|| ISSN(online): 2589-8698 || ISSN(print): 2589-868X ||
International Journal of Medical and Biomedical Studies
Available Online at www.ijmbs.info
PubMed (National Library of Medicine ID: 101738825)
*Index Copernicus Value 2018: 75.71*
Original Research Article
Volume 3, Issue 4; April: 2019; Page No. 96-104

# DEVELOPMENTAL DELAYS AND ITS PREDICTORS AMONG INFANTS- A CROSS SECTIONAL STUDY IN RURAL AREAS OF SILIGURI SUBDIVISION, DARJEELING DISTRICT, WEST BENGAL.

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**Article Info:** Received 14 March 2019; Accepted 15 April. 2019
**Cite this article as:** Chakraborty, Dr. S., Bhattacherjee, Dr., Das, D. K., & Dasgupta, Dr., S., (2019). DEVELOPMENTAL DELAYS AND ITS PREDICTORS AMONG INFANTS- A CROSS SECTIONAL STUDY IN RURAL AREAS OF SILIGURI SUBDIVISION, DARJEELING DISTRICT, WEST BENGAL. *International Journal of Medical and Biomedical Studies*, *3*(4).
**DOI: https://doi.org/10.32553/ijmbs.v3i4.187**
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**Conflict of interest:** No conflict of interest.

**Abstract**

**Background & objectives:** Developmental delay is a condition where a child fails to reach the different developmental domains at the expected age. Children who are developmentally delayed are less likely to be productive adults. The present study is aimed to determine the prevalence and predictors of global developmental delay among the infants of rural areas of Siliguri sub division, Darjeeling district, West Bengal

**Methods:** A descriptive epidemiological study with cross- sectional design was carried out among 780 infants in Siliguri subdivision, Darjeeling district, West Bengal. Thirty cluster sampling technique was used to select the study subjects. Data were collected by interviewing the respondents using a pre-designed and pre tested schedule. Development status was assessed using ASQ-3 scale and delay in more than one domain was defined as global developmental delay. Logistic regression was applied to find out the association between global development delay and different predictors.

**Results:** Overall prevalence of global developmental delay was 38.2%. Neonatal factors like birth weight (p=.000), h/o neonatal infection (p=.001) and neonatal jaundice (p=.000) was found to be significantly associated with global developmental delay. No statistical significance was observed with sociodemographic and maternal factors.

**Conclusion:** Developmental delay is high among the infants of the studied area and associated with some of the neonatal factors. Field based studies using appropriate screening tools from different parts of India including West Bengal will be helpful to find out the hidden cases and related factors.

**Key words:** Developmental delay, Predictors, Infants, ASQ-3, Darjeeling

## INTRODUCTION:

Child development is a dynamic process which specifies maturation of functions as well as acquisition of variety of skills for optimal functioning of the individual[1]. Development is influenced by variety of neonatal factors like genetic and chromosomal abnormalities, birth asphyxia, birth injuries, neonatal sepsis, hyperbilirubinemia, maternal factors like exposure of pregnant mother to certain drugs, toxins, infections, radiation, poor maternal nutrition and distal factors like maternal stress, poverty etc[2] . Developmental delay is a condition whereby children experience significant variation in the achievement of expected milestones for their actual age compared to same age peers[3]. Delay or abnormal development may affect individual domains[4] like gross motor development; fine motor development; personal and social development & general understanding; language; vision & hearing[1] or concurrently affect more than one domains which is also known as global developmental delay (GDD)[5] .

Children who are developmentally delayed are less likely to be productive adults in society on an equal basis with others. In India an estimated 10% of the under five children are having developmental delays[6] .Though the prevalence of GDD is not precisely known, some studies reported an estimation of affected children ranges between 1-3% [7,8] .

Screening of children for developmental delays and early interventions thus has been a priority issue and concern worldwide as well as in India. Earlier the delays are identified and interventions applied, more is the chance of remediating or even preventing the negative sequelae which results from developmental difficulties. However, studies so far conducted were mostly clinic/hospital based; lacking truly field based epidemiological data. Magnitude and predictors of the problem need to be explored and understood in various geographic regions and among diverse population groups and also among children of different age groups. The generated epidemiological data will also provide inputs regarding implementation of RBSK programme throughout the country.

In this context, the present study was planned with the objective of to determine the prevalence and predictors (socio demographic, maternal & neonatal factors) of global developmental delay among infants of rural areas of Siliguri sub division, Darjeeling district, West Bengal.

## Materials and Methods:

The present descriptive epidemiological study with cross- sectional design was conducted in the 4 community developmental blocks of Siliguri subdivision, Darjeeling district, West Bengal from May 2015- April 2016. Children born in a reference year from July 2014 to June 2015 were included as study subjects. Children with documented neurological deficits, less than one month of age (as assessment tool is not applicable) and whose parents were non-co-operative/unwilling, were excluded from the study. Parents/primary care givers of the infants, preferably mothers served as the respondents.

**Sample size and sampling technique:** Thirty cluster sampling technique was used to select the study subjects. Considering anticipated prevalence of development delay as 19.8%[9] , 95% level of confidence, 20% relative precision and design effect 2 finally the study was conducted among 780 infants. From the selected 30 clusters (Villages/ teagardens) list of households having eligible infants were prepared with the help of local health workers which served as sampling frame and from there 26 such households having eligible infants were selected by simple random sampling. From each household only one eligible infant was chosen randomly for detailed survey. If less than 26 infants were found in one cluster, then next village was included in the survey to maintain the cluster size.

**Data Collection:** Caregivers/mothers (respondents) were explained about the purpose and procedures of the study and their written

consents were taken prior to data collection. Data were collected at the selected household setting by interviewing the respondents using a pre-designed pre tested schedule consisting of questions regarding basic socio demographic variables and other maternal and neonatal predictors. Measurement of development status using ASQ-3 questionnaire (after validation of the questionnaire) for respective ages, review of the relevant records as well as observation of the child by the researcher was done.

**Ages and Stages Questionnaire -3 (ASQ -3):**

ASQ-3 is a comprehensive checklist of developmental status, standardized for children 1-66 months with age-appropriate questionnaires. The ASQ-3 has 21 questionnaires and each questionnaire has five subscales related to specific domains: Communication, Gross Motor, Fine Motor, Problem-Solving and Personal-Social. Each questionnaire/form contains 30 items, six for each subscale (domain), written in a simple language[10] .The ASQ has also been validated among the Indian children and reported to have 83.3% overall sensitivity and 75.4% specificity for detecting developmental delay[11] .

**Scoring of ASQ:**

Responses in relation to each item of the different domains of the respondents are assigned points: 'yes' receiving 10, 'sometimes' 5 and 'not yet' 0. The points are added up in each of the five domains to give the domain scores, and then a summary score was calculated. The average domain scores were compared to a derived screening cut-off score, recommended as 2 SD below the mean by the user's manual of ASQ-3. Scores in the monitoring zone were ≥ 1.0 but < 2.0 SD below the mean. Scores ≤ referral cut off (2.0 SD below the mean) indicated a possible delay in development and further assessment by professional was recommended[10]. Delay in two or more domains was considered as global developmental delay[5] .

**Data Analysis:** Collected data were checked for consistency and completeness and were entered in Microsoft Excel data sheet. Univariate and multivariate logistic regression was applied to test the significance. In regression analysis dependent variable was the global development delay and independent variables were various sociodemographic (gender, maternal literacy, occupation of the mothers, type of family, and socio economic status) maternal (age of the mother at delivery, parity, mode of delivery, h/o documented illness during pregnancy, PIH, APH) and neonatal factors (birth weight, multiple gestation, period of gestation, h/o neonatal infection, birth asphyxia, neonatal jaundice). P value less than 0.05 was considered as statistically significant. Analysis of the data was done by IBM SPSS version 20.

**Ethical Issues:** Ethical clearance was obtained from the Institutional Ethics Committee. Following the completion of the ASQ-3 assessment, brief feedback was provided to the parents about the development status. The children found to have developmental delay were referred to appropriate facilities along with the score card for further counselling and treatment if required.

**Results:**

**Background characteristics:**

Mean age of the study participants was 5.9 (SD±3.5) months. 50% of the study participants belonged to below 6 months of age and rest 50% up to 12months of age group. Majority of them were males (51.3%), Hindus by religion (84.0%), belonged to schedule caste category (52.6%) and residing in a joint family (62.1%). Overall 18.5 % of the mothers of the study subjects had no formal education. By occupation 95.4% of the mothers were homemaker. Highest proportion of study subjects belonged to socio-economic class III (41.2%). SES was calculated according to modified BG Prasad scale using AICPI (All India Consumer Price Index) August 2015.

**Prevalence of developmental delay:**

Among 780 study subjects 298 (38.2%) subjects had global developmental delay. Individual domain specific prevalence of delay was observed as 132(17%) in communication,

176(22.6%) in gross motor, 212(27.2%) in fine motor, 291(37.3%) in problem solving and 234(30%) in personal social domain. Overall 32 (4.1%) infants had delay in all 5 domains. [Fig 1]

**Relation between different predictors and global developmental delay:**

**Socio demographic factors**: In univariate as well as multivariate logistic regression model none of the socio demographic factors was found to be significantly associated with Global developmental delay (Table 1). The multivariate regression model was performed well determined by its non-significant p value (0.341) according to Hosmer Lemeshow test.

**Maternal factors:** Table 2 shows that there was no statistical significance between global developmental delay and different maternal factors in univariate as well as multivariate logistic regression analysis (p>.05) though a good fitness of the regression model was observed from Hosmer Lemeshow test (p=.983)

**Neonatal factors:** In univariate analysis odds of birth weight (p=.000), h/o neonatal infection (p=.001) and neonatal jaundice (p=.000) was found to be significantly associated with global developmental delay. Statistical significance was not found between global developmental delay and multiple gestation, period of gestation, birth asphyxia (p>.05). In multivariate logistic regression adjusting different factors statistical significance was observed only between lower odds of birth weight and global developmental delay (p=.000) although there was a good fit of the model as evident from non-significant p value from Hosmer Lemeshow test (p=.384) [Table 3].

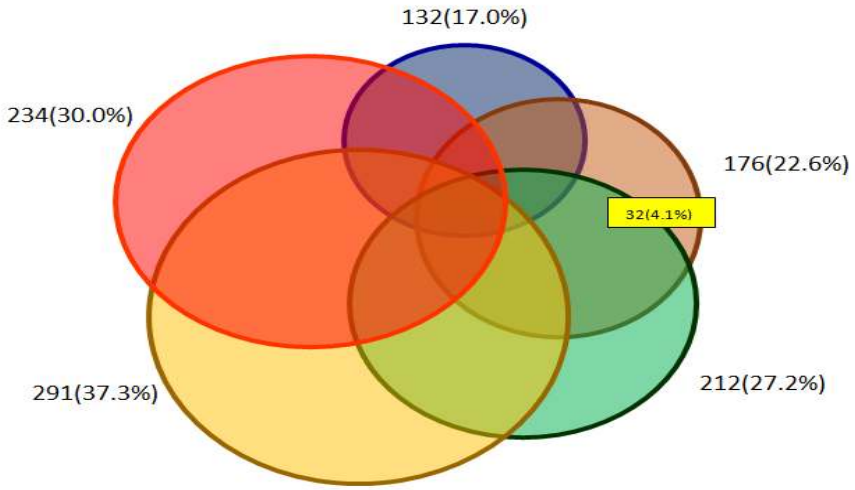


**Figure 1: Venn diagram showing distribution of infants according to presence of delay in different domains (n=780)**

**Table 1: Global developmental delay and sociodemographic factors (n= 780)**

| Sociodemographic factors | Global developmental delay | | N(%) | OR(95% CI) | AOR(95%CI) |
|---|---|---|---|---|---|
| | Present(%) | Absent(%) | | | |
| **Gender** | | | | | |
| Male | 141(35.2) | 259(64.8) | 400(100.0) | 1.293(.968,1.727) | 1(Referent) |
| Female | 157(41.3) | 223(58.7) | 380(100.0) | | 1.275(.954,1.706) |
| **Education of mother** | | | | | |
| Literate | 252(39.7) | 382(60.3) | 634(100.0) | 1.434(.977,2.105) | 1(Referent) |
| No formal education* | 46(31.5) | 100(68.5) | 146(100.0) | | 1.446(.963, 2.171) |
| **Occupation of mother** | | | | | |
| Homemaker | 282(38.2) | 457(61.8) | 739(100.0) | 1.164(.590,2.294) | 1(Referent) |
| Working outside | 16(39.0) | 25(61.0) | 41(100.0) | | 1.146(.575, 2.282) |

| | | | | | |
|---|---|---|---|---|---|
| **Type of family** | | | | | |
| Joint family | 177(36.6) | 307(63.4) | 484(100.0) | .834(.620,1.122) | 1(Referent) |
| Nuclear family | 121(40.9) | 175(59.1) | 296(100.0) | | .793(.584, 1.077) |
| **Socio economic status** | | | | | |
| Upper(SES I and II) | 111(41.9) | 154(58.1) | 265(100.0) | .791(.584,1.071) | 1(Referent) |
| Lower(SES III, IV, V) | 187(36.3) | 328(63.7) | 515(100.0) | | .856(.625,1.171) |
| **Total** | **298(38.2)** | **482(61.8)** | **780(100.0)** | | |

*Note: *No formal education included illiterate and non- formal literate*

**Table 2: Global developmental delay and maternal factors (n=780)**

| Maternal factors | Global developmental delay | | N(%) | OR(95% CI) | AOR(95%CI) |
|---|---|---|---|---|---|
| | Present(%) | Absent(%) | | | |
| **Age of the mothers (In years)** | | | | | |
| <20 | 51(38.9) | 80(61.1) | 131(100.0) | .964(.656,1.417) | 1(Referent) |
| ≥20 | 199(38.1) | 424(61.9) | 649(100.0) | | .896(.590,1.361) |
| **Parity** | | | | | |
| Primi para | 150(37.4) | 251(62.6) | 401(100.0) | 1.072(.803,1.431) | 1(Referent) |
| Multi para | 148(39.1) | 231(60.9) | 379(100.0) | | 1.115(.814,1.529) |
| **Mode of delivery** | | | | | |
| Normal vaginal delivery | 186(37.0) | 317(63.0) | 503(100.0) | 1.157(.857,1.563) | 1(Referent) |
| Caesarean section | 112(40.4) | 165(59.6) | 277(100.0) | | 1.141(.825,1.580) |
| **H/o documented illness of mother during pregnancy** | | | | | |
| Absent | 263(37.5) | 439(62.5) | 702(100.0) | 1.359(.848,2.177) | 1(Referent) |
| Present | 35(44.9) | 43(55.1) | 78(100.0) | | 1.559(.689,3.529) |
| **H/o PIH** | | | | | |
| Absent | 268(38.0) | 438(62.0) | 706(100.0) | 1.114(.684,1.816) | 1(Referent) |
| Present | 30(40.5) | 44(59.5) | 74(100.0) | | 1.239(.542,2.834) |
| **H/o APH** | | | | | |
| Absent | 294(38.4) | 472(61.6) | 766(100.0) | .642(.200,2.066) | 1(Referent) |
| Present | 4(28.6) | 10(71.4) | 14(100.0) | | .725(.193,2.720) |
| **Total** | **298(38.2)** | **482(61.8)** | **780(100.0)** | | |

**Table 3: Global developmental delay and neonatal factors (n= 780)**

| Neonatal factors | Global developmental delay | | N(%) | OR(95% CI) | AOR(95%CI) |
|---|---|---|---|---|---|
| | Present(%) | Absent(%) | | | |
| **Birth weight** | | | | | |
| Low birth weight | 99(63.1) | 58(36.9) | 157(100.0) | .275(.191, .396) | 1(Referent) |
| Normal birth weight | 199(31.9) | 424(68.1) | 623(100.0) | | .292(.200,.427) |
| **Multiple gestation** | | | | | |
| No | 291(37.8) | 478(62.2) | 769(100.0) | 2.875(.834,9.905) | 1(Referent) |
| Yes | 7(63.6) | 4(36.4) | 11(100.0) | | 2.199(.585,8.269) |
| **Period of gestation** | | | | | |
| Preterm | 25(42.4) | 34(57.9) | 59(100.0) | .829(.484,1.419) | 1(Referent) |
| Term | 273(37.9) | 448(62.1) | 721(100.0) | | .957(.531,1.724) |
| **H/o neonatal infection** | | | | | |
| Absent | 281(37.1) | 476(62.9) | 757(100.0) | 4.800(1.870,12.315) | 1(Referent) |
| Present | 17(73.9) | 6(26.1) | 296(100.0) | | 1.617(.344,7.608) |

| | | | | | |
|---|---|---|---|---|---|
| **H/o birth asphyxia** | | | | | |
| Absent | 286(38.0) | 466(62.0) | 752(100.0) | 1.222(.570,2.620) | 1(Referent) |
| Present | 12(42.9) | 16(57.1) | 28(100.0) | | .333(.097,1.143) |
| **H/o neonatal jaundice** | | | | | |
| Absent | 240(34.8) | 449(65.2) | 689(100.0) | 3.288(2.086,5.184) | 1(Referent) |
| Present | 58(63.7) | 33(36.3) | 91(100.0) | | 1.254(.325,4.847) |
| **Total** | **298(38.2)** | **482(61.8)** | **780(100.0)** | | |

## Discussion:

**Prevalence of global developmental delay:** Extent of developmental delay among infants in the studied area was found to be substantially high. Among 780 infants, overall 38.2% had global developmental delay. Various studies across the world reported prevalence of developmental delay among children of different age group ranging from 3.9% to 44.6% using different screening tools[2,9,12-17]. Higher prevalence of delay in the study area indicates probable delayed diagnosis of the cases. Geographical variation might have a hidden effect. Darjeeling district comes under the Sub Himalayan belt, extending from Kashmir to Assam, and is well known for the wide prevalence of hypothyroidism[18] .The role of Iodine on proper development of child is well-established[19]. Further research on the role of iodine deficiency in the mother and child, will be helpful in quantifying the extent of the problem in this region.

**Developmental delay and different predictors:**

**Socio-demographic factors:** Several studies conducted globally as well as in India identified different sociodemographic factors like gender [13-15,17,20-23], maternal education [9,16,20,22], occupation of the mother[22,23], type of family[13,17,23], socio-economic status[9,13,15,17,23,24] etc either to be significantly associated with developmental delay or no statistical significance was reported. However, in present study no statistical significance was found between these sociodemographic factors and global developmental delay. The possible explanation of more developmental disorders among males was due to influence of testosterone responsible for delay in maturation of specific processes within the brain[25]. The reason of higher proportion of developmental delay among female children in present study could possibly be explained by gender discrimination in Indian culture hence were neglected and deprived of adequate nurture and feeding and various studies[9,22,26] reported feeding practices, undernutrition and micronutrient deficiencies were significantly associated with developmental delay.

**Maternal factors:** Present study did not find any significant association between maternal factors and global developmental delay. Similar findings were also reported by several other studies where the same factors were also taken as predictors of developmental delay[13,16,17,22-24]. However, a study by **Walker et al**[27] in California reported that preeclampsia, particularly severe disease, is associated with Autism spectrum disorder and developmental delay; after adjustment for maternal educational level, parity, and pre pregnancy obesity. Significant association between PIH and developmental delay was also reported by **Thomaidis et al**[24]. Though present study did not reveal statistical significance between any maternal factors and global developmental delay, but higher proportion of delay was observed among the infants who had these maternal risk factors except APH. There lies the clinical significance of the study. Very few mothers had history of APH and this could be the probable explanation of the result found between APH and global developmental delay.

**Neonatal factors:** Among different neonatal factors birth weight, neonatal infection and neonatal jaundice was found to be significantly associated with global developmental delay in different regression model conducted in the present study. These findings were supported by

several other studies conducted globally as well as in India[4,16,17,21,23]. A study by **Vora et al**[12] also revealed that sepsis was significantly associated with developmental domains of TDSC but no association was found with meningitis. History of sepsis in developmentally delayed child was also mentioned by **Meenai et al**[2] in their study in Bhanpur, Bhopal. However, studies by **Sachdeva et al**[13] and **Vora et al**[12] contradict the association between neonatal jaundice and developmental delay observed in current study. However, in present study multiple gestation, period of gestation and birth asphyxia was not found to be significantly associated with global developmental delay which was supported and contradicted by several other studies across the world[2,12,13,16,17,20,21,23,24].

However, conduction of studies among different groups of population, children of different age groups, geographical areas, settings, using different study designs and screening tools might be the reason that studies so far conducted elicited different pictures regarding global developmental delay and its association with different predictors. Moreover, child's development depends upon the nature as well as the nurture as described by the biopsychosocial model of health[28] and Bronfenbrenner's bioecological model[29] . It is also said that maternal literacy has significant effect on children's cognitive development by providing varieties in daily stimulation, practices and provision of materials for child's cognitive stimulation[30] and only by improving parenteral literacy status, awareness generation and better utilisation of various maternal and child health related services will be possible, which in turn will be helpful to minimize the various maternal and neonatal risk factors of developmental delay.

The major limitation of the study is the assessment tool itself. In ASQ3 scale questions are set in a hierarchy order which cover two successive months. So infants, who were screened at early days, scored less and were considered as developmentally delayed. Further follow up visits were necessary to see whether the children reached their age appropriate developmental milestones. This may be the another reason that the present study showed a higher proportions of developmental delay among infants. Moreover, recall and social desirability bias is sometimes associated with the studies where interview of the study participants done. Factors for developmental delay which were observed here merely present an association and causality needs to be interpreted with caution. In spite of these limitations, a community based study producing greater generalizability of the findings, making it different from other studies which were mostly hospital/clinic based and this is the major strength of this study. Moreover, there are limited studies in India using ASQ scale specially highlighting the domains specific delay.

In conclusion, overall proportion of developmental delay among infants was considerably high in the studied area and also a remarkable number of infants had delay in all five domains. It is associated with some of the neonatal factors like birth weight, neonatal infection and neonatal jaundice but no statistical significance was observed with sociodemographic and maternal factors. So, it requires early case finding through special screening camps at remote areas, house to house visit by peripheral health workers at regular interval and sensitization of health care providers with different screening tools for this purpose. Special emphasis should also be given on RBSK and its services through IEC activities. The modifiable risk factors associated with developmental delay needs to be identified and addressed accordingly.

**References:**


1. Ghai OP. Normal and abnormal development. In: Ghai OP, Paul Vinod K, BaggaArvind, editors. Essential Pediatrics, Delhi, Thomson Press (India) Ltd; 2010: 22-23.
2. Meenai Z, Longia S. A study on prevalence & antecedents of developmental delay among

children less than 2 years attending well baby clinic. People's Journal of Scientific Research2009; 2(1):9-12.

3. World Health Organisation. Early Childhood Development and Disability: A discussion paper. World Health Organization, Geneva, 2012. Available from http: // apps. who.int /iris/bitstream/10665/75355/1/9789241504065_eng.pdf [Last accessed on November 20, 2017].
4. Kadapatti MG, Khadi PB. Prevalence of developmental delays among infants. Indian Streams Research Journal 2011; 1(6). Available at: http://www.ijsrp.org/print-journal/ijsrp-oct-2012-print.pdf [Last accessed September 20, 2016]
5. Riou EM, Ghosh S, Francoeur E, Shevell MI .Global developmental delay and its relationship to cognitive skills. Development Medicine & Child Neurology 2009; 51: 600-606.
6. Ministry of Health & Family Welfare. Rashtriya Bal Swasthya Karyakram (RBSK), Child Health Screening & Early Intervention Services under NRHM: Operational Guidelines. Delhi: Government of India; 2013. Available from http:// www.pbnrhm.org /docs/rbsk_guidelines.pdf [Last accessed on September 20, 2016].
7. Srour M, Mazer B, Shevell MI. Analysis of clinical features predicting etiologic yield in the assessment of global developmental delay. Pediatrics2006;118(1):139-145.
8. Yeargin-Allsopp M, Murphy CC, Cordero JF, Decouflé P, Hollowell JG. Reported biomedical causes and associated medical conditions for mental retardation among 10-year-old children, metropolitan Atlanta, 1985 to 1987. Development Medicine & Child Neurology1997 ;39(3):142-149.
9. Ali SS, Balaji PA, Dhaded SM, Goudar SS. Assessment of growth and global developmental delay: a study among young children in a rural community of India. International Multidisciplinary Research Journal 2011; 1(7): 31-34.
10. Squire J, Twombly E, Bricker D, Potter L. Introduction to ASQ. ASQ-3: User's guide, 3rd edition. Baltimore, Paul H. Brookes Publishing Co, 2009;3-9.
11. Juneja M, Mohanty M, Jain R, Ramji S. Ages and Stages Questionnaire as a screening tool for developmental delay in Indian children. Indian Pediatrics 2012;49:457-461.
12. Vora H, Shah P, Mansuri SH. A Study on Developmental Delay among Children Less Than 2 Year Attending Well Baby Clinic - Prevalance And Antecedent Factors. International Journal of Medical Science and Public Health 2013; 2(4):1084-1087.
13. Sachdeva S, Amir A, Alam S, Khan Z, Khalique N, Ansari MA. Global Developmental Delay and Its Determinants among Urban Infants and Toddlers: A Cross Sectional Study. Indian Journal of Pediatrics 2010;77:975-980.
14. Jacob KS, Kumari KS. Developmental profile of children under two years in the coastal area of Kochi, Kerala. Indian Journal of Applied Research2013;1(9):870-874.
15. Kyerematen V, Hamb A, Oberhelman RA, Cabrera L, Ortiz AB, Berry SJ. Exploratory application of the Ages and Stages (ASQ) child development screening test in a low-income Peruvian shantytown population. British Medical Journal Open 2014;4:1-4.
16. Bello A, Quartey J, Appiah L. Screening for developmental delay among children attending a rural community welfare clinic in Ghana. BMC Pediatrics 2013;13(119):1-7.
17. Bhattacharya T, Ray S, Das DK. Developmental delay among children below two years of age: a cross sectional study in a community development block of Burdwan district, West Bengal. International Journal of Community Medicine and Public Health 2017;4(5):1762-1767.
18. Biswas AB, Das DK, Chakraborty I, Biswas AK, Sharma PK, Biswas R. Goiter prevalence, urinary iodine, and salt iodization level in sub-Himalayan Darjeeling district of West Bengal, India. Indian Journal of Public Health 2014;58:129-133.

**19.** Bougma K, Aboud FE, Harding KB, Marquis GS. Iodine and Mental Development of Children 5 Years Old and Under: A Systematic Review and Meta-Analysis. Nutrients. 2013;5(4):1384-1416. doi:10.3390 /nu5041384.

**20.** Valla L, Larsen TW, Hofoss D, Slinning K. Prevalence of suspected developmental delays in early infancy: results from a regional population-based longitudinal study. BMC Pediatrics2015;215:1-8.

**21.** Chattopadhyay N, Mitra K. Neuro-developmental Outcome of High Risk Newborns Discharged from Special Care Baby Units in a Rural District in India. Journal of Public Health Research. 2015;4(1):318. doi:10.4081/jphr.2015.318.

**22.** Shaahmadi F, Khushemehri G, Arefi Z, Karimyan A, Heidari F. Developmental Delay and Its Effective Factors in Children Aged 4 to12 Months. International Journal of Pediatrics2015;3(1.1):396-402.

**23.** Lanka UVR, Dasari N, Siva C. A Cross Sectional Study of Factors Influencing Severity of Developmental Delay and Its Co Morbidities. International Journal of Innovative Research and Development 2015;4(4):33-41.

**24.** Thomaidis L, Zantopoulos GZ, Fouzas S, Mantagou L, Bakoula C, Konstantopoulos A. Predictors of severity and outcome of global developmental delay without definitive etiologic yield: a prospective observational study. BMC pediatrics. 2014 Feb 12;14(1):1-7.

**25.** Alisone, S. and Jenefer, S.(2007) Developmental pediatrics. Neil McIntosh, Peter Helms, Rosalind Smyth. Forfar & Arneil's text book of pediatrics.7th edition, Churchill Livingstone, 81-84.

**26.** Luo R, Shi Y, Zhou H, Yue A, Zhang L, Sylvia S et al. Micronutrient deficiencies and developmental delays among infants: evidence from a cross-sectional survey in rural China. British Medical Journal Open 2015;5: e008400.doi:10.1136/bmjopen-2015 -008400[Last accessed September 20, 2017].

**27.** Walker CK, Krakowiak P, Baker A, Hansen RL, Ozonoff S, Hertz-Picciotto I. Preeclampsia, placental insufficiency, and autism spectrum disorder or developmental delay. JAMA Pediatrics 2015;169(2):154-162.

**28.** Engel G. The need for a new medical model: a challenge for biomedicine. Science 1977. 196:129–136.

**29.** Bronfenbrenner U, Ceci SJ. Nature-nurture reconceptualised in developmental perspective: a bioecological model. Psychological Review1994; 101(4):568–586.

**30.** Sameroff AJ. Environmental risk factors in infancy. Pediatrics1998 ;102:1287–1292.