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The Relationship between Small for Gestational Age (SGA) at Birth and Developmental Delay in Children Aged 4 to 60 Months

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Abstract

Background
Progress in medical science and success in increasing the survival rate of vulnerable infants have raised the issue of future development in these children. This study aimed to investigate the relationship between small for gestational age (SGA) status at birth and developmental delay in children aged 4 to 60 months.

Materials and Methods
This study was a correlation descriptive through a multistage sampling method on 419 Iranian children aged 4 to 60 months who attended healthcare centers affiliated to Isfahan University of Medical Sciences and Healthcare Services, Iran. Data collection tools included a data collection checklist and the Ages and Stages Questionnaires (ASG). The data obtained were analyzed using the SPSS software (version 18.0).

Results
The results showed that 83 (19.8%) of 419 children in the study, had developmental delay and 336 (80.2%) had normal development. Comparison of developmental domains between the two groups of children based on birth weight, showed that there was a significant relationship between the birth weight of children and developmental delay in the domain of fine movements (p = 0.02, r=0.81), problem solving (p = 0.02, r= 0.73), and the total score (p =0.02, r= 0.87). In addition, the Chi-square test showed a significant relationship between small for gestational age (SGA) status at birth and developmental delay in children (p = 0.001).

Conclusion
Given the relationship between birth weight and developmental disorders, special attention to the birth weight of infants and performing regular care during pregnancy and afterwards for SGA children can prevent many developmental problems.

Key Words: Children, Developmental delay, Small for gestational age.

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1- INTRODUCTION

Progress in medical science and success in increasing the survival rate of vulnerable infants have raised the issue of future development in these children. In the last two decades, due to the promotion of health status among people as well as the use of vaccines and antibiotics, mortality and complications of infectious diseases among children have been reduced. But, due to the increased survival rate of infants with weights less than 1,500 gr and fetal ages below 30 weeks, and devising and using modern methods in the treatment of infertility, there has been a significant increase in the prevalence of developmental disorders in children (1). Developmental delay is a term which is generally used for children, who have not shown the prominent developmental characteristics expected from them due to their age, and is examined in the motor, cognitive, emotional, language, and social domains (2).

Human development is a huge and complex process. If we consider growth as an increase in body size and/or in its various parts, development must be considered equivalent to changes in action, which can be influenced by the environment surrounding the child (3). In other words, a set of changes that the human acquires during their lifetime for physical, mental, speech, and social promotion is called development or growth, which is influenced by genetic factors inherited from their parents, environmental factors, nutrition, and social stimuli. Therefore, any kind of disorder or abnormality occurring during the time of the egg formation to the events and incidences occurring during the perinatal period, delivery, and the first years after birth can affect the process of development and growth. The development rate is much faster during the childhood stages, particularly the first two years of life, than during the other stages of life. Any kind of damage or disorder in the brain and organs of the central nervous system during the first critical period of life, can have important and irreparable effects on the child’s development (4). Half of these disorders remain undetected until school age and are thus not treated, resulting in multiple complications which threaten the health and progress of society (5). It is estimated that about 200 million children worldwide do not enjoy desirable development and/or are failing to acquire it. The prevalence of this problem is not the same across the world, and is even higher in advanced countries. The rate has been reported to be up to 3% in at-risk populations (1, 6). The prevalence of developmental disorders in children in the meta-analyzed study was reported between 7 to 22.4% (7).

A wide range of demographic factors and causes including: prenatal, mental, social, heredity, and environmental factors contribute to its incidence. In other words, human development is a dynamic and continuous interaction between biological and acquired factors. The process of growth and development begins from the pregnancy period. Dangers existing in this period can affect the stage of physical development and lead to complications in the infant (1, 8). The main cause of developmental disabilities has remained unknown. But, from among its possible causes, we can refer to biologic factors, pregnancy, and environmental factors (9, 10). The fetal life and life outside the womb, along each other, define a path through which the individual's growth and development are formed under the influence of genetic, environmental, and social factors (9). Dangers threatening the health of children and even the health of adults sometimes begin from the fetal stage (11); and those infants are at risk of developmental delay who have a history of one or more risk factors before, during, or after birth. In these infants, the prevalence rate of motor development delay is 30%, which is above that in the normal population (12). Most of the unfortunate incidences in growth and development occur before birth (4, 5). According to studies conducted, most infant deaths and developmental disorders are disorders related to prematurity and low birth weight, as well as maternal pregnancy complications and congenital (chromosomal and metabolic) abnormalities (6, 9). Because of many challenging problems associated with having a child with developmental delay, early diagnosis and urgent and on-time referral are very important and can have the highest benefit to children with developmental disabilities and their families (13). Therefore, it is necessary to monitor the child development and screen the presence of such problems at each visit, especially the first visit of a child, in order to check their health. The development examination is carried out in five domains: physical (gross and fine motor skills), cognitive, emotional, communication, and problem-solving (speech comprehension and expression, visual-motor skills) development (4).

Studies have shown that inappropriate and abnormal conditions for the infant, maternal marital status, use of tobacco and alcohol during and after pregnancy, and prenatal, perinatal, and postnatal complications are risk factors for developmental delay. Preterm delivery and low birth weight, especially weights less than 1,500 gr, are known as very important risk factors. More than 20 million SGA infants are born annually across the globe, among whom 30% to 40% are term babies (10). In Iran, the survival rates of low birth weight and very low birth weight infants have been reported to be 98.4% and 66.6%, respectively (14). Despite the increased survival rate and reduced morbidity in low birth weight infants, the economic and social burden along with neurodevelopmental problems in these infants, are among other harmful effects of the birth of low weight infants (15, 16). Low birth weight infants are at risk of problems such as major sensor neural defects, cerebral palsy, cognitive and speech delays, neuro-motor and visual defects, hearing loss, behavioral and psychosocial abnormalities, and impaired school performance (15). Most children with low birth weight suffer from multi-disabilities (17), and these disabilities continue until school age or even beyond that (18); therefore, the majority of them need special and continuous care; and due to the necessity of reducing neonatal mortality and complications and the necessity of paying attention to the importance of delayed developmental growth of children, some plans should be codified and implemented.

First of all, prenatal midwifery care should be delivered in the most appropriate way for pregnant mothers to properly diagnose any problems and delay in developmental growth, and take appropriate actions accordingly. In addition, the postpartum period is also of great importance, and timely diagnosis and treatment has the best result and effect. Hence, this study was conducted in Isfahan city, Iran, with the aim of investigating the relationship between small for gestational age (SGA) status at birth and developmental delay in children aged 4 to 60 months.

2- MATERIALS AND METHODS

The present study is a correlation descriptive study conducted through a cluster multistage sampling method on 419 children who attended healthcare centers affiliated to Isfahan University of Medical Sciences. The inclusion criteria for the study were: Iranian mothers with children aged 4 to 60 months, having a minimum ability to read and write, and having received registered prenatal care. Also, the exclusion criteria for the study were: the fifth or higher pregnancies, smoking, alcohol consumption, or addiction during pregnancy, children who only live with one of their parents, children with apparent congenital abnormalities, mother's suffering from chronic diseases such as: anemia, diabetes, high blood pressure, and thyroid, autoimmune, cardiovascular, renal, and neurological diseases, suffering from problems related to eclampsia and preeclampsia pregnancies. For sampling, we prepared a list of healthcare centers affiliated to Isfahan University of Medical Sciences according to the list of the Ministry of Health. Next, we divided the city into nine areas: northern, northwestern, northeastern, southern, southwestern, southeastern, central, and eastern, and considered the healthcare centers in each area as clusters. In the next step, based on the population of children less than five years of age covered by each center, we allocated a quota to each center, and performed a random sampling using the Excel program; then, using the formula:

$N \geq \frac{z_1^2 - \frac{\alpha}{2}(1-P)}{\varepsilon_P^2}$, we calculated the study sample size to be 356 subjects, which increased to 419 subjects. Data collection tools included: an information questionnaire containing demographic, economic, social, and medical information, reproductive history (the recent pregnancy, and previous pregnancies), and a checklist prepared based on medical reports of pregnancies. The developmental status of children was studied in five domains. The Age and Stage Questionnaire has been used in many studies (19-21). The researcher completed the questionnaire using interviews, observation, and examination techniques. This questionnaire consisted of 19 questionnaires for 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 27, 30, 33, 36, 42, 48, 54 and 60 months of age. Each questionnaire contained 30 questions (six questions for each domain). Each question had three choices: Yes (the child is fully capable of doing the activity in the question) with a score of 10; No (For activities which have not been done so far) with a score of zero, and Sometimes (for activities which are done in some cases) with a score of five. This questionnaire was approved in 2009 with a reliability of 0.84 and a validity of 0.49 (16). The ability of this test to diagnose developmental disorders is above 96% (16). The validity of the check list was confirmed by 10 faculty members of Shahid Beheshti University of Tehran, and its reliability was measured by 10 mothers through the test-retest method using a one week interval; and a Pearson correlation coefficient of 98% was used to obtain the reliability. If a child does not obtain the winning score for the desired domain in the questionnaire, it means that he or she has a problem in that domain and it must be determined by a specialist that whether the child is healthy or has a disorder.

The sampling method was in a way that after the present study was approved and after the confirmation of the ethics committee, we went to healthcare centers in Isfahan city, and after introducing ourselves, and explaining the research objectives for mothers, we asked them to complete the written consent in case of willing to participate in the present study, and then complete the desired questionnaires in the presence of the researcher. Finally, the information obtained will be coded and entered in the SPSS software version 18.0, and will be analyzed using descriptive tests, Chi-square for SGA and domain of developmental delay, t-test for birth weight and domain of developmental delay and logistic regression tests. P-value less than 0.05 were statistically significant.

3- RESULTS

The aim of study was the relationship between Small for Gestational Age (SGA) at birth and developmental delay in children aged 4 to 60 months. The average age of mothers was 27.4± 4.7 years old. Results showed that 381 children (90.9%) were AGA (Appropriate for Gestational Age) and 29 children (6.9%) were SGA (Small for Gestational Age). The major of precipitants were term for gestational age (n=379, 94.5%), and girl baby (n=213, 51.3%). Demographic results are collected in **Table.1**.

Table-1: The characteristics baseline of the participants in the research

Variables		Number (%)
Mother's job	Housewife	366 (87.3%)
	Self-employed	2 (0.4%)
	Governmental sector	43 (10.2%)
	Private sector	8 (1.9%)
Mother's education	Elementary school	46 (10.9%)
	Middle school	50 (11.9%)
	High school	195 (46.5%)
	University degree	128 (30.5%)
Father's job	Worker	47 (11.2%)
	Private sector	28 (6.6%)
	Self-employed	226 (53.9%)
	Jobless	2 (0.4%)
	Governmental sector	112 (26.7%)
	Retired	4 (0.9%)
	Illiterate	5 (1.1%)
Father's education	Elementary school	53 (12.6%)
	Middle school	85 (20.2%)
	High school	168 (40%)
	University degree	108 (25.7%)
Birth weight	AGA	381 (90.9%)
	SGA	29 (6.9%)
Number of fetuses	One	391 (97.5%)
	Multiple	28 (6.6%)
Gestational age at birth	Term	379 (94.5%)
	Preterm	40 (9.54%)
Gender	Boy	206 (49.16%)
	Girl	213 (53.1%)

AGA: Appropriate for Gestational Age; SGA: Small for Gestational Age.

The results also showed that from among 419 children being studied, 83 (19.8%) had developmental delays, out of whom 15.7% (n=66) had weights above 2,500 gr, and 336 children (80.2%) did not have developmental delays (**Table.2**).

Table-2: The frequency distribution of developmental delay in the subjects of the study based on the birth weight

Variables		Developmental delay Number (%)	Normal Number (%)	Total Number (%)
AGA	≥2500 gr	66(15.7%)	315(75.1%)	381(90.9%)
SGA	1500-2500 gr	11(2.6%)	18(4.2%)	29(6.9%)
	1000-1500 gr	6(1.4%)	2(0.4%)	8(10.9%)
	<1000 gr	0(0%)	1(0.2%)	1(0.2%)
Total		83(19.8%)	336(80.2%)	419(100%)

AGA: Appropriate for Gestational Age; SGA: Small for Gestational Age.

Comparison of developmental domains between the two groups of children based on birth weight (using the independent t-test) showed that there was a significant relationship between the two groups; low and normal birth weight children, in the domain of fine movements (p = 0.02), problem solving (p = 0.02), and the total score (p = 0.02) (**Table.3**).

Table-3: The relationship between the birth weight of children and developmental delay in five domains

Developmental field	Birth weight status	Mean (SD)	P- value
Communication score	SGA	52.3(9.3)	0.7
	AGA	51.7 (9.3)	
Gross motor score	SGA	49 (14.4)	0.059
	AGA	52.5 (9.4)	
Fine motor score	SGA	45.4 (11.4)	0.02 r= 0.81
	AGA	50 (11.1)	
Problem solving score	SGA	47.8 (10.1)	0.02 r= 0.73
	AGA	51.8 (9.5)	
Personal-social score	SGA	53.1 (11)	0.9
	AGA	53.1 (8.1)	
Total field score	SGA	247.7 (32.7)	0.02 r= 0.87
	AGA	259.3 (28)	

AGA: Appropriate for Gestational Age; SGA: Small for Gestational Age; SD: Standard Deviation.

The results obtained from the Chi-square test showed that there was a significant relationship between birth weight for gestational age and developmental delay in children (p < 0.000), and SGA children would be 3.9 times more likely to suffer from developmental delay (**Table.4**). The results also showed that SGA children would be 4.2 times more likely to have developmental delays in the domain of gross movements, 3.8 times in the problem-solving domain, and 4.6 times in the socio-personal domain than normal children would (**Table.4**). In addition, the results obtained from the linear regression test showed that there was a significant relationship between birth weight and developmental delay (p = 0.001), and there was no significant relationship between children's developmental delay and age, history of convulsion, high-risk pregnancies, and use of assisted reproductive techniques (p>0.05).

Table-4: The relationship between small for gestational age (SGA) status at birth and developmental delay in children in different domains

Variables		SGA	AGA	P- value
Communication	Developmental delay	3	19	0.3
	Normal	29	350	
Gross motor	Developmental delay	4	12	0.01 OR= 4.25
	Normal	28	357	
Fine motor	Developmental delay	5	24	0.056
	Normal	27	345	
Problem solving	Developmental delay	5	17	0.00 OR= 3.83
	Normal	27	352	
Personal-social	Developmental delay	2	5	0.04 OR= 4.58
	Normal	30	364	
Total field	Developmental delay	14	61	0.000 OR= 3.92
	Normal	18	308	

*Chi-square test; OR: Odds Ratio; AGA: Appropriate for Gestational Age; SGA: Small for Gestational Age.

4- DISCUSSION

The results obtained from this study showed that in general, there was a relationship between birth weight for gestational age and developmental delay in children, and the relationship was significant in the gross movement, problem solving, and socio-personal domains. SGA infants are at risk of high neonatal complications. These babies have low gestational percentile weights (22). Disabilities are usually two to five times more likely to occur in low birth weight infants than in normal birth weight infants, and their prevalence increases with the decreased birth weight and gestational age. The rate of these disabilities is higher in boys than in girls. The progression towards developmental disorders is 30 times faster in infants weighing less than 2,000 grams than in normal weight babies (3, 5).

In a study by Soleimani et al., it was found out that preterm children are clearly different from their normal peers in the first 5 years of their lives in terms of hand tremors, gross motor abilities, and the ability to control the situation and their balance (4). Another study showed that the preterm birth of a baby could delay their achievement of developmental criteria (23). In addition, in a study in 2004, showed that the prevalence of motor developmental delays was 31% in high-risk infants, which was remarkably higher than that in the normal population, and that one of the most effective factors playing a role in the incidence of motor developmental delays in children, is the preterm birth of infants with a fetal age less than 37 weeks (25.6%) (24).

In general, different factors, which cause the birth of a low birth weight baby, are themselves considered as a potential risk for the incidence of developmental delays (25). In addition, due to the non-development of various organs of their body, a low birth weight baby is at risk of different problems. The occurrence of each of these problems will help the incidence of developmental delays in the infant; and the more premature the infant is, the more likely will be the occurrence of these problems (24). Also, Kerstjens et al. (2009) stated that low birth weight and preterm children aged less than 35 weeks were significantly different from the control group in all developmental domains, and that low birth weight and prematurity increased the chance of developmental delays in children 2.5 to 4.9 times (26). In the other study no significant relationship was found between birth weight and impaired motor development (27); Whereas, Hediger et al. (2002) found out that low birth to have effects on motor and social developmental delays.

They stated in their study that low birth weight was the most important perinatal predicting factor affecting development in girls, and that both factors: low birth weight and duration of pregnancy were related to social and physical development in boys (28). Whereas, Golombok et al. (2007) found out that low birth weight did not affect children's behavioral and emotional development, but that these children had lower performance in language development (29, 30). In a study by Amir AliAkbariet al. (2009), children with developmental delays had birth weights four times lower than children with normal development had (6). Soleimani et al. in their study, concluded that developmental delays occurred 5.86 times more in low birth weight infants than in normal weight infants (1). Furthermore in another study reported children’s low birth weight to be related to delayed motor development (11, 24). Other study also showed that infants with low birth weight history were significantly lower in the acquisition of gross motor skills than normal infants were, indicating that low birth weight children were more prone to motor developmental problems (31). A study showed that from among maternal and gestational factors, preterm delivery, SGA, and intrauterine growth retardation had significant relationships with developmental delays in the studied children (13). A large number of SGA-born babies have a chronic defect in receiving food and oxygen during the fetal stage, which in turn causes a chronic defect in their brain structure, thus resulting in developmental disorders. Slykerman et al. showed that there was no relationship between SGA and developmental delays at the age of one year (32); but Tenovuo et al. (2007) showed that SGA infants had a highly significant relationship with developmental delays compared with appropriate to gestational age (AGA) children (33). Prevalence of developmental disabilities was different in different studies, which could be due to differences in the study population, duration, and follow-up tools.

5- CONCLUSION

Given the positive and significant relationship between birth weight and developmental disorders, special attention to the birth weight of infants and performing regular care during pregnancy and afterwards for SGA children can prevent many developmental problems. Most cares must be focused to prevent SGA baby, and if these newborns are diagnosed, complete and consistent monitoring of development should be done preschool age.

6- CONFLICT OF INTEREST: Nine.

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