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Original Article

Intrinsic risk factors for gross motor delay in children aged 6-24 months

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Abstract

Background Gross motor is one of the skill domain with the highest parental concern as mastering it determines the autonomy of a child. Several internal risk factors including perinatal asphyxia, prematurity, low birth weight, wide fontanelle, and microcephaly have been studied in predicting gross motor delay with varied results. This study is made to arrange a strategic intervention on the prevention of delayed development.

Objective To evaluate perinatal asphyxia, gestation age <37 weeks, birth weight <2500 grams, microcephaly, and wide fontanelle as predictors of gross motor delay in children aged 6-24 months.

Methods A case control study design was used. Data collection was conducted by direct assessment of gross motor skill and parents' interview in Cipto Mangunkusumo National Hospital and Anakku Clinic, South Jakarta. Children with gross motor delay were included in the case group and children with normal gross motor were included in the control group. Data was analyzed using bivariate and multivariate analysis with a statistical significance value of P<0.05 and 95% confidence intervals.

Results One hundred and twenty-six subjects were studied, with 63 children in the case group and 63 children in the control group. Baseline characteristics of subjects were similar between the two groups. Microcephaly and gestation age <37 weeks were predictors of gross motor delay [(aOR 4.613; 95%CI 2.023 to 10.521; P<0.001) and (aOR 3.668; 95%CI 1.153 to 11.673; P=0.028)], respectively.

Conclusion Microcephaly and gestation age <37 weeks are significant predictors of gross motor delay in children aged 6-24 months. **[Paediatr Indones. 2019;59:27-32; doi: http://dx.doi.org/10.14238/pi59.1.2019.27-32].**

Keywords: *gross motor delay; risk factor; 6-24 month old*

There are 4 domains of development that has to be accomplished by a child according to his age range, such as gross motor, fine motor, communication and language, and cognitive. If a child fails to master a skill according to his age group, he is said to have a delayed development. Developmental delay can occur in those 4 domains, including gross motor.[1] Gross motor represents the role of big muscles that are responsible in movements such as walking, running, and jumping. The development of a child is like a mile stone. To be able to reach the next skill, a child has to mastered the skill in the lower stage. Gross motor is the first domain of the milestone that has to be mastered by a child.[2] Gross motor helps children to interact with their environment thus giving them chance to maximize their potential in other domains of development. Therefore, if a child has gross motor delay, he is in higher risk of having developmental delay in the other 4 domains.[3]

Global data shows that 5-10% of the children population have delayed development. This data also reports that the most frequent developmental delay

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occur in gross motor domain.[4] Unfortunately, out of all the children with motoric delay, only 10% of those who were succeed in receiving early intervention while early intervention itself is a strategic prevention in preventing developmental delay. Determining the risk factors of gross motor delay is seen to have the potential in increasing the proportion of children who received early intervention. Besides, if the detection of this developmental delay is too late, a child will lose his golden period of development.[3]

Several internal risk factors have been studied in predicting gross motor delay yet with varied results. Moreover, there has not been any study on internal risk factors of predicting gross motor delay in Indonesia. Therefore, this study is made to evaluate the internal risk factors, such as perinatal asphyxia, birth weight <2500 grams, gestation age <37 weeks, microcephaly, and wide fontanelle on predicting gross motor delay. The study is done in children aged 6 to 24 months. The lowest age cut off, which is 6 months, is chosen because this is the time when gross motor skill can be first assessed clearly and the highest age cut off, which is 24 months, is chosen referring to 3 years of age as the maximum golden period of a child's brain development, therefore we provide a year spare time for stimulation and catching-up the developmental delay.[5]

Methods

A case-control study was conducted in children aged 6-24 months in Paediatric Polyclinic of Cipto Mangunkusumo National Hospital and Anakku Clinic, South Jakarta from February 2018 to July 2018. Subjects were recruited consecutively. Children aged 6-24 months with gross motor delay whose parent had agreed to sign the informed consent form were included in the case group. As for the control group, we included all children aged 6-24 months with normal gross motor whose parent also had agreed to sign the informed consent form. Data were collected from direct assessment of gross motor skill and parents' interview regarding their child's history. We first identified subjects with gross motor delay and without gross motor delay, then we collected the data of the possible internal risk factors such as history of perinatal asphyxia, birth weight, head circumference, gestation age of the child before he was born, and size of the fontanelle retrospectively.

In this study, gross motor delay was assessed using the Developmental Milestone Table according to the children's age that can be seen in **Table 1**.[6] Children who were not able to do the gross motor skill associated to the group age below their age, were said to have gross motor delay. For example, if a nine-month-old was unable to sit on their own, which was a skill that has to be mastered in a six-month-old (T**able 1**), he was said to have gross motor delay. Whereas if this child was able to sit on his own, yet was not able to pulled to stand, he was still said to have normal gross motor. Using the definition published by WHO, low birth weight was defined as birth weight less than 2500 grams.[7] Also using the definition published by WHO, prematurity was defined as gestation age less than thirty-seven weeks.[8] Head circumference of the child was measured using plastic tape and the result was plotted to Nelhaus graph. Microcephaly was defined when a value was found below the SD -2 curve.[9] Information about history of perinatal asphyxia was obtained through parents' interview. The child was said to have a history of perinatal asphyxia when the parents said there was no direct crying when the child was born. In this study, we measured the size of anterior fontanelle to define the fontanelle size as it is the last fontanelle that will be closed in a child development. The measurement was done by measuring the horizontal and vertical axis of the fontanelle, then the sum of these was divided by two. The reference used to define the recommended size of anterior fontanelle according to the child's age was a study by Esmaeili *et al.*[10]

Table 1. Cut-off points for age of attainment of developmental milestones[6]

Age (months)	Gross motor development
3	Lift up on hands, no head lag if pulled to sit from supine
6	Sits without support
9	Pulled to stand
12	Walks alone
18	Runs
24	Walks up and down stairs

Unpaired case control method was used to calculate the required sample size, with an assumed

odds ratio (OR) for each variable (perinatal asphyxia, birth weight, head circumference, gestation age, fontanelle size). We assumed the largest OR for fontanelle size, with a power of 80% and a type I error of 5%, resulting in 63 subjects in each group without matching. The chi-square test was used in bivariate analysis. Variables with a P value of <0.25 in bivariate analysis were included into the multivariate analysis. Logistic regression with backward stepwise elimination was used in multivariate analysis. Results were presented in OR, 95% confidence intervals, and a statistical significance value of P. All data were analyzed by *SPSS for Mac 23.0*. The study protocol was approved by the Medical Research Ethics Committee of the Faculty of Medicine, Universitas Indonesia.

Results

There were 63 subjects in the case group (gross motor delay) and 63 subjects in the control group (normal gross motor). Nineteen subjects from the case group and 35 subjects from the control group were obtained from Klinik Anakku, South Jakarta. The rest were obtained from Paediatric Polyclinic of Cipto Mangunkusumo National Hospital. Both groups were similar in their demographic characteristics shown in **Table 2**.

Predictive factors for gross motor delay in children are shown in **Table 3**. Bivariate analysis showed that perinatal asphyxia, gestation age <37 weeks, birth weight <2500 grams, and microcephaly were all significant predictive factors for gross motor delay. Multivariate analysis showed that microcephaly (aOR 4.613; 95% CI 2.023 to 10.521; P<0.001) and gestation age <37 weeks (aOR 3.668; 95% CI 1.153 to 11.673; P=0.028) were significant predictive factors for gross motor delay. The result of multivariate analysis can be seen in **Table 4**.

Discussion

After taking into account 4 predictive factors (perinatal asphyxia, prematurity, low birth weight, and microcephaly) in multivariate analysis, our results showed that microcephaly and prematurity (gestation age <37 weeks) were significant predictors of gross motor delay. It was found in our study that children with microcephaly had higher odds of developing gross motor delay compared to those without microcephaly. This was consistent with several previous studies, including a study held by Scharf RJ *et al.*,[12] who assessed the head circumference of children when they were 9 months and 24 months old, where they

Table 2. Baseline characteristics of subjects

Characteristics	Gross motor delay (n=63)	Normal gross motor (n=63)	Total (%)
Gender, n(%)			
Male	41 (65.1)	38 (60.3)	79 (62.7)
Female	22 (34.9)	25 (39.7)	47 (37.3)
Age			
< 1 year old	23 (36.5)	17 (27)	40 (31.7)
1-2 years old	40 (63.5)	46 (73)	86 (68.3)
Gestational age			
< 37 weeks	16 (25.4)	5 (7.9)	21 (16.7)
≥ 37 weeks	47 (74.6)	58 (92.1)	105 (83.3)
Birth weight			
< 2500 gram	17 (27)	6 (9.5)	23 (18.3)
≥ 2500 gram	46 (73)	57 (90.5)	103 (81.7)
Microcephaly			
Yes	36 (57.1)	13 (20.6)	49 (38.9)
No	27 (42.9)	50 (79.4)	77 (61.1)
Wide fontanelle			
Yes	25 (39.7)	20 (31.7)	45 (35.7)
No	38 (60.3)	43 (68.3)	81 (64.3)

Table 3. Bivariate analysis of predictive factors of gross motor delay (n=126)

Variables	Gross motor delay (n=63)	Normal gross motor (n=63)	OR (95% CI)	P value
Perinatal asphyxia				
Yes	14	3	5.714	0.004
No	49	60	(1.553 to 21.026)	
Gestation age				
< 37 weeks	16	5	3.949	0.009
≥ 37 weeks	47	58	(1.347 to 11.574)	
Birth weight				
< 2500 grams	17	6	3.511	0.011
≥2500 grams	46	57	(1.281 to 9.625)	
Microcephaly				
Yes	36	13	5.128	<0.001
No	27	50	(2.332 to 11.280)	
Wide fontanelle				
Yes	25	20	1.414	0.353
No	38	43	(0.680 to 2.942)	

Table 4. Multivariate analysis with backward stepwise elimination of predictive factors of gross motor delay

Variables	B	SE	Adjusted OR (95%CI)	P value
Gestation age <37 weeks	1.300	0.591	3.668 (1.153 to 11.673)	0.028
Microcephaly	1.529	0.421	4.613 (2.023 to 10.521)	<0.001
Perinatal asphyxia	0.708	0.057	3.849 (0.960 to 15.430)	1.348
Birth weight <2500 grams	0.422	0.680	1.526 (0.402 to 5.785)	0.534

found that children with small head circumference had higher odds to develop gross motor delay with adjusted OR in 9 months was 2.71 (95%CI 1.62 to 4.56) and adjusted OR in 24 months was 3.28 (95%CI 1.61 to 6.67), a study by Gordon-Lipkin *et al.*[11] that showed children with microcephaly had significant increased risk of developing gross motor delay, and by Uswatun *et al.*[9] who also stated that there was a significant association between head circumference and global developmental delay. In the process of growth and development of a child, head circumference is often associated with the size of his brain. Microcephaly showed that there is a disruption in neurodevelopment, hence was not able to support his development, including his motor development.[9]

Our finding about prematurity was also aligned with several previous studies, such as a study by Bang K[14] who reported that prematurity was a significant predictor for delay development and a study by De Moura DR *et al.*[13] that also showed history of prematurity in children was significantly associated with delayed development, especially in motoric and social area. They also reported in their study that gross motor domain was the most domain influenced by history of prematurity. Another previous study by Kerstjens JM *et al.*[15] also showed consistent finding with our result. They found that children who were born prematurely had 1.14 times higher odds in developing gross motor delay every one-week reduction of their gestational age before aterm (OR 1.14; 95%CI 1.09 to 1.19; P<0.001). This study demonstrated that the risk of delayed development will increase exponentially, inversely proportional to the reduction of child's gestational age starting from 25 to 36 weeks. This was supported by the fact that

the optimum growth of the brain happens during the 3rd trimester of pregnancy. In this range of time, cortex volume of the brain was increasing until four times, also followed by increment of synaptogenesis, growth of neurons, myelination, and focused apoptosis, which were all directed to the enhancement of connectivity in the brain. In utero environment was more adequate to support all the brain maturation process compared to post-natal environment. Injury to the brain caused by disturbance of its maturation process was suspected to have a role in increasing the risk of gross motor delay in children with premature history.[15] Nonetheless, a study by Arumsari *et al.*[16] presented contradicted result with our study. They found that after adjusting with other factors, prematurity insignificantly associated to gross motor delay occurrence. It was stated that the insignificance found might be due to the small sample size and short duration of study. However, Arumsari et al. also discussed that global development delay was associated with multi-factors so that a premature child might experience normal development if other factors related to his growth and development were sufficient.[16]

Limitation to this study was biased information which might be obtained from retrieving data retrospectively, especially history of perinatal asphyxia, birth weight, and gestation age of the child. Also, history of perinatal asphyxia was only assessed through parents' interview in asking whether there was a history of direct crying after the child was born.

We finally conclude that microcephaly and gestation age <37 weeks are significant predictive factors for gross motor delay in children aged 6-24 months.

Conflict of Interest

None declared.

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