

Growth and developmental delay among children at 2 years of age in rural Maharashtra, India : A cross sectional study

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Abstract

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Keywords:

- First 1000 days
- rural children
- Neurodevelopment
- Bayley Scale of Infant and Toddler Development
- malnutrition

Background: First 1000 days of life is a critical period for brain development. Adequate nutrition, responsive care giving and positive environment in these days lay the foundation for a child's growth and development. Sparser population, struggle with basic health services, and low educational status of parents affect the neurodevelopment in rural settings.

Objectives: Our aim was to assess the anthropometry and neurodevelopment of rural children at 2 years of age in Velhe taluka of Pune, Maharashtra and identify neurodevelopmental determinants in rural India.

Method: Ours was a community based analytical cross-sectional study which included 120 children at completed 2 years of age. Trained workers collected the socioeconomic and demographic data by interviewing parents. Growth measurements were taken using standard procedures and analyzed as per World Health Organisation growth charts. Neurodevelopment was assessed using the Bayley Scales of Infant and Toddler Development by trained personnel. Statistical analysis was performed using the Chi-square test, with p value of < 0.05 as statistically significant.

Results: In our study, 26.5% children were underweight, 30.9% stunted and 8.3% wasted. Developmental assessment showed that 38.7% children had below average scores in all domains whereas 79.4% were in below average category for at least 1 domain, language being most commonly delayed (68.8%).

Conclusion: Our study showed high prevalence of malnutrition and developmental delay in rural children of Velhe taluka of Pune at 2 years of age. Factors like weight for age and iron supplementation were significantly associated with domain wise delay. Targeted interventions are thus needed to promote appropriate infant care practices, parental awareness and early stimulation.

Introduction:

The first 1,000 days from conception to child's second birthday form a critical window that shapes lifelong well-being^[1]. Brain development begins soon after conception and continues rapidly during early life through processes such as neuronal differentiation, migration, synapse formation, pruning, and myelination^[2]. By the age of two years, the brain reaches approximately 80% of its adult size. Critical to learning and remembering is neuronal plasticity, which permits the central nervous system to reorganize neuronal networks in response to environmental stimulation, both positive and negative. There is increasing evidence that positive experiences and relationships can buffer the impact of negative experience and toxic stress^[3]. Ensuring good health, adequate nutrition, responsive care giving and a positive environment in these first 1000 days of life lay the foundation for child's cognitive and physical development, and ultimately benefit society. Growth is the increase in size and number of cells, leading to physical maturity whereas development refers to highest attainment of maturation in different domains. Socio-emotional development is important in control of one's feelings, building relationships with others, and ability to explore the surroundings^[4]. This kind of development which starts right after birth is nurtured through daily interactions with parents and other people around the children^[5].

Developmental delay occurs when a child exhibits significant delay in the acquisition of skills in one or more domains of development. Any delay will have an ever-lasting impact on the child's social skills needed for leading a productive life later. Consequently such delays impart long-term effects on the health of a community. Globally, an estimated 250 million children under five years fail to reach their full developmental potential^[6]. This whole process of neurodevelopment is affected by interplay of multiple factors. Precisely, rural geographical conditions entailing sparser population, struggle with basic health services, and comparatively low educational status of parents affect the parent-child interaction in turn affecting

the neurodevelopment in rural settings. There are few international and indigenous studies that assessed the neurodevelopment of children in rural population. Among these, the studies using standardized, performance-based assessment tools are limited in India. Many studies have used parent-reported measures, which may introduce reporting bias. To best of our knowledge there is no study done in Western Maharashtra, India which assessed the neurodevelopment in rural children at 24 months of age, after completion of first 1000 days of life in children. Therefore, the present study is carried out to determine the prevalence of developmental delay using the Baley Scale of Infant Development (BSID) to provide high-precision data and physical growth in children at 2 years of age in the rural area of Pune, Maharashtra. We also aim to study neurodevelopmental determinants in rural India. By generating context-specific evidence, this study aims to support early stimulation therapies, timely detection of developmental delay, targeted interventions, and policy planning to promote optimal neurodevelopment during early childhood.

Materials and methods:

The study was done in Velhe taluka in Pune district, Maharashtra. It is entirely a rural area comprising of 129 villages with approximate population of 65000, catered by 6 primary health centers and 30 sub centers. This was community based analytical cross-sectional study carried out from March 2025 to August 2025. The sample size was calculated for objective to study the prevalence of developmental delay in rural children. The following formula was used for calculating the sample size;

$$n = Z^2 P(1-P)/d^2$$

Where n is the sample size, Z is the statistic corresponding to a confidence level of 95%, P is expected prevalence of 7.9% and d is precision of 5% and non response rate of 10%.

120 children at 2 completed years of age from villages in Velhe taluka were randomly selected using simple random sampling. Children with severe comorbidities were excluded. Children whose parents consented to participate were included in

the study. Trained community workers collected the socioeconomic and demographic data by interviewing parents with validated questionnaire. The children were called on a particular day for formal anthropometric and neurodevelopmental assessment at a dedicated place. 1 home visit and

2 phone calls were made before declaring a subject to be non available. 18 such children did not attend the assessment session. Out of the 102 children who attended the assessment, 5 uncooperative and 4 ill children could not be examined. Hence remaining 93 children were evaluated.

Table I Results of anthropometric evaluation of the children

Parameter		Moderate Category		Severe Category		Total
		Male	Female	Male	Female	
Weight for age (W/A)	Underweight	11	8	4	2	25 / 94
		(21.5%)	(18.6%)	(7.8%)	(4.6%)	(26.5%)
Height for age (H/A)	Stunting	11	5	5	5	26 / 84
		(25.5%)	(12.1%)	(11.6%)	(12.1%)	(30.9%)
Weight for height (W/A)	Wasting	6	1	0	0	7 / 84
		(13.9%)	(2.4%)	(0)	(0)	(8.3%)
Mid Upper Arm Circumference (MUAC) for age	Moderate acute malnutrition (11.5 to 12.5cm)					3.2%
	Normal (More than 12.5cm)					96.8%

Growth measurements were taken as per the standard norms. The child's weight was measured via tared weighing using an OMRON Weight Scale HN 283, adjusted to 0.0kg. For the measurement of length, an infantometer was used. The length was measured to the nearest 0.1 cm. The anthropometric parameters were analyzed as per World Health Organization (WHO) growth charts.

Assessment of neurodevelopment involves specialized neurological tools to enable early identification of developmental delays. The BSID-III/BSID-IV are an extensive formal developmental assessment tool, widely regarded as the gold standard diagnostic tests for assessing children aged 1-42 months. These scales evaluate cognitive, language (receptive and expressive), motor (fine and gross), social-emotional, and adaptive behavior domains through structured, play-based tasks[7]. Trained personnel used this most sensitive and specific objective BSID IV scale for assessing these children. Here child was asked to perform simple age appropriate tasks. Raw scores were converted to composite scores. The children were then categorized into extremely low, borderline,

low average, average and above average groups in each of 3 domains namely, cognitive, motor and language. The children with composite scores less than 85 were considered as at risk or having mild delay, those with scores less 70 as having moderate delay and children scoring less than 55 as having severe delay.

All the data was collected and analyzed statistically. Appropriate management and referrals to more advanced health facilities were provided for all children if required.

Statistical methods for data analysis:

Descriptive statistics were used to describe the data. Mean and standard deviation was used to describe the numerical variables whereas frequency and percentage for categorical variables. Chi2 test was used to see association between two categorical variables. Logistic regression was used to see the impact of independent variables on binary dependent variable. P value less than 0.05 was considered statistically significant. All analysis was done using SPSS version 25.

Results:

Table I shows distribution of children according to their growth parameters.

26.5% children were underweight, 30.9% children stunted and 8.3% children wasted. 6.3% were severely underweight and 11.9% severely stunted.. No child was severely wasted.

The formal neurodevelopmental assessments of these children using BSID IV showed results as depicted in figure I (a) and (b).

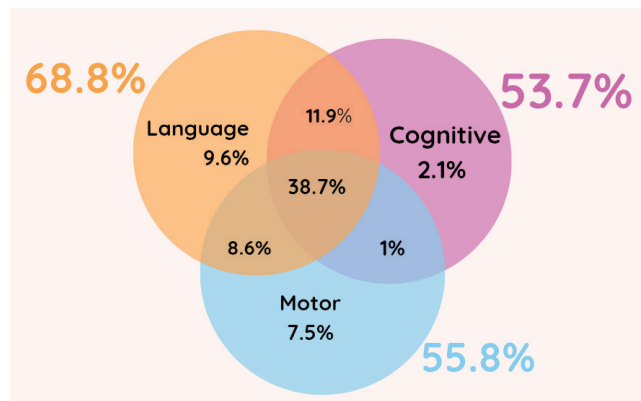


Fig. I(a) Domainwise distribution of children with below average developmental scores (total 79.4% children)

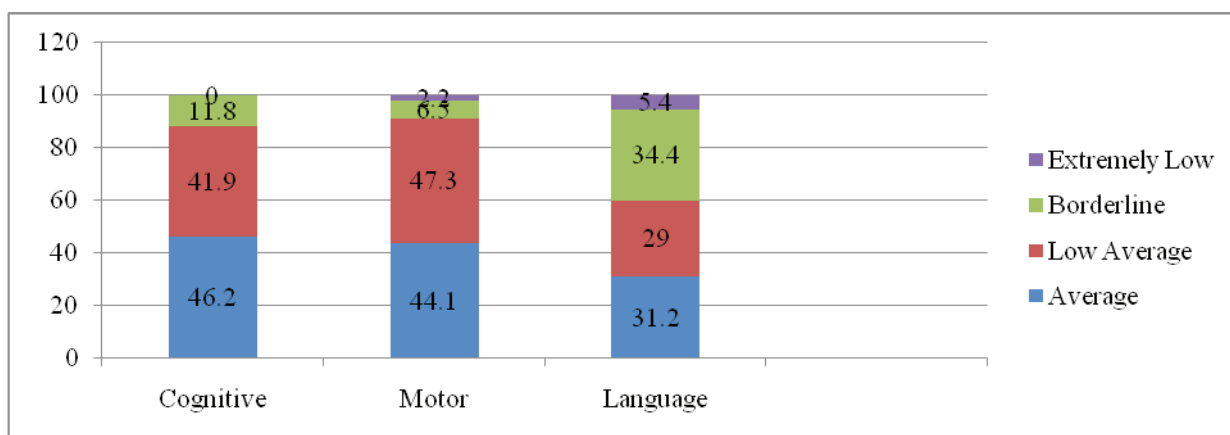


Fig. I(b) Results of neurodevelopmental assessment of children using BSID IV in percentage

Out of total 93 children, 46.2% had average cognitive function. Low average cognitive scores were also substantially common (41.9%). 47.3% of rural children fell within the low average range in motor domain whereas 44.1% children had average motor scores. 34.4% of rural children fell within the borderline range in language domain while 29% were in low average category. 38.7% children had below average scores in all domains

whereas 79.4% were in below average category for at least 1 domain. 46.2% children fell into below borderline levels in any 1 or more domain but only 0.01% had moderate to severe delay in all domains. Mean composite scores were 86.9%, 83.5% and 88.6% in cognitive, language and motor domains respectively. This indicates greater developmental vulnerability among rural children of Velhe taluka of Pune.

Table II Demographic, socioeconomic, environmental and lifestyle related factor wise distribution of children

Factor	Category	Frequency (%)
Maternal age	20-35yrs	98.9
	>35yrs	1.1
Modified KuppuswamiScale	Upper lower	4.4
	Lower middle	28.6
	Upper middle	65.9
	Upper	1.1
Maternal education	Illiterate and primary school	2.2
	Middle and high school	47.2
	Diploma and above	50.6
Antenatal risk factors	No	55.9
	Yes	44.1
Place of delivery	Hospital	100
Sex	Male	52.7
	Female	47.3
Birth weight	<2.5kg	15.1
	2.5-3.5kg	73.1
	>3.5kg	11.8
Mode of delivery	Normal	67.7
	Caesarean Section	32.3
Presentation at birth	Breech	12
	Vertex	88
Natal risk factors	No	72
	Yes	28
Exclusive breast feeding	<6months	55.9
	6 months	44.1
Initiation of complementary feeding	6 months	4.3
	6-12 months	95.7
Screen time per day	No	23.7
	<1hr	30.1
	>=1hr	46.2
Play time per day	No	2.2
	<3hrs	79.6
	>=3hrs	18.3
Night Sleep	Adequate (>8hrs)	84.9

	Inadequate (<8hrs)	15.1
Primary care provider	Parents	95.7
	Others	4.3
Junk food frequency	No	21.5
	<1/week	3.2
	>1/week	75.3
Vaccination as per national immunization schedule	Incomplete	18.3
	Complete	81.7
Maternal awareness about routine newborn care - marks obtained in questionnaire	Less than 50%	78.5
	More than 50%	21.5

Table II shows distribution of children as per demographic, socioeconomic, environmental and lifestyle related factors.

Maximum mothers were of typical reproductive age group between 20-35 yrs. Nearly half of the rural mothers studied till middle and high school (47.3%) and another 50.5% had intermediate/diploma-level education. The majority of families were distributed across the upper-middle class (65.9%). All children were delivered at hospital. Out of 93 children, 52.7% were male and 47.3% were female. Normal birth weight (2.5–3.5 kg) remained the predominant birth weight category (73.1%) in rural population. A large majority (67.7%) delivered by normal vaginal delivery. 88% children were born by vertex presentation. Majority of children (72%) did not have any natal risk factors. More than half (55.9%) of these children were exclusively breastfed for less than 6 months. But the complementary foods were started between 6-12 months in almost 95.7% children. Only 23.7% children reported no screen time, consistent with Indian Academy of Pediatrics (IAP) guidelines. Only 18.3% children reported playing outdoors for 3 hours or more in a day. 84.9% children take adequate night sleep daily. None of the rural children attended any daycare facility; rather 95.7% children were being cared by parents primarily. 75.3% children consumed junk food more than once a week. 81.7% children received complete vaccination as per national immunization schedule. A questionnaire validated by 2 Pediatricians was given to mothers to assess

their awareness about routine newborn care. The analysis showed that 78.5% of them did not have required basic knowledge.

Table III Findings related to routine newborn care

	Category	Frequency (%)
Vit D supplements	Not given	55.9
	<1 yr	32.3
	>=1 yr	11.8
Iron supplements	Not given	80.6
	<6months	9.7
	>=6 months	9.7
Otoacoustic Emissions (OAE)	Yes	30.1
	No	69.9
Neonatal thyroid screening	Yes	28
	No	72

Table III shows additional findings related to routine newborn care which were observed during the study.

Majority rural children (55.9%) did not receive any Vitamin D supplementation during first year of life. 80.6% children did not receive any iron supplements.

Only 30.1% of children had undergone hearing screening within 1 month of age. 72% babies were not tested for congenital hypothyroidism despite universal screening being recommended.

Some factors showed significant association with one of the 3 domains. Table IV (a) and (b) shows their effects.

Table IV(a) Factors significantly associated with domainwise development in children(Chi2 test used, p value of ≤ 0.05 was considered significant)

		Language			Cognitive			Motor		
		Low average	Average	P value	Low average	Average	P value	Low average	Average	P value
Sex	Male	18	11	0.032*	22	22	0.634	21	23	0.441
	Female	9	18		17	21		23	18	
Iron	Not given	25	18	0.018*	34	32	0.341	34	34	0.202
	<6 months	0	5		2	5		7	2	
	>= 6 months	2	6		3	6		3	5	
Night sleep	Adequate (>8hrs)	22	26	0.382	28	40	0.011*	39	34	0.451
	Inadequate (<8hrs)	5	3		11	3		5	7	

Table IV(b) Factors significantly associated with domainwise development in children(Chi2 test used, p value of ≤ 0.05 was considered significant)

		Cognitive					Language					Motor				
		Extremely low	Borderline	Low Average	Average	P value	Extremely low	Borderline	Low Average	Average	P value	Extremely low	Borderline	Low Average	Average	P value
W/A	Normal	0	5	23	36	0.019*	3	18	18	25	0.360	2	4	24	31	0.345
	Under Weight	0	6	12	5		2	10	6	5		0	2	14	7	
MUAC	11.5-12.5 cm	0	1	1	3	0.502	1	1	0	1	0.144	1	0	1	1	0.002
	>12.5 cm	0	10	38	42		4	31	27	28		1	6	43	40	
Primary Care provider	Others	0	0	1	3	0.466	2	1	0	1	0.001*	0	0	2	2	0.941
	Parents	0	11	38	40		3	31	27	28		2	6	42	39	

Sex was significantly associated with language category, $p = 0.032$. Males were more likely to score 'Low Average' scores while females were more likely to score 'Average' scores. Iron supplementation was significantly associated with language category, $p = 0.018$. All children with 'Extremely low' language scores were not given iron supplements. Children who received iron had higher proportions of 'Average' scores. Children without adequate night sleep had a higher proportion of 'Low Average' cognitive scores while children with adequate night sleep of minimum 8 hrs had more 'Average' scores indicating significant association with cognitive development, $p = 0.011$.

Higher W/A levels were associated with a higher proportion of Average cognition. The trend was linear and significant, $p = 0.019$. There was a statistically significant association between MUAC and motor category, $p = 0.002$. Children with MUAC 11.5-12.5 cm had a higher proportion of Extremely low motor scores. Children with parents as primary caregivers demonstrated significantly better neurodevelopmental outcomes in language category compared to those cared for by others, $p = 0.001$.

Discussion :

To best of our knowledge, this is the first study done in Western Maharashtra assessing anthropometry and prevalence of neurodevelopmental delay in rural children.

Globally, 23.2% under five children are stunted, 6.6% wasted and 13% underweight^[8]. In India, this prevalence is Stunting - 29.3% to 35.5%, Underweight - 31.8% to 32.1% and Wasting - 17.3% to 19.3%^[9]. Our study showed similar percentage of stunted (30.9%) and underweight (26.5%) children.

Prevalence of wasting (8.3%) in our study was lower to Indian data. This can be probably due to the narrow age group studied and small sample size.

Following table V summarizes findings of few international and national studies done so far to find out the prevalence and determinants of developmental delay in early childhood, few of them focusing especially on rural children.

It has been proved that by 3 years of age children will complete most of their motor, language, cognitive, social and emotional development. In a study done by Namazzi G et al in Eastern Uganda, 12.7% of 487 infants aged 9 to 15 months had neurodevelopmental delay in at least one of the domains^[4]. As against, a study done in urban slums of Nepal by Biswokarma et al in 2022 showed that 56.4% of children in age group of 0-5 yrs had developmental delay in two or more domains^[10]. In India, the prevalence of developmental delay among those under the age of 2-3 years varies approximately from 2% to 20% from various studies like those done by Nair MK et al^[11], Chand et al^[12] and Gupta A et al^[13]. Rashtriya Bal Swasthya Karyakram in India, showed developmental delay affecting nearly 10% of children in early childhood^[14]. Our study showed that 38.7% children had below average scores in all domains and 79.4% were in below average category for at least 1 domain. To our surprise 46.2% children fell into below borderline levels in 1 or more domain but only 0.01% had moderate to severe delay in all domains. Similarly, severe impairment was seen in 1.85% infants in a study done in Eastern Uganda^[4].

Our study showed *language domain* to be most commonly delayed (68.8%) followed by motor domain (55.8%) similar to the studies done by Chand et al^[12] and Lakshmi A et al^[15] as mentioned in above table.

Table IV(c) Important factors studied for domainwise development in children(Chi2 test used, p value of ≤ 0.05 was considered significant)

		Cognitive					Language					Motor				
		Extre Mely low	Bord er-line	Low Aver-age	Aver-age	P value	Ex-tre Mely low	Bord er-line	Low Aver Age	Aver age	P value	Ex-tre Mely low	Bord er-line	Low Aver age	Aver age	P value
Ma- ter- nal educa- tion	illiter- ate	0	0	0	2	0.602	0	1	0	1	0.972	0	0	0	2	0.844
	Middle and high school	0	5	18	20		2	15	13	13		1	3	20	19	
	Diplo- ma and above	0	6	21	19		3	15	14	14		1	3	23	19	
KS class	Upper lower	0	1	2	1	0.883	0	1	2	1	0.723	0	0	1	3	0.824
	Lower middle	0	3	11	12		0	8	8	10		0	3	13	10	
	Upper middle	0	7	25	28		5	22	17	16		2	3	28	27	
	Upper	0	0	1	0		0	1	0	0		0	0	1	0	

Higher prevalence of 38.7% of low development scores in rural children in our study was probably due to narrow age group, diagnostic test used for assessing neurodevelopment and exclusive rural population.

Firstly, we examined the children after completion of 1000 days i.e. at 2 years of age when maximum interactive impact of nutrition, socioeconomic factors, early stimulation practices, environmental exposures, and psychosocial stressors has occurred. Other studies done in various states of India included variable age groups from 0-5 yrs of age. For example, a study done by Agrawal et al in 2018 included children of age group 0-5 yrs from urban slums of Agra showing 12.2% prevalence of developmental delay^[16]. Recently Laxmi et al in

2024 studied 314 children of 12-36 months of age and found 14.9% had developmental delay in at least any one domain^[15].

Secondly, we used *most objective* BSID IV scale to assess the neurodevelopment of these children whereas many studies have used either TDSC or ASQ tool. The BSID are considered the “gold standard” diagnostic tool for neurodevelopmental assessment, typically showing high accuracy, sensitivity and specificity of >85%. Scales like ASQ and TDSC have also reported prevalence ranges between 1.5% and 19.8% indicating significant magnitude of the problem. Zafar et al studied 200 children in Bhopal and found prevalence of 9.5% for any developmental delay using TDSC^[17]. Most objective nature of the tool used is likely to be

responsible for more precise results in our study. We found mean composite scores of all cognitive, language and motor domains in low average category. Nizar A et al assessed 3,062 children from Bangladesh, Pakistan, and Tanzania using the BSID III at two years of age to identify factors associated with development scores. They found that the mean Bayley-III composite score for cognitive (84.8) and language (87.8) development were in low average category while for motor domain were 90.8^[18]. However, another study by Kuhn et al in rural China used BSID III and found that the means of all four development scales were closer to the lower threshold (score = 69)^[19].

Thirdly, we studied *exclusively rural children*. As against this, a study by Vora et al^[20] in Gujarat and Venugopal et al^[21] in South India were done in hospital based settings. They showed 9.5-10% prevalence of developmental delay. There are few studies done in rural regions of India. A community-based cross-sectional study by Sharma et al. found a prevalence of developmental delay to be 16.2% in children aged 2 months–6 years in a rural community of North India^[22]. The high prevalence of developmental delays in rural population highlights the need for routine developmental screening and early intervention programs.

It has been recently estimated that in developing nations, 200 million children under age of five are not reaching their developmental potential because of poverty, malnutrition, infection, lack of stimulation and education and instability in the home. Amongst all, nutrition, maternal education and socioeconomic factors are the common determining factors for neurodevelopment of a child.

Malnutrition and impaired early childhood development are two giant childhood health problems in the developing world which often co-exist. A study by Upadhyay et al on 114 children with severe acute malnutrition showed consistent improvement in developmental quotient with improvement in nutritional status^[23]. A community-based study by Oumer et al. in Southwest Ethiopia among 507 mother–

child pairs found that stunting and underweight were predictors of development delay^[24]. However our study did not show significant association of stunting and wasting with developmental delay. We found a significant association between W/A and cognitive category. Our data also suggested that kids with moderate malnutrition as per MUAC may have more motor delays, which fits existing literature.

Poor maternal education is often cited as having a predictive value for poor developmental outcome. A study by Sachdeva et al. identified that lower education of mothers was associated with higher odds of global developmental delay^[25]. Similarly, AMANHI – ACT study by Nizar A et al also found that cognitive and language scores were lower in children whose mothers had no formal education^[20]. Contrary to above findings our study showed no statistically significant association between maternal education and development of the child as shown in table IV (c). This was probably due to majority mothers (97.8%) in our study had studied above middle school level.

Socio economic status of parents is also a proven factor affecting neurodevelopment in early childhood. Global review by Rakesh in 2023 also showed low socioeconomic status of parents to be associated with poor neurodevelopment in children^[26]. But we did not find any statistically significant association between socioeconomic status and development in a child as per table IV (c). The reason can be majority of families (65.9%) belonged to upper-middle class.

We also found some factors like adequate night sleep and primary care givers to be associated with neurodevelopment of toddlers. But these results should be interpreted with caution due to small sample size.

Some additional findings regarding routine newborn care were also observed during our study highlighting low coverage for universal screening programs and nutritional supplementation in rural areas of India. Children less than 12 months need 400 international units (IU) of vitamin D each day as per CDC recommendations and IAP^[27]. But majority rural children (55.9%) did not receive any Vitamin D

supplementation during first year of life. Similarly, AIIMS guidelines recommend iron supplementation to children aged 6-60 months in the dose of 1-2 mg/kg/day as most of India has >40% prevalence of anemia^[28]. But it was found that 80.6% children did not receive any iron supplements. Our data suggested iron supplementation may be linked to better language outcomes, which matches pediatric nutrition literature. As universal screening, IAP emphasizes on hearing screening of all newborn babies before one month of age to diagnose hearing loss before three months of age^[29]. Only 30.1% of children in our study had undergone hearing screening within 1 month of age. Based on Indian Society for Pediatric and Adolescent Endocrinology (ISPAE) guidelines, all newborns should undergo screening for Congenital Hypothyroidism (CH) using cord blood or heel prick blood (after 48-72 hours of life)^[30]. But in our study 72% babies were not tested for congenital hypothyroidism.

Conclusions:

This study showed high prevalence of malnutrition and developmental delay in rural children of Velhe taluka of Pune at 2 years of age. We found that 38.7% of rural children have below average scores in all domains of neurodevelopment and 79.4% have delay in either of the domains. Factors such as W/A and iron supplementation are significantly associated with domain wise delay in these children. To bridge the developmental gaps identified in rural children we recommend to

1. Promote parental awareness regarding early stimulation, and appropriate caregiving practices through Public-Private Partnerships (PPP).
2. Ensure consistent access to Vitamin D and Iron supplementation.
3. Encourage >3 hours of daily play and limit daily screen time to < 1 hour to protect neurodevelopment.
4. Strengthen universal newborn screening programs such as thyroid and hearing screening to enable early identification of preventable causes of developmental delay.
5. Implement routine neurodevelopmental

screening at 24-30 months, focusing on identifying delays and early intervention services.

Limitations and future reserach

Being cross-sectional study, it captured neurodevelopmental status at a single point in time. Hence, longitudinal follow-ups are needed to provide a more comprehensive understanding of developmental trajectories. Although adequate for analysis, the sample size was relatively small and might not represent the vast cultural and socioeconomic diversity of the Indian population. Information regarding breastfeeding, screen time, play duration and night sleep duration was based on parental recall which is subject to reporting and social desirability bias and might not be completely accurate. So further detailed studies are needed focusing on domain-specific, individual determinants.

What this study adds?

There is high prevalence of developmental delay and malnutrition in rural children of Velhe taluka of Pune emphasizing need for early stimulation.

There are domain specific factors affecting neurodevelopment of these children which need to be addressed.

Ethical approval

This study was approved by Institutional Ethics Committee, Deenanath Mangeshkar Hospital and Research Centre, Pune. (IHR_2024_Feb_PD_526)

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Conflicts of interest

There are no conflicts of interest.

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Declaration of study subjects' consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the study subjects have given his/her/their consent for his/her/their clinical information to be reported in the journal. The study subjects understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Table V Examples of studies done to find out the prevalence and determinants of developmental delay in children

Author, Year	Place, Country	Population and age group	Sample size	Tool used	Prevalence of developmental delay	Significant associated factors
Nair MK (2009) [11]	Kerala, India	0- 5 years (Rural area)	12520	TDSC*	2.5%	--
Zafar M. (2009) [17]	Bhopal, India	0-2yrs (well baby clinic)	200	TDSC	9.5%	--
Juneja M. (2012) [31]	North India	4-24 months	200	ASQ, DASII#	51% on ASQ, 45% on DASII	--
Vora H. (2013) [20]	Gujarat, India	1 month - 2 years (Well baby clinic)	200	TDSC	9.5%.	Natal risk factors like Preterm birth, sepsis
Cusick& Michael Georgieff (2016) [32]	United States	Review	-	-	-	Maternal nutrition, breastfeeding, and complementary feeding
Gupta A. (2016) [13]	Haryana, India	4-18 months (Community based)	221	Questionnaire	6.3%	--
Bhattacharya T. (2017) [33]	West Bengal, India	2-23 months (Community based)	277	TDSC	7.9%.	Gender, birth weight, maternal education and place of delivery
Arora N. (2018) [34]	India (5 geographically diverse regions)	2-9 yrs	3964	Neurodevelopmental Screening Tool (NDST)	9.2% in children aged 2-<6 years.	Non-institutional delivery, perinatal asphyxia, neonatal illness, postnatal infections, stunting, low birth weight/prematurity.

Agarwal D. (2018) [16]	Agra, India	0-5 yrs (Urban slums)	458	Developmental Milestone Chart (DMC)	Overall 12.2 %. Infancy (0-11 months) - 5.7 % 12-23 months - 20.3 %	Nutrition, maternal education , low birth weight
Kumar P. (2019) [35]	UP, India	12-23 months (rural)	682	BSID III	15.5%	Maternal education, nutritional status and socioeconomic status
Banerjee A. (2019) [36]	West Bengal, India	0-5 years (rural children)	1536	WHO growth charts and Denver Development Screening Test II, TDSC scale and Amiel-Tyson method	6.5%	Malnutrition for 0-3 yr age group
Namazzi G.(2019) [4]	Eastern Uganda	9-12 months	487	Malawi Developmental Assessment Tool	12.7% in 1 of the domains, 1.8% in 3 or 4 domains most affected- social behavior (10.7%)	Multiparity, birth asphyxia and postnatal complications
Gupta S. (2021) [37]	West Bengal, India	0-2 yrs	240	TDSC	6.6%	Gender, maternal education, socioeconomic status, parity, birth weight and birth spacing
Bishwokarma A. (2022) [10]	Nepal	0-5yrs (Urban Slum)	165	DMC	56.4% delayed in two or more domains	Age, sex, socioeconomic status and height for age
Rakesh D. (2023) [26]	Global review	-	-	-	-	Low socioeconomic status

Lakshmi A. (2024) [15]	Nagpur, India	12-36 months (PHC)	314	Pediatric Development Screening Tool (PDST).	14.9% in at least any 1 domain 3.5% global developmental delay. highest for language-10%	Maternal education and Nutritional status
Venugopal G. (2024) [21]	South India	2 months to 2 years (Immunization clinic)	300	TDSC	10% 43.3% - multiple item delay	Maternal education, gestational age and neonatal infections
Chand R. (2025) [12]	North India	6 months to 3 years (Rural community)	400	ASQ	20% global developmental delay personal-social (43.5%) fine motor (40.5%)	--
Nizar A. (2025) [18]	Bangladesh, Pakistan, and Tanzania	2 years of age	3062	BSID III and HOME-IT Tool \$	Mean composite scores in low average category	Maternal education, nutritional status and vaccination status

[TDSC*- Trivendrum Developmental Screening Chart, ASQ#-The Ages and Stages Questionnaires, DASII#- Developmental Assessment Scale for Indian Infants, HOME-IT Tool\$- Home Observation for Measurement of the Environment Inventory]

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