Iranian Journal of Pediatrics Society
Volume 1, Number 1, 2007: 60-66

Original Article

The Incidence of Motor Developmental Delay in High Risk Infants and Most Effective Risk Factors in This Regard

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ABSTRACT

***Background**: High risk infants have a history of one or more risk factors for developmental delay (DD) .The incidence of DD in these infants is higher than normal. The aim of this study was to determine the incidence of motor developmental delay (MDD) and most powerful risk factors in high risk infants who had been referred to a developmental disorder center in Iran.*

***Materials and Methods** This was a descriptive analytical case – control survey. A total of 396 infants, aged 1month -3 years, with the history of one or more risk factors for MDD were studied. Infants with MDD were defined as cases and those without MDD were defined as controls. .Data was collected using a demographic questionnaire, a neurological assessment form, INFANIB Scoring Sheet, and movement and tone assessment in 8 standard positions.*

***Results:** The incidence of MDD in high risk infants was 30.55% (significantly higher than normal). The most powerful risk factors in infants with MDD, were prematurity (25.6%), low birth weight (19%), neonatal seizures (7.4%), hyaline membrane disease (6.6%), systemic infections of mothers during pregnancy (5.7%), and severe neonatal hyperbilirubinemia (4.9%) in sequence.*

***Conclusion:** Necessary attempts should be done for elimination or limitation of risk factors, in order to decreasing the incidence of MDD. Special attention should be paid to high risk infants in order to early detection and treatment of MDD.*

***Key words:** Developmental Delay, Risk factors, Prematurity, Low Birth Weight.*

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INTRODUCTION

In Iran, infants mostly present to health centers for routine vaccination as well as periodical measurement of length, weight and head circumference. Although it is now broadly accepted that periodic developmental assessments are very important, in Iranian health centers and pediatric clinics, developmental status of infants is not assessed systemically. Due to the higher incidence of developmental delay in high risk infants, these periodic developmental assessments are highly recommended in them. These infants have a history of one or more prenatal, perinatal or postnatal risk factors. Regarding the higher incidence of developmental disorders in this group compared to

normal population, early diagnosis of these disorders is very important (1, 2), because early therapeutic and rehabilitative interventions will have better results in them (3).

The aim of this study was to determine the incidence of motor developmental delay (MDD) and the most important risk factors in high risk infants.

MATERIALS AND METHODS

This study was conducted in Developmental Disorder Center of SABA, related to University of Social Welfare and Rehabilitation Sciences (USWR), in Tehran, Iran .It was a descriptive analytical case-control study.

Participants

First, a one-day workshop was held to train the health workers of Tehran health centers, regarding the infants' referral and the important risk factors for MDD. Also all pediatric clinics in Tehran were requested to refer the infants with a history of risk factors to SABA Center. Parents of infants with history of risk factors for MDD were referred to SABA Center as well. The study was conducted during March 2002-November 2003, and had the approval of the Ethic Committee of USWR in Tehran. During that time, there were 403 infants aged 1 month-3 years who had the history of one or more risk factors for MDD and were residing in Tehran. The exclusion criteria were age >3 yrs, progressive motor disorders and lack of enthusiasm. In infants under 2 years and with the history of prematurity, we calculated the corrected age instead of chronological age. Seven infants were excluded from the survey due to the lack of enthusiasm. The remaining infants were involved in survey if their parents would like to participate. A total of 396 infants were enrolled in the study.

Measures

Following admission of infants, a questionnaire including demographic information (age, sex, consanguinity of parents, type of delivery, number of siblings, familial history and the history of pre, peri, and postnatal risk factors) was filled out for them. The prenatal risk factors included vaginal bleeding, systemic bacterial and viral infections (rubella, chicken pox and hepatitis B), toxemia of pregnancy (hypertension), diabetes mellitus, asthma , gastrointestinal diseases, significant anemia , premature rupture of membrane, thyroid diseases, uterine problems, and cardiac diseases of mother, multiple gestations, and teratogens. The perinatal risk factors included pre maturity, prolonged labour and asphyxia, fetal distress, nuchal cord, and placenta previa. The postnatal risk factors included low birth weight (LBW), neonatal seizure, hyaline membrane disease (HMD), severe hyperbilirubinemia, sepsis, congenital anomalies, neonatal pneumonia, metabolic disorders, congenital heart diseases, urinary tract infections, and severe anemia. Infant's growth was examined generally and neurologically by a trained pediatrician. The neurological assessment form included primitive and postural reflexes, cranial nerve sensation, cerebellum, gait (if necessary) assessment and head circumference measurement. The movement variability, muscle tone and antigravity movements were also assessed by the pediatrician in 8 standard positions (supine, side lying, prone, pull to sit, sitting, standing, horizontal suspension, and protective reaction). The pediatrician also assessed tone, posture and reflexes by INFANIB Scoring Sheet only in 4-18 months infants. Infants with MDD were defined as the case group. Infants who had been referred for other reasons and did not have MDD were defined as the control group.

Data analysis

Data were analysed using SPSS software. Comparative differences between the two groups were analysed using Chi-square, t test, and two-way analysis of variances. Statistical significance was set at $p=0.05$.

RESULTS

Age of infants: This study was conducted on 396 high risk infants referred to SABA Center. The majority of infants (88.38%; 350 out of 396) were under 2 years, 55.30% (219 out of 396) were under 1 year and 11.60% (46 out of 396) were between 2-3yrs. In the case group, more than half of the infants (52.89%; 64 out of 121) were under 1yr, 30.57% (37 out of 121) were between 1-2 yrs and 16.52% (20 out of 121) were between 2-3 yrs.

Incidence of MDD: Based on neurological examination and assessment forms, 121 infants had MDD, thus the incidence of MDD in high risk infants was % 30.55 (121 out of 396).

Sexuality: The number of referred female infants was only a few more than male infants in the two groups. There were 71 (51.82%) females and 66(48.18%) males in the control group. There were 65(53.72%) females and 56(46.28%) males in the case group.

Consanguinity of parents: There was a statistically significant difference between the two groups in regard to parents being relatives (p=0.001). There were 13.78 % (19 out of 137) consanguinity of parents in the control group and 25.62% (31 out of 121) in the case group.

Number of siblings: The number of five children or more in one family did not affect the incidence of MDD (P= 0.231). 2.34% (3 out of 128) of the control group were living in seven-member or larger families whereas this rate was 3.44% (4 out of 116) in the case group.

Familial history: There was no statistically significant difference between the two groups in regard to having a positive familial history for MDD (P=0.507). 18.25% (25 out of 137) had a positive familial history in the control group. This rate was 15.70% (19 out of 121) in the case group.

Method of delivery: The caesarean delivery did not cause developmental delay (PV=0.169). There were 55.47% (76 out of 137) caesarean delivery in the control group and 47.11% (57 out of 121) in the case group.

Prenatal risk factors: Table 1 shows the number of prenatal risk factors in the two groups. The case group in comparison with the control group had no more history of prenatal risk factors (P=0.07). 17.77% (24 out of 135) of the control group and 27.96% (33 out of 118) of the case group had a positive history of prenatal risk factors. The percentage of different risk factors in case and control groups is shown in histogram 1.The most common prenatal risk factors in prenatal history positive MDDs were systemic bacterial infections (20.6%;7 out of 34), hypertension (14.7%;5 out of 34) , diabetes mellitus (8.8%;3 out of 34) and viral infections (8.8%;3 out of 34) of the mother during pregnancy sequentially.

Table 1. Prenatal risk factors in case and control groups

Prenatal risk factors	Control Group	Case Group	Total	df	Value	Sig
	n (%)	n (%)				
Negative	111(82.22)	85(72.03)	196	1	3.745	.053
Positive	24(17.77)	33(27.96)	57			
Total	135	118	253			

Perinatal risk factors: Table 2 shows the number of perinatal risk factors in the two groups. The case group in comparison with the control group had more perinatal risk factors (P=0.004). 17.55 % (23 out of 131) of the control group and 33.88% (41 out of 121) of the case group had a positive history of perinatal risk factors. The percentage of perinatal risk factors in case and control groups is shown in histogram 2 and prematurity has the highest percentage (22 out of 137; 16.05% in control and 32 out of 121; 26.44% in the case group). Also the most common perinatal risk

factor in perinatal history positive MDDs was prematurity (75.6%; 31 out of 41).

Table 2. Perinatal risk factors in case and control groups

Perinatal risk factors	Control Group	Case Group	Total	df	Value	Sig
	N(%)	N(%)				
Negative	108(82.44)	80 (66.11)	188	1	8.850	.003
Positive	23(17.55)	41(33.88)	64			
Total	131	121	252			

Postnatal risk factors: Table 3 shows the number of postnatal risk factors in the two groups. Children in the case group compared to the control group were exposed to a higher number of postnatal risk factors (P =0.03). 35.33 % (47 out of 133) of the control group and 49.16% (59 out of 120) of the case group had a positive history of postnatal risk factors. The percentage of different postnatal risk factors in case and control groups is shown in histogram 3.The most common postnatal risk factors in postnatal history positive MDDs were low birth weight (39.65%, 23 out of 58), neonatal seizure (15.50%, 9 out of 58), hyaline membrane disease (13.80%, 8 out of 58) and severe hyperbilirubinemia (10.3%, 6 out of 58) sequentially.

Table 3. Postnatal risk factors in case and control groups

Postnatal risk factors	Control Group	Case Group	Total	df	Value	Sig
	N(%)	N(%)				
Negative	86(64.66)	61(50.83)	147	1	4.955	.026
Positive	47(35.33)	59(49.15)	106			
Total	133	120	252			

Comparison of risk factors: Comparison of prenatal, perinatal and postnatal risk factors in the case group indicated that prematurity (25.6%,31 out of 121), low birth weight (19%,23 out of 121) ,neonatal seizures (7.4%,9 out of 121), hyaline membrane disease (6.6%,8 out of 121), systemic infections of the mother (5.7%,7 out of 121), and severe hyperbilirubinemia that needed exchange transfusion (4.9%,6 out of 121) were the most common factors in sequence.

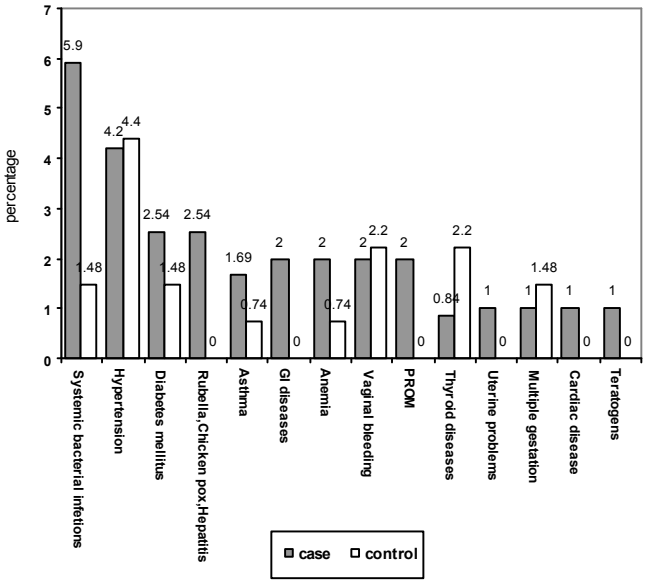

Figure 1. Prenatal risk factors in case and control

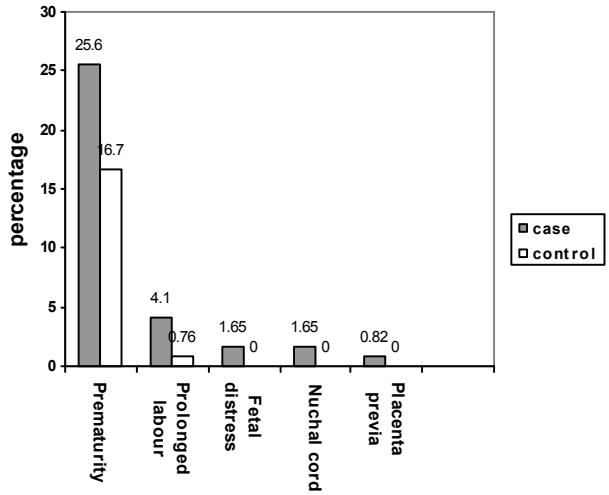

Figure 2. Perinatal risk factors in case and control groups.

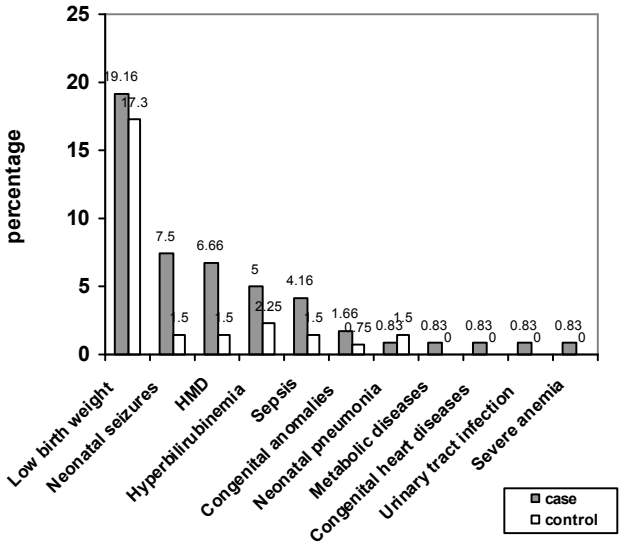

Figure 3. Postnatal risk factors in case and control groups.

DISCUSSION

According to the results of this study, the incidence of MDD in high risk infants is 30.55%.This incidence is considerably higher than that of normal population because the incidence of cerebral palsy (established MDD) in normal population is 2-4/1000 (2, 4). This result supports other studies; Geoffrey (1998) and his colleagues showed that very low birth weight (<1.5 kg) results in increasing the incidence of CP to 5-15% and other developmental disorders (e.g. mental retardation, speech delay,…) to 25-50% (3). Also in case of birth asphyxia, the incidence of cerebral palsy significantly increases, as it is seen in apgar score of 0-3 in minutes of 1,5,15 and 20 of birth, the incidence of CP increases to 1.5%, 4.7%, 16.7%, 36% and 57.1% respectively (5). Furthermore, the incidence of cerebral palsy increases significantly with the history of risk factors like kernicterus, multiple gestation, intracranial hemorrhage, minor and major malformations, severe bronchopulmonary dysplasia, and post hemorrhage hydrocephaly (3).

Based on the above mentioned facts, determination of the most important risk factors in each society is highly emphasized, due to their effect on increasing the incidence of cerebral palsy and generally developmental delay.

According to the results of this study, the history of consanguinity in parents of children with MDD was significantly higher than controls. This contributes the cause of developmental delay by autosomal recessive disorders. Most inborn errors of metabolism (IEMs) are inherited as autosomal recessive and are considered as one of the causes of MDD in infants. Consanguity of parents causes appearance of IEMs in infants while they are simply preventable (1).

According to the results of this study, the number of 5 children or more in one family does not cause developmental disorders. High number of children in a family is not considered as a direct factor in eliciting high risk pregnancies but in some references pregnancies of sixth and more need more cares and in some sources, are considered as high risk pregnancies (6).

Regarding the results of this study, a history of developmental delay or cerebral palsy in the family or in close relatives of an infant does not affect the appearance of MDD in that infant. In some references the known developmental diseases in the family with specific inheritance like mandelian autosomal and X-linked recessive, help in the diagnosis of infant's disease (1).

According to the results of this study the method of delivery does not affect incidence of developmental delay in infants. In some other references, caesarean method is considered as a risk factor that needs careful supervising of an experienced physician and nurse (1).

Regarding the results of this study, a history of prenatal risk factors in infants with developmental delay was more than those in the control group but showed no significant differences. The most common prenatal risk factors in history positive cases were

systemic bacterial infections. In one study (7), intrauterine infection, maternal pyrexia, and the presence of thrombophilic disorders have been identified as major risk factors for subsequent CP. The interactions of viral or bacterial infections during pregnancy, normal or abnormal fetal cytokines responses, as antenatal causes of the neuropathology of CP are now areas of research priority. In some references prenatal factors like teratogenic drugs, radiation, vaginal bleeding and important diseases of the mother especially diabetes, hypertension, (pre-eclampsia and eclampsia), are emphasized as the cause of high risk pregnancies and consequently the birth of high risk infants, but the role of these factors in the cause of cerebral palsy by formation of asphyxia, or injuries to the developing brain is also important (3). Due to the multiplicity of prenatal factors in this study (14 factors); for better determination of the effect of each factor on MDD incidence, another study with a larger sample size should be performed.

Based on the results of this study, perinatal risk factors affect the MDD incidence. The most common perinatal risk factors were prematurity and asphyxia respectively. These two factors are mentioned as important factors in various references and studies. Generally different causes of prematurity can also be considered as a potential danger for appearance of developmental delay .On the other hand a premature infant, because of its different premature organs is exposed to various hazards. These problems play a role in causing developmental delay, like hyaline membrane disease, that results in decreasing oxygenation of brain. An infant with less GA will have more problems (1, 2).

In one study (8), the effect of prematurity on developmental outcome at the corrected age of 18 and 24 months was determined. The study showed that at 18 and 24 months corrected age, 40% of the very prematurely born children had both delayed mental and/or psychomotor development. In another study conducted in rehabilitation centers of Tehran on 200 children with cerebral palsy, prematurity was one of the most important factors causing cerebral palsy (69cases; 34.5%) (6). Regarding the results of the study by Geoffrey M. and his colleagues, 10-20% of children with cerebral palsy had the history of asphyxia. Also the severity of asphyxia has a direct relation with the incidence of cerebral palsy (3). In a study conducted in Iran, asphyxia was similarly the important cause of cerebral palsy (45%) (6).

Based on this study, postnatal risk factors are effective in causing developmental delay in infants. The most important factors were sequentially low birth weight (under 2500 gr), neonatal seizures, hyaline membrane disease and severe hyperbilirubinemia in need of exchange transfusion.

Factors that cause intrauterine growth retardation (IUGR), also cause various problems like hypoglycemia, asphyxia, polycytemia, hypothermia and dysmorphology, in neonatal period (1).

In one study conducted in Iran on 200 cases with cerebral palsy, low birth weight and severe hyperbilirubinemia were determined as effective factors in causing cerebral palsy (6). In another studies, researchers showed that the combination of severe prematurity and intrauterine growth retardation constitutes serious developmental handicaps including CP, blindness, deafness, and mental retardation, and predisposes the infant to physical and developmental delays (9, 10). In another study (11), it has been shown that fetal growth restriction is associated with an increased risk of poor neurological outcome. This includes an increased risk of cerebral palsy in babies greater than 32 weeks' gestation.

CONCLUSION

In general, according to the results of this study, the incidence of developmental delay in high risk

infants' population is more than normal population. Therefore, due to the impossibility of developmental assessment of all infants for the time being, all specialists and staff related to these infants should know the symptoms of developmental delay in the first year of life, so that they can diagnose those affected or suspicious of having developmental delay as soon as possible in order to get better therapeutic results.

Also, it became generally determined that the most common risk factors in infants with MDD, are prematurity, low birth weight, neonatal seizure, hyaline membrane disease, systemic bacterial infections of the mothers in pregnancy, and severe hyperbilirubinemia in sequence. Thus, considering the above factors as the most common risk factors, a careful program is highly recommended to eliminate these factors.

ACKNOWLEDGEMENT

We would like to thank parents of infants, health workers, medical staff and pediatricians who willingly cooperated with us, and referred the infants. Also, we would like to acknowledge Mahmoud Hajaran, Ali Abbaspour and Masoumeh Aran for their cooperation, Chancellor and Vice-Chancellor of the research division of the University of Social Welfare & Rehabilitation Sciences for their ongoing financial support.

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