Original Research Article

Study of perinatal factors in children with developmental delay

Goli Sri Charan[1]*, Jayant Vagha[2]

[1]Department of Pediatrics, Acharya Vinobha Bhave Rural Hospital, Jawaharlal Nehru Medical College, Maharashtra, India
[2]Department of Pediatrics, Datta Meghe Institute of Medical Sciences, Sawangi, Wardha, Maharashtra, India

*Correspondence:
Dr. Goli Sri Charan,
E-mail: golicharan36@gmail.com

ABSTRACT

Background: Birth history gives important information in children with developmental delay. Developmental challenge in children is an emerging problem across the globe, which is largely associated with improved neonatal survival. The present study highlights the importance of birth history in children with developmental delay in our hospital. The objective of this study was to study the perinatal events in children with developmental delay.
Methods: Observational descriptive study was conducted on children between 6 months to 5 years who were admitted in Pediatric wards with suspected history of developmental delay. DDST II scale was performed on these children and children who failed on Denver II scale were recruited into the study. Birth history was noted in detail, if available, documentation of birth events was asked for and noted. Developmental history with developmental quotient (DQ), were noted in detail.
Results: 135 children had developmental delay, 113 (83.70%) were born by vaginal delivery and 22 (16.30%) were born by caesarian section, 46 (34.18%) had no cry at birth and remaining 89 (65.92%) had normal cry at birth. 104 (77.04%) were born by term gestation and 31 (22.96%) were born preterm. Birth weight was normal in 78 (57.7%) children, LBW was seen 47 (34.81%) and 5 children each with VLBW and ELBW and 35 (25.93%) were IUGR. On comparing the children born gestational age and birth body weight with all four domains, there was no significant difference.
Conclusions: Global developmental delay was more common in children born at preterm, low birth weight, IUGR and children who had birth asphyxia. Birth weight and gestational age did not significantly affect any particular domain of development.

Keywords: Birth asphyxia, DDST II Scale, Global developmental delay, Prematurity

INTRODUCTION

A thorough knowledge and understanding of the normal development of the infant and young child is just a fundamental to anyone concerned with the care of children, especially Pediatricians, as is anatomy to the surgeon. Pediatricians and others must know the normal, and the variations from the normal, before they attempt to diagnose the abnormal. Without such an assessment we are unable to make a proper diagnosis, to arrange proper treatment, and to help the parents or school medical officer as much as we should. A thorough knowledge of the normal should be just as much the basis for the study of the abnormal and of disease.[1]

Developmental delay is one of the most common conditions encountered by pediatricians in clinical practice. Early identification and diagnosis have implications for treatment (as in congenital hypothyroidism), genetic counseling and estimation of the risk of recurrence, management of possible associated

conditions, prognostication and prevention, both at the individual and community level. The developmental delay causes significant psychosocial and economic burden on the family and the country. Birth history gives important information with developmental delay.[2] Developmental challenge in children is an emerging problem across the globe, which is largely associated with improved neonatal survival. Improved newborn care is leading to salvage of many critically ill newborns, but many of them survive with brain damage, leading to ultimate developmental disability. Sick neonates, particularly preterm babies, very low birth weight (VLBW) and extremely low birth weight (ELBW) babies (birth weights less than 1500 and 1000 g respectively) with perinatal hypoxia and hypoxic-ischaemic encephalopathy, sepsis, severe jaundice etc. are most vulnerable to poor neuro-developmental outcome.[3] The study was performed to find out the importance of birth history in children with developmental delay.

METHODS

The present study was conducted at the Department of Pediatrics, Acharya Vinoba Bhave Rural Hospital, Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha, Maharashtra, India. It was conducted for a period of two years from 1st August 2014 to 31st July 2016. It was an observational study. The study was initiated only after obtaining permission from the Institutional Ethics Committee, (Reference number DMIMS (DU)/IEC/2014-15/835) Acharya Vinoba Bhave Rural Hospital, Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha, Maharashtra, India.

Inclusion criterion

All the children from 6 months to 5 years of age admitted in Pediatric wards suspected of Developmental delay, which do not pass on the DDST II.

Exclusion criteria

- Patients who are not willing to participate in the study
- Patients who failed on DDST - II scale but developmental delay was present only in one domain of development.

Methodology

In this study, children between 6 months to 5 years who were admitted to the pediatric ward with suspected developmental delay who could not clear on DDST- II scale were included in the study. 135 children were recruited for this study as per the criteria.

### Clinical history and evaluation

Detailed history, general and physical examination was carried out and growth was assessed with detailed birth history is taken including obstetric complications during the pregnancy; history of illness, infection, radiation exposure or injury and social habits, e.g. smoking of the mother are noted. Drug or alcohol ingestion and poor diet during pregnancy is documented. The birth weight of the baby is recorded with gestational age and mode of presentation. Details of any intrapartum or perinatal problems are recorded with details of cry/birth asphyxia at birth and duration of stay in NICU if present and the diagnosis during the stay is noted. Family and past history are also noted in detail with a proper pedigree chart as required with details of consanguinity.

Developmental history was obtained in detail and developmental quotient was calculated in all the four quadrants of development. All the details were documented in a pre-designed proforma.

Anthropometry included Weight and Height of the children were taken.

Flow chart
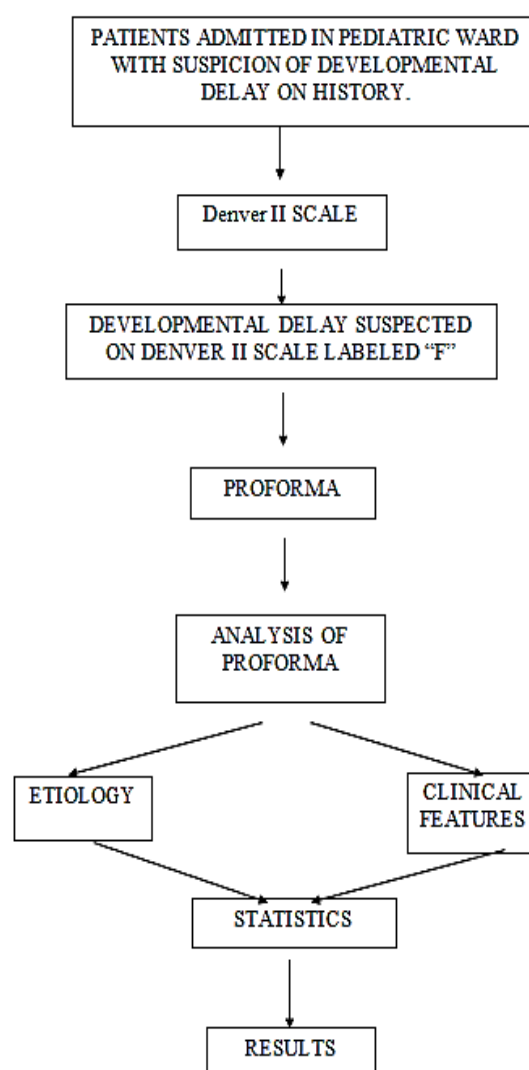
General examination of the patients was done in detail Following were noted

- Vital parameters like pulse rate, respiratory rate and blood pressure
- Abnormalities like pallor, edema, icterus, cyanosis, clubbing and significant lymphadenopathy
- Detailed head to toe examination was done.

Presence of dysmorphism was noted. Systemic Examination was done in detail. Central nervous system Examination (4) was done in detail. DDST II scale was used to assess the development:

Denver developmental screening test - II (5)

DDST II was used as it is very easy to perform requiring very less time frame.

Test administration

General instructions

The Denver II can be used to screen a child repeatedly from the birth to 6 years of age. To use the same test form on more than one occasion, it is suggested that a new age line to be drawn each time the child is screened, and that the scoring of items be done in such manner as to distinguished the scores for each administration.

All items must be tested in accordance with standardized administration procedures.

Order of testing

The order of presenting items should be flexible, and the sequence should be adjusted according to the responsiveness of the child. It is generally helpful to place one or more age appropriate test items on the table so that child can amuse him/herself while the examiner asks the parent the reportable items of the personal-social sector. The child's free activity while "report" items are being asked of the caregiver is considered part of the evaluation, and the examiner should be attentive to the child's spontaneous behaviour. Test items may be scored on the basis of any relevant behaviour observed by the examiner even if it occurs before or after the formal testing.

Item scoring

- 'P' for pass - the child performs the item or caregiver reports that the child does the item
- 'F' for fail - the child does not perform the item
- 'N.O' for No opportunity - the child has not had the chance to perform the item, due to restriction from the caregiver or other reasons
- 'R' for refusal - the child refuses to attempt the item. Then the child was asked to repeat the test at a later date.

Interpretation

- Advanced items
- Normal items
- Caution item
- Delayed item
- No opportunity item

Interpretation of test

- Normal: No delays and a maximum of 1 caution conducted routine rescreening at next well-child visit
- Suspect: Two or more cautions and/or one or more delays
- Untestable: Refusal scores on one or more items completely to the left of the age line or on more than one item intersected by the age line in the 75 - 90% area.

If the test is untestable the test is repeated later on next day.

A room adjacent to the Pediatrics ward was selected where there was minimum disturbance for the administration of the test. Rapport between the child and examiner was built before the test was begun, in an attempt to ensure that the child felt comfortable and also cooperative. The test was administered in a standardized manner to enhance reliability and maintain consistency (e.g. instructions were read out from the test manual). Goniometer was used to assess the tone of the muscle using Amiel-Tison method.

Low birth weight

Weight less than 2.5 kgs was taken as low birth weight.

Small for gestational age (SGA) and intrauterine growth restriction

Weight< 10th centile for gestation

Appropriate for gestational date (AGA)

Neonates were categorized as appropriate for gestational age (birth weight between 10th and 90th centile for gestation) according to previously published data

Developmental quotient (DQ)

The numeric expression of a child's developmental level as measured by dividing the developmental age by the chronologic age and multiplying by 100.

Birth asphyxia

Birth asphyxia was considered if the APGAR score at 10th minute was less than five. When the APGAR score was not available, the following criteria were used to

label birth asphyxia: history of delayed cry for more than 5 minutes after birth; baby turning blue and requiring oxygen therapy while having difficulties in breathing; lethargy and/or seizures within 72 hours of birth.

Statistical analysis

The results obtained were tabulated and analysed using appropriate statistical programme, statistical package for Social Sciences (SPSS), version 17.0 and Graph Pad Prism 5.0. The results were compared using the Chi square test and multiple logistic regressions, p value was calculated. The results were tested at 5% level of significance.

RESULTS

There were total 110 homozygous (SS type) and 55 heterozygous (AS type) children between the age of 6 months to 15 years, who presented to the pediatric outpatient department (sickle cell clinic) or were admitted.

There were 50 normal siblings/children (AA) in whom sickling test and hemoglobin electrophoresis was negative, they acted as controls. There were 73 (66.36%) males and 37 (33.64%) females (Male:female ratio 1.97:1) among (SS type) and 36 (65.45%) males and 19 (34.55%) females (male:female ratio 1.89:1) among (AS type) children.

While in normal children Male female ratio was 1.63:1. Majority belonged to lower and middle socioeconomic class.

Table 1 shows the information about birth events regarding the type of delivery. Out of the 135 children, 113 (83.70) were delivered by vaginal delivery and 22 (16.60%) were delivered by caesarean section. Table 2 shows Type of delivery when compared with the standard population, the value was not statistically significant (p value = 0.86).

Table 1: Type of delivery.

Type of delivery	Frequency	Percentage
Vaginal delivery	113	83.70
Caesarean section	22	16.30
Total	**135**	**100**

Table 2: Type of delivery when compared with the standard population.

Type of delivery	Observed value	Standard value	Z value	P value
LSCS	16.30	15	0.96	0.33, ns
Vaginal delivery	83.70	85	0.17	0.86, ns

Table 3: Birth asphyxia.

Birth asphyxia	Frequency	Percentage
Baby cried immediately after birth	89	65.92
Baby didn't cry	46	34.18
Total	**135**	**100**

Table 3 shows information regarding birth history, Out of 135 children in the study, 46 (34.18) children gave history of birth asphyxia/delayed cry and 89 (34.18%) gave history of normal cry at birth.

Table 4: Gestational age.

Gestational age	Frequency	Percentage
Full Term	104	77.04
Preterm	31	22.96
Total	**135**	**100**

Table 5: Pre-terms when compared to the standard population.

Parameters	Observed value	Standard value	Z value	P value
Preterm	22.96	11	8.74	0.0001, s

Table 4 shows distribution of gestational age in children with global developmental delay. Out of 135 children, 104 (77.04%) Children were born at full term gestation and remaining 31 (22.96%) children were born preterm. Table 5 shows pre-terms when compared to the standard population, there was significant proportion of preterm born children in the present study.

Table 6 shows relationship between gestational age with gross motor DQ. Mean gross motor DQ in full terms were 31.3 and in preterms were 32.87 which was low in children born by term gestation, but statistically the value was not significant (p value = 0.69, NS).

Table 6: Gestational age versus gross motor DQ.

Group	Number	DQ-Mean	SD	95%CI	P-Value
Full term	104	31.30	19.73	27.47 - 35.14	0.39 p = 0.69, NS
Pre term	31	32.87	17.37	26.49 - 39.24	
Total	**135**	**31.66**	**19.16**	**28.40 - 34.92**	

Table 7 shows relationship between gestational ages with fine motor DQ. Mean fine motor DQ in full terms were 37.65 and in preterms mean fine motor DQ was 36.29, which was lower in preterm born children, but the value was statistically insignificant (p value = 0.752, NS).

Table 8 shows relationship between gestational age with Language DQ. Mean Language DQ in full terms were 37.71 and in preterms were 35.51 which was less in children born at preterm gestation, but the value was statistically insignificant (p value = 0.646, NS).

Table 7: Gestational age versus fine motor DQ.

Group	Number	DQ-Mean	SD	95%CI	P-Value
Full Term	104	37.65	21.85	33.40 - 41.90	0.3760.31 p = 0.752, NS
Pre Term	31	36.29	18.18	29.62 - 42.95	
Total	**135**	**37.34**	**21.00**	**33.76 - 40.91**	

Table 8: Gestational age versus language DQ.

Group	Number	DQ-Mean	SD	95%CI	P-Value
Full term	104	37.71	22.47	33.34 - 42.08	0.46 p = 0.646, NS
Pre term	31	35.51	25.81	26.04 - 44.98	
Total	**135**	**37.20**	**23.20**	**33.25 - 41.15**	

Table 9: Gestational age versus social DQ.

Group	Number	DQ-Mean	SD	95%CI	P-Value
Full term	104	49.45	25.90	44.41 - 54.48	0.28 p = 0.780, NS
Pre term	31	50.90	23.20	42.39 - 59.41	
Total	**135**	**49.78**	**25.23**	**45.49 - 54.08**	

Table 9 shows relationship between gestational age with social adaptive DQ. Mean Social DQ in full terms was 49.45 and mean language DQ in children born at preterm gestation was 50.90, mean social adaptive DQ was lower in full terms but the value was statistically insignificant (p value = 0.780, NS).

Table 10 shows birth weight distribution in children with developmental delay. Out of 135 children, 78 (57.77%) children had normal birth weight, followed by 47 children had Low birth weight and, 5 each had very low birth weight and extremely low birth weight at birth.

Table 11 shows proportion of low birth weight children when compared with the standard population, there were significant number (p value = 0.0001) of children with lower birth weight in the present study.

Table 10: Birth weight distribution.

Birth weight	Frequency	Percentage
Normal	78	57.77
LBW	47	34.81
VLBW	5	3.70
ELBW	5	3.70
Total	**135**	**100**

Table 11: Proportion of low birth weight children when compared with the standard population.

Parameters	Observed value	Standard value	Z value	P value
Low birth weight	42.33	28	4.83	0.0001

Table 12 shows the distribution of IUGR (intra uterine growth restriction) children. Out of 135 children in the study, 35 children were born IUGR and remaining 100 were normal.

Table 13 shows the proportion of IUGR babies in the study when compared to the standard population, the value was statistically significant (p value = 0.014).

Table 12: IUGR distribution.

Birth weight	Frequency	Percentage
Normal	100	74.07
IUGR	35	25.93
Total	**135**	**100**

Table 14 Shows relationship between birth weight and gross motor DQ. Mean Gross motor DQ in normal birth weight children of developmental delay was 31.1 and mean DQ in LBW was 32.43, which was lower in the

children with normal birth weight but the value was statistically insignificant (p value = 0.69, NS).

Table 13: The proportion of IUGR babies in the study when compared to the standard population.

Parameters	Observed value	Standard value	Z value	P value
IUGR	25.93	21	2.45	0.014

Table 15 shows relationship between birth weight and Fine motor DQ. Mean Fine motor DQ in normal birth weight children of developmental delay was 31.1 and mean DQ in LBW was 32.43, mean fine motor DQ was low in children with normal birth weight, which was statistically insignificant(p value = 0.304, NS).

Table 16 shows relationship between birth weight and Language DQ. Mean language DQ in normal birth weight children of developmental delay is 39.82 and mean DQ in LBW was 33.63, mean language DQ was low in children with LBW than with normal birth weight, which is statistically insignificant(p value = 0.126, NS).

Table 17 shows relationship between birth weight and social DQ. Mean social adaptive DQ in normal birth weight children of developmental delay was 49.51 and mean social DQ in LBW children was 50.15.

Mean social DQ was lower in children with normal birth weight, which is statistically insignificant (p value = 0.884, NS).

Table 14: Birth weight versus gross motor DQ.

Group	Number	DQ-Mean	SD	95%CI	P-Value
Normal	78	31.10	19.56	26.69-35.51	
LBW and others	57	32.43	18.74	27.46-37.41	0.39 p = 0.69, NS
Total	**135**	**31.66**	**19.16**	**28.40 - 34.92**	

Table 15: Birth weight versus fine motor DQ.

Group	Number	DQ-Mean	SD	95%CI	P-Value
Normal	78	31.10	19.56	26.69-35.51	
LBW and others	57	32.43	18.74	27.46-37.41	1.03 p = 0.304, NS
Total	**135**	**31.66**	**19.16**	**28.40-34.92**	

Table 16: Birth weight versus language DQ.

Group	Number	DQ-Mean	SD	95%CI	P-Value
Normal	78	39.82	21.69	34.92-44.71	
LBW and others	57	33.63	24.86	27.03-10.23	1.53 p = 0.126, NS
Total	**135**	**37.20**	**23.20**	**33.25-41.15**	

Table 17: Birth weight versus social DQ.

Group	Number	DQ-Mean	SD	95%CI	P-Value
Normal	78	49.51	26.23	43.59-55.42	
LBW	57	50.15	24.01	43.78-56.53	0.146 p = 0.884, NS
Total	**135**	**49.78**	**25.23**	**45.49-54.08**	

DISCUSSION

Perinatal events

In this study found strong correlation of developmental delay with abnormal birth events.

Type of delivery

In the present study, total numbers of children presented with developmental delay were 135, out of which 113 (83.7%) children were born of vaginal route while 22 (16.30%) children were born by LSCS as shown in Table 1. Study found no significant difference between the two, but vaginally delivered babies were more when compared with the standard population and this was statistically insignificant as shown in Table 2. Thomaidis et al, in his study found that developmental delay was more in the children born by vaginal route, 87 (61.26%), than born out of caesarean section i.e. 55 (38.74%), however there was no significant difference between the two groups in the study.[6] Our study also endorses similar trends. Suchdeva et al, also showed no correlation between the developmental delay and type of delivery.[7] In his study,

the number of children with developmental delay born out of vaginal delivery was 21 (63.66%) and born by Caesarian section were 12 (36.67). In the study by Tikaria et al, observations were made similar to our study wherein 80% children with developmental delay were born by and caesarean section by 20%, studies found no significant correlation of developmental delay with mode of delivery.[8] Incidence of vaginal delivery was high in our set up, as it belongs to rural background, where deliveries are conducted by vaginal route, in absence of trained obstetricians and pediatricians resulting in intra-natal complications with postnatal consequences.

Birth asphyxia

In the present study found high rate of children with birth asphyxia on birth history. As shown in Table 2, out of 135 children, 46 (34.18%) children had history of birth asphyxia/delayed cry with some or the other signs and symptoms of perinatal/intranatal asphyxia on history, while the remaining children had normal perinatal events, but we must mention here, one of the limitations of our study is that we had to rely on the history the parents or relatives elicited. This study found higher proportion of birth asphyxias as the cause of developmental delay compared to other studies. Few studies, Nguefack et al, and Meliegy et al, had high proportions of birth asphyxias similar to ours as a cause of developmental delay.[9,10] Nguefack et al, had 68 (44.40%) children with history of birth asphyxia similar to the present study as a leading cause of developmental delay.[9]

Most of the studies found etiology of birth asphyxia to be around 9 - 23% in children with developmental delay in their studies, and birth asphyxia was taken as an important predictor of developmental delay. Some Indian studies by Jain et al, Tikaria et al, and Sachdeva et al, found birth asphyxia in 9.8%, 20%, and 9% of children enrolled in their studies respectively which are lower than our study.[7,8,11] Thomaidis at al, found birth asphyxia in 18 (12.6%) out of 142 children and Koul et al, found 26 (23.63%) children with the above etiology.[6,12,18] The high incidence of birth asphyxia in our study could be due to perinatal and/or obstetric complications and also due to inclusion of only the inpatient children. Most of the children were delivered at home with lack of appropriate post resuscitation care resulting in hypoxic injury leading to an increase in the incidence of birth asphyxia in our study.

Gestational age

In the present study, out of 135 children, 104 (77.03%) children were in the gestational age ≥37 weeks (term) while 31 (22.97%) babies were born preterm Table 3. Consistent to our findings, studies found global developmental delay more frequent in preterm children. Wong and chen et al, in his study observed out of 537 children with global developmental delay, 96 (17.8%) were born preterm.[13] Takaria et al, in his study found

13% children had history of prematurity and Sachdeva et al, also found preterm delivery in 7 (21.21%) out of 33 children with developmental delay on screening, similar to our study.[7,8] Similarly other studies by Meiliegy EI et al, and Nguefack et al, also found prematurity correlating with global developmental delay.[9,10]

The percentage of the preterm children in the present study was double that of the preterm in the general population (22% versus 11%). When compared with the proportion of preterms in general population they were significantly higher in our study as shown in Table 3.1(p value = 0.0001), they were 2 times more frequent than general population. Preterm babies may have multifactorial etiology for global developmental delay namely low birth weight, maternal illnesses, and predisposition to neonatal sepsis, neonatal seizures leading to prolonged stay at NICU. Tables 4.1, 4.2, 4.3, 4.4 show that the mean gross motor DQ, fine motor DQ, language DQ, and social adaptive DQ when compared with gestational age i.e. preterms with full terms, did not show significant difference.

Although prematurity is a commonly mentioned risk factor related to developmental delay, the previous literature found on longitudinal follow up that 80 - 95% of preterm infants were free of severe disabilities. The causes and complications of prematurity have been found to be more predictive of developmental outcome than prematurity alone. Significant difference between the two groups was not seen, as the other group might be of the children born at full term gestation who were probably more prone to birth asphyxias thereby reducing the mean DQ in all the developmental domains.

Birth weight

In the present study, as shown in Table 5, out of 135 children with developmental delay, 78 (57.8%) cases were having birth weight ≥ 2.5kg while 57 (42.2 %) cases had birth weight <2.5 kg. On elaborating, out of 57 children, 5 were having birth weight between 1000 - 1499 grams and remaining 5 children had birth weight less than 1000 grams. As shown in Table 5.1 LBW babies were present in a significantly higher number (p value = 0.0001) when compared to the standard population. Tikaria et al, found low birth weight in 26 (46%) out of 46 children. This finding was similar to our study.[8] Wong and Chen et al, found low birth weight in only 96 of 537 children with global developmental delay which is less compared to ours (42.2%).[13]

This may be because of their criterion which they took as low birth weight was, children less than 2 Kg body weight at birth. Table 7.1, 7.2, 7.3, 7.4 shows relation between the birth weight with Gross motor DQ, fine motor DQ, language DQ, social and adaptive DQ milestones respectively. There is no significant difference between the mean DQ with the birth weight. Although low birth weight is a commonly mentioned risk factor

related to developmental delay, the previous literature indicated that it by itself when taken in isolation is relatively not so important. Teplin SW et al showed that a significant proportion of ELBW children had no severe disabilities on follow up.[14] Aylward GP et al, found similarly the combined average intelligence quotient/developmental quotient (IQ/DQ) of all low birth weight groups was 97.77 (SD 6.19); for control subjects the mean IQ/DQ was 103.78 (SD 8.16).[15] This difference was statistically significant but perhaps not clinically significant. Drillien CM et al, also found there is no significant difference in IQ/DQ when compared 299 LBW children with normal birth weight. Thus, birth weight alone may not be a good predictor of developmental delay in the children later in their life.[16]

IUGR

In the present study, we found 35 (25.93%) out of 135 children had IUGR at birth which is consistent with other studies Table 6. we found a strong association of IUGR with developmental delay. Table 6.1 shows proportion of IUGR births is significantly high (p value = 0.014) when compared with the standard population. Thomaidis et al, found IUGR as an independent factor as a predictor of developmental delay in children than preterm delivery. In their study, IUGR was found in 32 (22.5%) of 142 children similar to the present study.[6]

IUGR is a sole predictor of developmental delay, as these children were associated with low socioeconomic status as shown by Thomaidis et al, and more chances of neonatal complications such as hypoglycemia, Birth asphyxia, Meconium aspiration etc.[6] Thus in our study IUGR was a more significant contributor than prematurity, in causation of developmental delay.

Recommendations

- Prevention of birth asphyxia should be achieved through antenatal and intranatal monitoring
- Prevention of preterm deliveries should be achieved through good antenatal care, early recognition and treatment of maternal illnesses
- Maternal nutrition, care during pregnancy and monitoring should be considered as a priority
- Safe birth practices and no home deliveries
- Training of personnel, obstetric and NRP workshops, CMEs, training and awareness programmes should be organized regularly
- Facility based neonatal care (FBNC) needs to be advocated at the primary health care level
- MCH - maternal and child health care augmentation and its sustenance is utmost important
- Public awareness about the various schemes put forth by the government of India for these differently abled (Divyang) children is essential to bring them in the mainstream of health care.

CONCLUSION

Developmental delay was more common in children born at preterm, low birth weight, IUGR and children who had birth asphyxia.

Birth weight did not significantly affect any particular domain of development.

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