	Normal	45	96.84	15.670	.192	-1.862	9.151
	High risk	45	93.20	9.997			

mal infants. In Tavasoli et al study (13), 58 cases aged 18±2 month with history of LBW (1900±382.4) were evaluated for motor skills. They were compared with 30 normal-weights at birth or NBW children (3150±473.5) by PDMS-2. They did not find significant association between sex and motor quotients scores in LBW group and also between low birth weight and NBW groups. LBW children achieved significantly lower scores in grasping, visual-motor integration skills and fine motor quotient.

In our study 27% cases had history of birth asphyxia with significant lower motor scores. Sukha and et al (14), evaluated 70 infants 12-14 month with history of hypoxic ischemic encephalopathy (HIE) grade 2 and 3 that were referred for occupational therapy. They used PDMS for motor skills assessment and showed that infants with higher grade of HIE had more motor deficits. They recommended more attention on these cases and early rehabilitation principles.

We had some limitations in our study such as small sample size, difficult in examination of cases because of their lower ages.

It is worth to mention that PDMS has its strengths and limitations and not recommended to use as sole tool for assessment of development and clinical decision making (15).

Conclusion

In conclusion, gross, fine and total motor scores in high risk infants of 3- 6 months old are significantly different in comparison with matched healthy group.

Developmental evaluation of high risk infants at ages under 12 months is needed especially when come to health centers for vaccination, in order to measure fine and gross motor aspects and if needed, improvement of motor deficits with rehabilitation. Follow up of these children is critical to ensure that these skill shortcomings resolved completely and treatments are successful in the long term for all children and families.

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Conflicts of interest: None declared.

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