ORIGINAL ARTICLE

Correlation of Intelligence Quotient (IQ) of Children Younger than 12 Years Old with History of Preterm Birth

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Abstract

Background: Intelligence is the ability of using the different powers and effective behaviors or adapting to new situations or diagnosing conditions and qualities of the environment. It seems that a considerable damage to the brain as a result of premature birth in the last weeks of pregnancy in the maturational - structuring process of the brain can be correlated with Intelligent Quotient (IQ). Due to the high incidence of preterm birth and its associated disorders and its impact on the society and according to a few studies in this field, this study was conducted with the aim of determining the association between IQ and preterm birth. **Materials and Methods:** This cohort study was performed on 303 children of school age. All subjects randomly allocated to cohort groups (n=147) or controls (n=156) with or without any history of preterm birth, respectively. In this study, in addition to demographic characteristics such as age, sex, gestational age at the delivery and parents' educational levels, the standard Raven test was used by trained interviewers to measure the IQ in children. Then data were analyzed by Statistical software SPSS version 16.0 by central statistical indicators of independent T tests and Chi-square test. Significant difference was set at P<0.05. **Results:** The mean IQ of the children in the study, obtained the score of 99.75±9.26 regarding which the independent T-test results showed no significant difference between two groups. In this study, no significant relationship was found between age and gestational age and IQ (P=0.499 and P=0.255, respectively). But this study showed a significant positive correlation between IQ and weight and head circumference at birth (r=0.179, P=0.002 and r=0.299, P=<0.001, respectively).
Conclusion: Unlike results of a few previous studies on this issue, no significant differences were found between the two groups. It is recommended that future studies to be done on broader populations, and behavioral and psychological dimensions should be considered. **[GMJ. 2013;2(3):120-125]**

Keywords: Intelligent Quotient (IQ); Prematurity, School age; Raven Test

Introduction

Intelligence is a mental ability and includes several aspects such as reasoning, planning, problem solving, abstract thinking, using language, and learning. In other words, intelligence can be characterized by the ability of assimilating local knowledge, recalling past events both near and far, logical reasoning, addressing the concepts, turning abstract concepts into words and words into abstract concepts and analyzing form structures [1].

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Intelligence Quotient (IQ) is a measure of the ability of current performance and it does not necessarily indicate the future. Intelligence is a multi factorial trait that many of the genetic and environmental factors may play a role in [2].

Factors affecting the children's IQ in several studies include maternal age, maternal education, maternal smoking, age, and weight of the child at birth. Babies who are born before 37 weeks have IQ 4 to 8 times less than full-term children [3]. Children weighing less than 2500 grams at birth are associated with a significant reduction in IQ. The birth order of the child in the family and the gender is confounding factors in Intelligence [4].

Previous studies have shown that breastfeeding and its duration has a positive impact on the child's IQ [5-8]. But other researchers have reported that there is no significant correlation between IQ and the type and duration of breastfeeding [9, 10]. The delivery method is another factor that seems to have an impact on a child's IQ, but there are conflicting opinions in this regard [11].

The gestational age less than 37 weeks is one of the most important health indicators of any society and the survival of neonates has a direct relationship with gestational age and birth weight. Premature neonates have many problems such as acute respiratory distress syndrome, chronic lung disease, and mental and neurological adverse effects in long term [12]. Despite the considerable progress that has been made in identifying the causes of premature birth, preterm birth rates are increasing. The results of studies in Iran showed that the incidence of prematurity is increasing and has reached from about 13% to 30% in the past three decades [13].

It seems that the potential damage to the brain as a result of premature birth in the last weeks of pregnancy occurs in maturational-structural process of the brain including increased neuronal network connections, dendritic arborisation, increase in synaptic Junctions, neurochemical maturation, and enzymatic processes; these damages can be linked with IQ [14] and may have long-term consequences such as disabilities in adulthood. Due to the high prevalence of preterm birth and the importance of its associated disorders and its undesirable effects on society and limited researches about this issue, this study was conducted with the aim of surveying the relationship of preterm birth and the IQ.

Materials and Methods

Subjects
This was a cohort study and included 303 children of school age divided into cohort groups (n=147) and controls (n=156). This number according to the same study, considered the 95% confidence level and test power of 80%. Purposeful sampling was done in this study. The cohort groups were consisted of children with a history of premature birth and the control group included children with a history of full-term delivery. In this study, preterm birth was considered as delivery before 37 weeks of gestational age. Samples were selected into two groups based on records at Seventeenth-of-Shahrivar Hospital in Rasht. We studied the hospital records of 5-11 years in this center and determined premature and normal children and then they were invited to the study. Furthermore, in order to negate the effects of age and sex on IQ, matching methods were used. To moral considerations, the study goals were explained for parents and personal information of the samples remained confidential and consent was taken from the participants.

Data collection
In this study, in addition to demographic characteristics such as age, sex, gestational age of mother at delivery time and parents' educational levels, the Raven test was used by trained interviewers to measure the IQ in children. Raven's Progressive Matrices are a non-verbal test, which was established in 1938 by Raven and was revised in 1956 and is composed of 36 matrices or designs which in each, a part has been removed. The subject should find removed part from six different options. The test has been prepared and published for children 5 to 11 years old and adults with mental retardation. And now it is a common test for measurement of the IQ in all counseling centers. Reliability and validity of the Raven's

Progressive Matrices have been confirmed in previous studies (The Cronbach's alpha coefficient for internal consistency was 0.95 and for reliability r=0.961) [15].

Data Analysis

Then data were analyzed by Statistical software SPSS version 16.0 by central statistical indicators of independent T tests and Chi-square test. Significant difference was set at P<0.05.

Results

The mean age of children was 126.55± 9.42 months for the cohort group and 126.55± 9.37 months for the control group. The mean age of children in both groups was not statistically different (p=1.00). The mean gestational age of total children was 36.26 ±2.75 weeks. The mean birth weight and head circumference at birth for the total population of the study was 2760.23±260.35gr and 33.37±1.75cm, respectively (Table-1). In the cohort group, 43.5% (n = 64) and in the control group, 32.7% (n=51) were men. Chi-square test showed no significant difference between the two groups (P=0.06; Figure-1).

The average IQ score of the children was 99.75±9.26. The independent T-test results showed no significant difference between the two groups as well.

In this study, the Pearson correlation ratio showed no significant relationship between age and gestational age and IQ (P=0.49 and P=0.25, respectively); but the test showed a significant direct correlation between weight and head circumference at birth and the IQ (r=0.179, P=0.002 and r=0.299, P<0.001, respectively). The details of this correlation are given in Table-2.

Table-1. Investigating the correlation of intelligence quotient (IQ) of children younger than 12 years old with history of preterm birth. Mean and standard deviation (SD) of age, gestational age, birth weight, and head circumference in the cohort and control groups.

Variables	Cohort Group (n=147)	Control Group (n=156)	Total (n=303)	P-Value
	Mean±SD	Mean±SD	Mean±SD	
Age (months)	126.55±9.49	126.55±9.37	126.54±9.33	P=1.00
Gestational age (week)	33.74±1.45	38.63±1.06	36.26 ±2.75	P<0.001
Birth weight (gr)	2226.81±106.06	3260.57±204.84	2760.23±260.35gr	P<0.001
Head circumference (cm)	32.72±1.63	33.97±1.64	33.37±1.75cm	P<0.001

Table-2. Investigating the correlation of intelligence quotient (IQ) of children younger than 12 years old with history of preterm birth; correlation coefficients between IQ and age, gestational age, birth weight, and head circumference in the in the cohort and control groups.

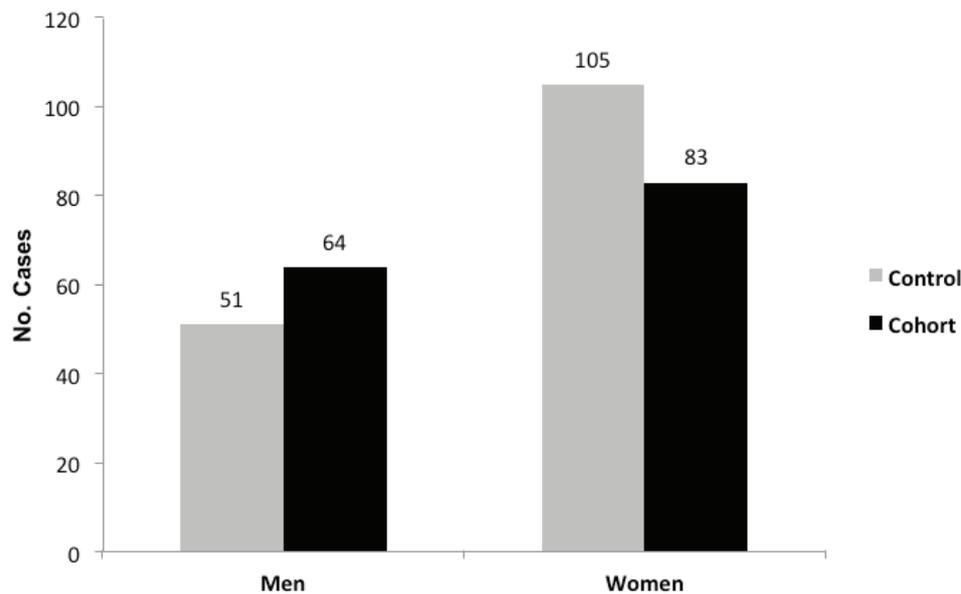| Study group		Age	Weight	Gestational age	Birth head circumference
Cohort	r	0.04	0.05	0.20	0.28
	P	0.56	0.47	0.01	P<0.001
Control	r	- 0.14	0.12	0.45	0.33
	P	0.07	0.12	P<0.001	P<0.001

Figure-1. Investigating the correlation of intelligence quotient (IQ) of children younger than 12 years old with history of preterm birth; distribution of genders in the cohort and control groups.

Discussion

In this cohort study patients were studied in two groups which were not significantly different from each other in terms of gender distribution and educational levels of parents, according to initial matching in the study. In other studies, factors affecting IQ such as education level of parents was similar between groups [16-18].

Our results showed no significant difference in IQ levels between the two groups. Based on the review of conduct literature, many studies have been conducted around IQ in preterm children born before 32 weeks of gestational age compared with healthy children; so far, few studies have been conducted on preterm children born in over 32 weeks of gestational age. Comparing premature children delivered before 32 weeks and healthy children in many studies, lower IQs and higher levels of deficit in academic achievements, attention, behavior, and executive and emotional performances have been reported [17, 18]. In an evaluation of conduct studies on preterm children born after 32 weeks, Van Bar et al evaluated

377, 32 to 36 weeks preterm children, and 182 eight year old healthy children in 2008 and the results showed that, the need for specialized training and the level of retardation in preterm children were more than healthy groups. IQ levels were slightly but significantly lower in the preterm group than the healthy controls [14]. Also, behavioral problems and attention deficits were slightly more prevalent in preterm children compared with the control group. In Chyi et al study in 2008, 970 preterm infants (gestational age between 32 to 36 weeks) were compared with 13670 term infants in terms of school functioning which conducting surveys concluded that children born prematurely require higher education services [19].

The differences of the present results from other studies may be relevant to sample size and the test used in this study. In this study Raven test was used, while a few similar studies used the Wechsler test. As one of the study limitations, disorders of mood, behavior and attention among both groups were not examined, and it is suggested that future studies consider this limitation.

Conclusion

Despite matched groups in factors affecting on IQ in this study, unlike the results of a few studies about this issue, we found no significant difference in the two studied groups telling the fact that there is no significant association between the IQ score and premature birth. Results suggest that future assessments should be done on broader populations and should consider behavioral and psychological aspects.

Acknowledgement

References

1. Kaplan HI, Sadock BJ, Grebb JA. Synopsis of psychiatry behavioral sciences clinical psychiatry. 9th ed. Lippincott Williams and Wilkins. 2003:178.

2. Breslau N, Dickens WT, Flynn JR, Peterson EL, Lucia VC. Low birth weight and social disadvantage: Tracking their relationship with children's IQ during the period of school attendance. Intelligence. 2006;34(4):351-62.

3. Goldenberg RL, DuBard MB, Cliver SP, Nelson KG, Blankson K, Ramey SL, et al. Pregnancy outcome and intelligence at age five years. Am J Obstet Gynecol. 1996;175(6):1511-15.

4. Drane DL, Logemann JA. A critical evaluation of the evidence on the association between type of infant feeding and cognitive development. Pediatr Perinat Epidemiol. 2000;14(4):349-56.

5. Oddy WH, Kendall GE, Blair E, De Klerk NH, Stanley FJ, Landau LI, et al. Breast feeding and cognitive development in childhood: a prospective birth cohort study. Pediatr Perinat Epidemiol. 2003;17(1):81-90.

6. Horwood LJ, Darlow BA, Mogridge N. Breast milk feeding and cognitive ability at 7-8 years. Arch Dis Child Fetal Neonatal Ed. 2001;84(1):23-7.

7. Silva AA, Mehta Z, O'Callaghan FJ. Duration of breast feeding and cognitive function; population based cohort study. Eur J Epidemiol. 2006;21(6):435-41.

8. Roa MR, Hediger ML, Levine RJ, Naficy AB, Vik T. Effect of breastfeeding on cognitive development of infants born small for gestational age. Acta Pediatr. 2002;91(3):267-74.

9. Jain A, Concato J, Leventhal JM. How good is the evidence linking breastfeeding and intelligence?. Pediatrics. 2002;109(6)1044-53.

10. Lucas A, Stafford M, Morley R, Abbott R, Stephenson T, MacFadyen U. Efficacy and safety of long chain polyunsaturated fatty acid supplementation of infant formula milk: a randomized trial. Lancet. 1999;354(9194):1948-54.

11. Roemer FJ, Rowland DY. Long term developmental outcomes of method of delivery. Early Hum Dev. 1994;39(1):1-14.

12. Wannous S, Arous S. Incidence and determinants of low birth weight in Syrian government hospitals. East Mediterr health J. 2001;7(6): 966-74.

13. Taheri P, Abbasi E, Abdeyazdan Z, Fathizadeh N. The effects of a designed program on oxygen saturation and heart rate of premature infants hospitalized in neonatal intensive care unit of Al-Zahra Hospital in Isfahan in 2008-2009. Iran J Nurs Midwifery Res. 2010;15(2):66–70.

14. Van Baar AL, Vermaas J, Knots E, De

Kleine MJK , Soons P. Functioning at School Age of Moderately Preterm Children Born at 32 to 36 Weeks' Gestational Age. Pediatrics. 2009;124(1):251-7.

15. Baraheni MN. Raven's Progressive Matrices as applied to Iranian children. Educational and Psychological Measurement. 1974;34(4):983-8.

16. Gurka MJ, LoCasale-Crouch J, Blackman JA. Long-term cognition, achievement, socioemotional, and behavioral development of healthy late-preterm infants. Archives of pediatrics & adolescent medicine. 2010;164(6):525-32

17. Reijneveld SA, Dekleine MJK, Van Baar AL, Kolle´e LAA, Verhaak CM, Verhulst FC, et al. Behavioral and emotional problems in very preterm and very low birth weight infants at age 5 years. Arch Dis Child Fetal Neonatal Ed. 2006;91(6):423-8.

18. Aarnoudse-Moens CSH, Weisglas-Kuperus N, Van Goudoever JB, Oosterlaan J. Meta-Analysis of Neurobehavioral Outcomes in Very Preterm and/or Very Low Birth Weight Children. Pediatrics. 2009;124(2):717-28.

19. Chyi LJ, Lee HC, Hintz SR, Gould JB, Sutcliffe TL. School outcomes of late preterm infants: special needs and challenges for infants born at 32 to 36 weeks gestation. J Pediatr. 2008;153(1):25-31.