Examining the correlation of Apgar with cognitive development and symptoms of behavioral disorders among children and adolescents aged 5, 8, and 12 years old

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Abstract

Introduction: Prenatal events such as premature birth, low birth weight, and low Apgar score can affect life after birth. The present study aimed to determine the correlation between birth Apgar score and cognitive development and symptoms of behavioral disorders in children and adolescents.
Materials and Methods: In the present study 300 children aged 5-12 years old entered the study. Neonatal Apgar score and other information related to the neonatal at birth were extracted from delivery records. Cognitive development was evaluated by the Raven's Coloured Progressive. Symptoms of behavioral disorders were assessed by the Rutter Behavioral Disorders Questionnaire for parents and the validity of 97% and reliability of 92% were achieved. Data analysis was performed in SPSS software. The data obtained from the questionnaires were analyzed using Pearson correlation coefficient.
Results: The correlation between Apgar score and cognitive development was equal to 0.351 which was significant at $P < 0.001$. there was a significant relationship between Apgar score and cognitive development. Also, the correlation between Apgar score and attention-deficit/hyperactivity disorder (ADHD), antisocial behavior, maladaptation, anxiety, and aggression was 0.368, 0.265, 0.419, 0.434, and 0.553, respectively. All of them were significant at $P < 0.001$, i.e., there was a significant inverse relationship between Apgar and attention-deficit/hyperactivity disorder, antisocial behavior, maladaptation, anxiety, as well as aggression.
Conclusion: Factors that reduce the Apgar score at birth can affect cognitive development and behavior in childhood and adolescence and cause many problems. On the other hand, more hospitalization of these infants in their intensive care unit can lead to disruption in child development.

Keywords: Apgar score, Cognitive development, Symptoms of behavioral disorders, Children and adolescents

Introduction

Children are the human capital of the future and a vital and essential component for the existence and the future of nations. Communities and families strive to ensure children's health, enabling them to have an opportunity to reach their potential; therefore, all the facilities need providing to achieve this goal (1, 2).

Medical science aims to give life to vulnerable children, but will every vulnerable child who has a chance to survive go through the natural cognitive development process? Will he/she behave like normal children? Half of the behavioral disorders are not discovered by school-age therefore not treated. Hence, they will threaten social health and development and impose a heavy financial burden on society (3).

Having examined the cognitive development and behavioral disorders in vulnerable children from birth to puberty and comparing them with normal children, we can determine the degree of deviation from the path at each stage of cognitive development and evolution. Parallel to the path of physical health, it is possible to draw the roadmap to mental health development from infancy to puberty; concurrently with physical health care in health centers, behavioral and cognitive problems are also diagnosed, and the treatment of these disorders should begin as soon as possible (4). Whether the diagnosis or follow-up of cognitive development of a vulnerable child during any stage of development will undergo a standard process or not is up to a psychologist (5). If a psychologist can detect the abnormal process of cognitive development and evolution in the early stages of development, he/she could prevent its progression and reduce further complications. By the said method, the community's mental health can be improved to some extent (6).

The Apgar score is widely used to assess the infant's physical condition immediately after birth and indicate perinatal side effects. This score is based on the objective observation of 5 symptoms traditionally used by anesthesiologists to monitor patients' status, including skin color, heart rate, reflex irritability, muscle tone, and respiratory effort (7). Each of the symptoms is coded on a 2-point Likert scale, and the Apgar score is calculated as the sum of the sub-scores (8). A review of earlier studies shows that low Apgar scores could be associated with ADHD (9, 10).

Although weighing less than 1,500 grams occurs in only 1-2% of infants, these births account for a large proportion of infant mortality and short and long-term complications such as developmental defects. Moreover, at school age, these children possess weaker physical development, cognitive function, and productivity, and these complications appear to persist into adulthood. Therefore, creating significant problems for society (10). Thus, this study aims to determine the correlation between the Apgar score, cognitive development, and signs of behavioral disorders among children and adolescents born in three time periods of 2006, 2009, and 2012 at the Hafez University of Medical Sciences, in Shiraz.

Materials and Methods

This was a descriptive correlational study and 300 children aged 5-8 and 12 years old were included. In this research, the Apgar score and other neonatal information were extracted from maternity records. The children participating in this research had no congenital anomalies and trauma. The cognitive development of these children and adolescents was measured by Raven's Coloured Progressive Matrices Test and the validity of 41% and reliability of 62% were obtained (11). Symptoms of behavioral disorders in these children were assessed by the Rutter Children's Behavior Questionnaire and the validity of 97% and reliability of 92% were obtained (12). Data analysis was performed by SPSS software. The statistical population in this research was children born during 2006-2012 at Hafez University of Medical Sciences, Shiraz, who were selected by cluster sampling and systematic random sampling methods. After determining the clusters of the participants born in 2006, 2009, and 2012 at Hafez University of Medical Sciences, by referring to the HIS manager of the hospital, the list of all the mothers who gave birth in 2006, 2009, and 2012 was prepared. Afterwards, 100 samples were systematically and randomly selected from the list each year, 50 of whom were children with normal Apgar scores and 50 were children with Apgar scores below 7 who were transferred to the neonatal intensive

care unit after birth. The researcher randomly selected the first sample of each year from children with normal Apgar scores and those with Apgar scores below 7, informed the mother of the nature of the research, and asked her to refer to the Hafez Hospital with her child if interested for Raven's Coloured Progressive Matrices Test and Rutter Children's Behavior Questionnaire at specified times. If the mother did not want to cooperate, she was removed from the list; if interested, the next person on the list would be contacted by regular random sampling. The files of the mothers who were willing to cooperate were examined in the archive and the information needed about the mother and infant was extracted. The nature of the research and Rutter Children's Behavior Questionnaire was explained to the mother when she referred to the clinic with her child. Then, the questionnaire was given to the mother and the Raven's Coloured Progressive Matrices Test was taken. The minimum time spent for mother and child was 40 min.

The data was analyzed by SPSS software. Statistical analyses were accomplished using Pearson correlation coefficient. A P value < 0.05 was considered significant.

Results

After performing the statistical analyses, it was appeared that the correlation between Apgar and intelligence quotient (IQ) was equal to 0.351 which was significant at $P < 0.001$.

Furthermore, as shown in Table 1, the correlations between Apgar score and attention-deficit/hyperactivity disorder, antisocial behavior, incompatibility, child anxiety, and aggression were equal to 0.368, 0.265, 0.419, 0.434, and 0.553, respectively, which were also significant at $P < 0.001$, so that there was a significant inverse relationship between the Apgar score and ADHD, antisocial behavior, incompatibility, child anxiety, and aggression. In other words, children with an Apgar score below 7 had more symptoms of behavioral disorders, such as ADHD, antisocial behavior, incompatibility, child anxiety, and aggression, than those with a typical Apgar score.

Discussion

The research results showed that the Apgar score had a significant relationship with cognitive development and symptoms of behavioral disorders in children and adolescents. In other words, factors reducing Apgar score, including premature birth, low birth weight, and other factors, can affect cognitive development and behavior in childhood and adolescence and cause many problems for the individual. On the other hand, a higher hospitalization rate of these infants in the intensive care unit can disrupt the child's development process .

As a descriptive study, the development of 80 premature children in age groups of 4, 6, and 12 months with a history of hospitalization in the neonatal intensive care unit of Imam Sajjad Hospital, Yasuj, was investigated. The results showed that, despite the natural development in most infants hospitalized in the neonatal intensive care unit for prematurity, a considerable number of these infants had developmental disorders and required early checkups to prevent complications (13).

In research conducted during 1983-87 in Denmark, the men who were willing to participate were those evaluated for joining the army. A comparison was made between the soldier's medical and intelligence tests with the medical records during delivery. The result of this study showed that an Apgar score below 7 in the first 5 minutes of birth was associated with the prevalence of neurological disability and low cognitive function in early adulthood (12).

In 2015, in a research conducted in Urmia, the developmental growth of children during the first year was assessed based on the Ages and Stages Questionnaire. Consequently, the prevalence of developmental delay in children was 18.8%, with the highest prevalence related to communication (7.1%), and the lowest prevalence of developmental delay was related to large movements (0.9%). The developmental delay in boys was also higher than that of girls. Given the considerable prevalence of developmental delay, screening and follow-up programs are suggested for the developmental growth of children (13).

Table 1. Correlation matrix between Apgar and symptoms of behavioral disorders in children and adolescents.

		Apgar	Aggression	Anxiety	Incompatible behavior	Antisocial behavior	Hyperactivity disorder
Apgar	r	1	0.553*	0.434*	0.419*	0.265*	0.368*
	P		0.000	0.000	0.000	0.000	0.000
	N	300	294	290	299	296	298
Aggression	r	0.553*	1	0.426*	0.664*	0.335*	0.446*
	P	0.000		0.000	0.000	0.000	0.000
	N	294	294	286	294	290	292
Anxiety	r	0.434*	0.426*	1	0.512*	0.248*	0.539*
	P	0.000	0.000		0.000	0.000	0.000
	N	290	286	290	290	286	288
Incompatible	r	0.419*	0.664*	0.512*	1	0.293*	0.459*
behavior	P	0.000	0.000	0.000		0.000	0.000
	N	299	294	290	299	295	297
Antisocial behavior	r	0.265*	0.335*	0.248*	0.293*	1	0.165*
	P	0.000	0.000	0.000	0.000		0.005
	N	296	290	286	295	296	294
Attention	r	0.368*	0.446*	0.539*	0.459*	0.165*	1
deficit/Hyperactivity	P	0.000	0.000	0.000	0.000	0.000	
disorder	N	298	292	288	297	294	298

* P value < 0.001. r, Pearson's correlation coefficient. N, Sample size.

A study was also conducted in Denmark that showed parental education and maternal intelligence were the main predictors of IQ, which should be included in cognitive development research as standard. Postnatal and screening factors also predict IQ, but their contribution could be relatively small (14). However, it can be concluded that a child's cognitive development can be affected by maternal intelligence and social class. According to Forns et al (2012), the relationship between maternal intelligence and cognitive development was different in terms of social class (15).

In research conducted in 2014, the hypoxic-ischemic encephalopathy of children can harm the early development of language, i.e., when the child can interpret and express language. This study showed that 60% of male infants born at 35 weeks old with a low Apgar score had a significant delay in language development (16).

The cause of autism is unknown, although studies have shown that specific problems during pregnancy and infancy can reduce intelligence and increase the risk of autism. A meta-analysis conducted in March 2007 concluded that the autism risk factors were both genetic and environmental. The risk factors associated with autism were as follows: abnormal fetal appearance, fetal distress, umbilical cord problems, birth trauma, maternal bleeding before and during childbirth, early age of newborn, congenital anomalies, low Apgar score in the first 5 minutes of birth, meconium aspiration, ABO blood group incompatibility, RH, and increased bilirubin (17).

In a piece of research, it was concluded that a low Apgar score in the first minute increased

the symptoms of ADHD. The problems causing physical and psychological damage to the baby during pregnancy and childbirth can be identified through Apgar. A study was performed to determine whether Apgar scores were related to the severity of ADHD symptoms in children previously diagnosed with the condition. Hence, the severity of ADHD symptoms while quitting the drug was compared in two groups of children with ADHD: those with low Apgar scores (less than or equal to 6) and those with higher Apgar scores (greater than or equal to 7). The study results showed that low Apgar scores per minute after childbirth significantly increased the severity of ADHD symptoms. These findings determine the importance of appropriate care during pregnancy and before pregnancy (18).

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Authors' Contributions

MB and HJ designed the conception of the study; HJ, NS and SEH focus of the statically analysis; MB, HJ and NS technical support and conceptual advice. All authors contributed to the drafted the manuscript, revised it critically and approved the final version.

Conflict of Interest

The authors declare that they have no Conflict of interest.

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