Risk factors of developmental delay in children from the age group of 6 months to 6 years

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Abstract

Background: Infants at risk for developmental delay (DD) have a history of one or more risk factors that occurred during pregnancy, the perinatal period, or after birth. Despite numerous studies on high-risk pregnancies and child development in advanced countries, there is scanty data from developing nations like India.

Objectives: To determine the antenatal, natal and postnatal risk factors of DD in children aged 6 months to 6 years.

Method: A case-control study comprising 61 infants with DD and 61 controls was carried out at Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe) in Maharashtra from December 2019 to May 2020. Children with DD were taken as cases and children without DD as controls. A questionnaire delivered to mothers was used to gather data. Data analysis was carried out using STATA, version 10 software.

Results: Common risk factors were caesarean sections (55%), infections (58%), and chronic disorders during pregnancy (49%). Maternal infections, chronic diseases during pregnancy, caesarean section, failure to cry after birth and absence of breastfeeding were significantly more in cases compared to controls.

Conclusions: In this case-control study, maternal infections, chronic diseases during pregnancy, caesarean section, failure to cry after birth and absence of breastfeeding were risk factors of DD in children aged 6 months to 6 years.

(Key words: Risk factors, Antenatal, Natal, Postnatal, Development delay, Children)

Introduction

Developmental delay (DD) is still regarded as one of the issues in the health system despite advances in medical sciences[1]. Prevalence of DD is reported to be 2 in 1000 in healthy infants, but rises to 60 in 1000 in high-risk infants[2]. Global DD is a severe delay in two or more of the following domains: social/personal, speech/language, cognition, gross/fine motor, and daily living activities[3]. Infants at risk for DD have a history of one or more risk factors that occurred during pregnancy, perinatal period, or after birth. Preeclampsia, placental abruption, immaturity, intrauterine growth restriction, mother's underlying illnesses, including multi-morbidity and addiction, young maternal age, multiple gestations, low maternal educational level, and being a single mother household are all risk factors before birth[4,5,6]. Preterm birth and caesarean section delivery are the most significant perinatal risk factors for DD[7]. Postnatal risk factors include lack of breastfeeding, low birth weight, low Apgar scores, cerebral haemorrhage and kernicterus[8,9]. Despite numerous studies on high-risk pregnancies and child development in advanced countries, there is scanty data from developing nations like India.

Objectives

To determine the antenatal, natal and postnatal risk factors of DD in children aged 6 months to 6 years.

Method

A case-control study was carried out in Acharya Vinoba Bhave Rural Hospital, Sawangi (Meghe) located in Maharashtra from December 2019 to May 2020. The children admitted in the paediatric ward aged 6 months to 6 years who were suspected of DD were taken as Cases and children without DD were taken as Controls. We started the study after getting written informed consent.

We collected data using questionnaire for mothers of the children regarding selected risk factors of DD and their medical records if available. It consisted of the antenatal, natal and postnatal histories.

- Prenatal risk factors: multiple gestation, chronic illnesses and infections during pregnancy, along with a history recurrent miscarriage.
- Perinatal risk factors: the type of delivery.
- Postnatal risk factors: Weight of the newborn, duration of NICU stay, history of seizure, history of mechanical ventilation, history of whether baby cried after delivery, hyperbilirubinaemia, breastfeeding, history of respiratory distress, history of hypoglycaemia

Ethical issues*:* Study approval was obtained from the Institutional Ethics Committee of Datta Meghe Institute of Medical Sciences, Sawangi (Megha) Wardha, Maharashtra, India. Written informed consent was obtained from the parents of the participating children.

Statistical analysis: Data analysis was carried out using STATA version 10 software. Chi-square test was used for analysis of qualitative variables, while continuous variables were compared between cases and controls using

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independent-samples t-test. Associations of variables with outcomes are expressed by odds ratio (OR) with 95% confidence interval (95% CI). Statistical significance was set at $p < 0.05$.

Results

Table 1 shows the distribution of the children according to their weight.

Table 2 shows the distribution of the children according to their mother's age. Elderly mothers were seen more in cases as compared to controls

Table 1: ***Distribution of children according to their Weight***

Birth weight	Cases: n (%)	Controls: n (%)
<2.5 kg	24 (39.3)	11 (18.0)
≥ 2.5 kg	37 (60.7)	50 (82.0)
Total	61 (100.0)	61 (100.0)

Table 2*: Distribution of children according to their mother age*

Mother's age	Cases: n (%)	Controls: n (%)
<20 years	02 (03.3)	03 (04.9)
20-30 years	30 (49.2)	45 (73.8)
30-40 years	29 (47.5)	13 (21.3)
Total	61 (100.0)	61 (100.0)

Table 3 shows the exposure to maternal infection of cases and controls. Among the cases, 35 of the 61 mothers had maternal infection whilst among the controls only 2 of the 61 mothers had maternal infection and the difference was highly significant (p=0.0000).

Table 3: ***Exposure to maternal infection of cases and controls***

Exposure to maternal infection	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	35	02	37	34	5.703667 - 1381.926	31.11	0.0000*
No	26	59	85				

Table 4 shows the frequency of multiple gestation among cases and controls. Among the cases, 8 of the 61 mothers had multiple gestation whilst among the controls 5 of the 61 mothers had multiple gestation and the difference was not significant (p=0.5488).

Table 4: ***Frequency of multiple gestation in cases and controls***

Multiple gestation	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	08	05	13	1.75	4448878 - 8.152192	0.82	0.5488
No	53	56	109				

Table 5 shows the frequency of a history of habitual abortion among cases and controls. Among the cases, 14 of the 61 mothers had a history of habitual abortion whilst among the controls 2 of the 61 mothers had a history of habitual abortion and the difference was not significant (p=1.0000)

Table 5: ***Frequency of history of habitual abortion in cases and controls***

History of habitual abortion	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	14	02	16	-	-	31.11	1.0000
No	47	59	106				

Table 6 shows the frequency of a history of chronic disease during pregnancy among cases and controls. Among the cases, 30 of the 61 mothers had a history of chronic disease during pregnancy whilst among the controls 2 of the 61 mothers had a history of chronic disease during pregnancy and the difference was highly significant (p=0.0000).

Table 6: ***Frequency of history of chronic disease during pregnancy in cases and controls***

History of chronic disease during pregnancy	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	30	02	32	29	4.808231 - 1184.437	26.13	0.0000*
No	31	59	90				

Table 7 shows the frequency of preterm birth among cases and controls. Among the cases, 35 of the 61 mothers had preterm births whilst among the controls 2 of the 61 mothers had preterm births and the difference was highly significant (p=0.0000).

Table 7: ***Frequency of preterm birth in cases and controls***

Preterm birth	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	35	02	37	-	-	33.00	0.0000*
No	26	59	85				

Table 8 shows the frequency of delivery by caesarean section among cases and controls. Among the cases, 34 of the 61 mothers were delivered by caesarean section whilst among the controls 27 of the 61 mothers were delivered by caesarean section and the difference was highly significant (p=0.0000).

Table 8: ***Frequency of delivery by caesarean section in cases and controls***

Delivery by caesarean section	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	34	11	45	8.666667	2.656104 - 44.73784	18.24	0.0000*
No	27	50	77				

Table 9 shows the frequency of babies crying immediately after birth among cases and controls. Among the 61 cases, 22 babies did not cry immediately after birth whilst among the 61controls only 1 baby did not cry immediately after birth and the difference was highly significant (p=0.0000).

Table 9: ***Frequency of babies crying immediately after birth in cases and controls***

Babies crying immediately after birth	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	39	60	99	.0454545	.0011014 - .281208	19.17	0.0000*
No	22	01	23				

Table 10 shows the requirement of NICU stay among cases and controls. Among the 61 cases, 53 required NICU stay whilst among the 61controls only 2 babies required NICU stay and the difference was highly significant (p=0.0000).

Table 10: ***Frequency of NICU stay in cases and controls***

Requirement for NICU stay	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	53	02	55	13.33136	-	51.00	0.0000*
No	08	59	67				

Table 11 shows the frequency of a history of hypoglycaemia among cases and controls. Among the 61 cases, 10 had a history of hypoglycaemia whilst among the 61controls none had a history of hypoglycaemia and the difference was significant (p=0.0020)

Table 11: ***Frequency of a history of hypoglycaemia in cases and controls***

History of hypoglycaemia	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	10	0	10	2.241521	-	10.00	0.0020*
No	51	61	112				

Table 12 shows the frequency of a history of convulsions among cases and controls. Among the 61 cases, 15 had a history of convulsions whilst among the 61 controls none had a history of convulsions and the difference was significant (p=0.0001).

Table 12: ***Frequency of a history of convulsions in cases and controls***

History of convulsions	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	15	0	15	3.586749	-	15.00	0.0001*
No	46	61	107				

Table 13 shows the frequency of a history of prolonged hyperbilirubinaemia among cases and controls. Among the 61 cases, 21 had a history of prolonged hyperbilirubinaemia whilst among the 61 controls 5 had a history of prolonged hyperbilirubinaemia and the difference was significant (p=0.0009).

Table 13: ***Frequency of a history of prolonged hyperbilirubinaemia in cases and controls***

History of prolonged hyperbilirubinaemia	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	21	05	26	6.333333	1.864327-33.41648	11.64	0.0009*
No	40	56	96				

Table 14 shows the frequency of a history of respiratory distress among cases and controls. Among the 61 cases, 30 had a history of respiratory distress whilst among the 61 controls 2 had a history of respiratory distress and the difference was highly significant (p=0.0000).

Table 14: ***Frequency of a history of respiratory distress in cases and controls***

History of respiratory distress	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	20	02	22	4.396597	-	18.00	0.0000*
No	41	59	100				

Table 15 shows the frequency of breast feeding among cases and controls. Among the 61 cases, 46 were not on breast feeding whilst among the 61 controls 8 were not on breast feeding and the difference was highly significant (p=0.0000).

Table 15: ***Frequency of breast feeding in cases and controls***

Breast feeding	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	15	53	68	0.0731707	0.0144948-0.22935	32.82	0.0000*
No	46	08	54				

Table 16 shows the frequency of assisted ventilatory support in NICU among cases and controls. Among the 61 cases, 39 required assisted ventilatory support whilst among the 61 controls none required assisted ventilatory support and the difference was highly significant (p=0.0000).

Table 16: ***Frequency of assisted ventilatory support in cases and controls***

Assisted ventilatory support	Cases *(n=61)*	Controls *(n=61)*	Total	Odds ratio	Confidence interval	Chi square test	p-value
Yes	39	0	39	10.0802	-	39.00	0.0000*
No	22	61	83				

Discussion

Prenatal risk factors, such as chronic illnesses and infections during pregnancy, as well as hospital-related risk factors, such as caesarean section, were both significant risk factors in children with DD. Prenatal, natal, and postnatal parameters include systemic infection during pregnancy, chronic disease in pregnancy, caesarean section, preterm, neonatal hyperbilirubinaemia, NICU stay, and infants not breastfed were all substantially linked to developmental delay[10]. By identifying its determinants, the primary goal of this study is to create a more complete picture of newborn DD. Infant DD and high-risk pregnancies are significantly correlated. The findings of this investigation further supported this.

Present study which shows statistically significant differences between cases and controls in antenatal risk factors of maternal problems such as chronic diseases during pregnancy and infections 49% and 58% higher than controls respectively. A high-risk pregnancy has a prominent association with DD in infants. Pregnant women experience more severe infections from a variety of pathogens than non-pregnant women because as the pregnancy progresses, immunologic changes may hamper pathogen clearance, increasing the severity of some infections[11].

Preterm labour, maternal age, and low birth weight are regarded to have significant influences on a child's development[12]. In the current study, 47% mothers were above 30 years old. According to an Iranian study, children's growth was delayed as a result of conditions like diabetes, hypertension, consanguineous marriage, history of abortion, high-risk pregnancies, and low birth weight[13]. DD was more common in premature babies. In this study, cases were much more likely than controls to experience prenatal risk factors such preterm birth and caesarean sections. In this study, preterm birth was linked to increased risk of DD and similar results have been found in other studies[14]. Stoelhorst GM, *et al*[15] examined the impact of preterm on developmental outcomes and found that 40% of extremely prematurely born children had impaired mental development, psychomotor development, or both at 18-and-24-months corrected ages.

The study's findings, which were confirmed by others, showed that babies delivered via caesarean section had a nine-fold higher likelihood of developing DD later in life than babies delivered vaginally. In a study by Kerstjens JM, *et al*[16] caesarean section had a significant correlation with DD in a univariate analysis. Similar results were found in a study by Bajalan Z, *et al*[17]. In our study low birth weight was significantly related to DD. Tavasoli A, *et al*[18] found a similar DD in fine motor domain in newborns with low birth weight. Demirci A, *et al*[19] reported that there was a significant difference between children in the DD group and children in the control group in terms of birth weight.

According to Soleimani F, *et al*[20] postnatal risk factors can have an impact on both development of the fetus and infant. These include NICU stay, breathing with mechanical ventilation, oxygen therapy, etc. A higher risk of DD was associated with a lower first-minute Apgar score Our findings are consistent with this study. Compared to the control group in our study, infants with chronic hyperbilirubinaemia had a increased risk of developing DD. Similar to this, a study in Tehran found that severe hyperbilirubinaemia had a negative impact on the development of DD[21].

Breastfeeding was linked to a lower risk of DD in our study. According another study, infants who were exclusively breastfed for at least four months were 50% less likely to have problems with their gross motor coordination than those who had never been breastfed[22]. In the present study babies who did not cry at birth and babies who required mechanical ventilation were significantly associated with DD as compared to controls. A study by Jauhari P, et al[23] found hypoxic ischaemic encephalopathy (HIE) in 41.8% of children with intellectual disability in paediatric outpatients in Northern India.

There are some limitations to the study. Firstly, the study was only done in one rural hospital and the number of patients was small. Therefore, more research with large sample size and long duration would be beneficial.

Conclusions

In this case-control study, maternal infections, chronic diseases during pregnancy, caesarean section, failure to cry after birth and absence of breastfeeding were risk factors of DD in children aged 6 months to 6 years.

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