



# Growth and Development of Toddlers in Rural and Urban Settings: A Correlational Study of Environmental Determinants

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## Abstract

**Background of the study:** Early childhood, particularly the toddler period (1–3 years), is a critical phase for physical growth and developmental maturation. Environmental determinants such as housing, sanitation, water supply, and pollution play an important role in shaping child health outcomes, yet comparative rural–urban evidence linking these factors with both growth and development remains limited in the Indian context. **Objectives:** To assess and compare the growth and developmental status of rural and urban toddlers and to examine the association between selected environmental variables and growth and developmental outcomes among toddlers residing in Lucknow, Uttar Pradesh. **Materials & Methods:** A quantitative, comparative descriptive survey design was adopted. Sixty toddlers aged 1–3 years (30 rural, 30 urban) were selected using convenience sampling. Growth was assessed using anthropometric measurements interpreted according to WHO growth standards, while developmental status was evaluated using a structured checklist adapted from the Denver Developmental Screening Test and ICDS guidelines. Environmental variables included housing condition, drinking water source, sanitation facilities, waste water disposal, and air pollution exposure. Data were analyzed using descriptive statistics, independent *t*-tests, and Spearman rank correlation analysis. **Results:** Normal growth was observed in 66.6% of rural toddlers and 80% of urban toddlers. Mean growth scores did not differ significantly between rural ( $5.53 \pm 0.78$ ) and urban toddlers ( $5.60 \pm 0.89$ ) ( $t = 0.308$ ,  $p = 0.759$ ). Similarly, developmental scores were comparable between rural ( $23.77 \pm 4.46$ ) and urban groups ( $24.77 \pm 3.65$ ) ( $t = 0.950$ ,  $p = 0.346$ ). Among rural toddlers, drinking water sources and sanitation facilities showed strong positive correlations with growth ( $r_s = 0.700$ ,  $p < 0.001$ ), while housing condition demonstrated a significant association with developmental milestones ( $r_s = 0.581$ ,  $p < 0.01$ ). In urban toddlers, air pollution was moderately associated with growth ( $r_s = 0.530$ ,  $p = 0.002$ ), whereas drinking water, sanitation, and waste water disposal exhibited strong positive correlations with developmental outcomes ( $r_s = 0.700$ ,  $p < 0.001$ ). **Conclusion:** Growth and developmental outcomes were broadly comparable between rural and urban toddlers; however, environmental determinants showed differential associations across settings. Safe drinking water, sanitation, and housing conditions emerged as key contributors to optimal growth and development. The findings emphasize the need for integrated, environment-focused child health interventions tailored to both rural and urban communities.

**Keywords:** Toddlers; Growth; Development; Environmental factors; Rural–urban comparison; Child health

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## INTRODUCTION

Early childhood, particularly the toddler period between one and three years of age, represents a critical developmental phase characterized by rapid physical growth and progressive acquisition of cognitive, motor, language, and socio-emotional skills. During this stage, children transition from complete dependence to increasing

autonomy, marked by independent walking, emerging speech, problem-solving abilities, and social interaction. Despite this progress, toddlers remain highly dependent on caregivers for nutrition, protection, stimulation, and emotional security, making the caregiving environment a decisive factor in shaping developmental outcomes..

Growth and development, though interrelated, represent distinct dimensions of child health. Growth refers to measurable quantitative changes in physical parameters such as weight, height, and body circumferences, whereas development denotes qualitative functional maturation involving motor coordination, language acquisition, cognitive abilities, and social behavior. Growth assessment

relies on anthropometric indices, while development is evaluated through milestone attainment appropriate for chronological age [1].

The World Health Organization identifies physical growth as one of the most sensitive indicators of a child's overall health and nutritional status. Growth faltering during early childhood, often resulting from inadequate nutrition, recurrent infections, or poor environmental conditions, can lead to irreversible developmental deficits if not detected and addressed promptly [2]. To facilitate early detection, WHO recommends routine monitoring using standardized growth indicators such as weight-for-age, height-for-age, and mid-upper arm circumference, alongside developmental screening as part of essential child health services [3,4].

Globally, an estimated 250 million children under five years of age in low- and middle-income countries are at risk of failing to achieve their developmental potential due to poverty, malnutrition, inadequate stimulation, and poor health [5]. According to UNICEF, approximately one-fifth of children worldwide are stunted, highlighting the persistent burden of early childhood undernutrition despite global health initiatives [6]. Consequently, early childhood development has become a central focus of public health strategies, emphasizing integrated approaches that combine nutrition, health care, responsive caregiving, and supportive environments.

In India, although maternal and child health indicators have improved substantially over the past two decades, undernutrition and developmental delays continue to pose major public health challenges. Data from the National Family Health Survey-5 indicate that more than one-third of children under five years of age are stunted, with higher prevalence observed in rural areas compared to urban settings [7]. These disparities reflect differences in socioeconomic status, maternal education, access to healthcare, sanitation facilities, and environmental hygiene.

To address these challenges, the Government of India has implemented large-scale programs such as the Integrated Child Development Services, POSHAN Abhiyaan, and the Rashtriya Bal Swasthya Karyakram, which focus on nutrition, growth monitoring, and early identification of developmental delays. Professional bodies such as the Indian Academy of Pediatrics recommend the use of WHO growth standards and periodic developmental screening to ensure timely intervention during early childhood [8].

Uttar Pradesh, the most populous state in India, continues to experience a high burden of childhood undernutrition and developmental vulnerability. NFHS-5

data reveal that nearly 40% of children under five in the state are stunted, with rural communities disproportionately affected [7]. Environmental determinants such as poor housing, inadequate sanitation, unsafe water, and suboptimal maternal nutrition remain significant contributors to these outcomes [9].

Lucknow district, encompassing both urban and rural communities, provides a unique setting to examine these disparities. While urban areas offer better access to health and educational services, urban slums and peri-urban regions are often characterized by overcrowding, pollution, and compromised sanitation. Rural areas, on the other hand, continue to face challenges related to poverty, limited health infrastructure, and lower awareness regarding child care practices [10]. Community-based studies conducted in Lucknow have demonstrated associations between toddler growth and factors such as maternal education, breastfeeding practices, and household environment, underscoring the importance of contextual assessment [11].

Despite the recognized importance of environmental determinants, most Indian studies focus predominantly on nutritional status, with limited exploration of developmental outcomes and their relationship with environmental variables in a comparative rural-urban framework. This study addresses this gap by simultaneously assessing growth and development and examining their association with selected environmental factors among toddlers residing in rural and urban communities of Lucknow.

## **METHODOLOGY**

A quantitative research approach with a comparative descriptive survey design was adopted to assess and compare the growth and development of toddlers residing in rural and urban communities and to examine their association with selected environmental variables. This design was chosen as it permits systematic observation and comparison between groups without manipulation of study variables, making it suitable for community-based child health research.

The study was conducted in selected rural villages and urban localities of Lucknow district, Uttar Pradesh. These settings were selected based on accessibility, feasibility of data collection, and their ability to represent diverse environmental and socioeconomic conditions. The target population comprised toddlers aged one to three years living in rural and urban areas of Lucknow. The accessible population included children within this age group who were available during the data collection period and whose parents or caregivers provided informed consent.

A total of 60 toddlers were included in the study, with 30 participants selected from rural communities and 30 from urban communities using a non-probability convenience sampling technique. This method was adopted due to logistical feasibility and ease of access to eligible participants. Toddlers aged between one and three years whose parents or caregivers were willing to participate and who were present at the time of data collection were included in the study. Children, who were acutely ill, medically unfit at the time of assessment, older than three years, or diagnosed with growth retardation or chronic medical conditions were excluded.

Data were collected using a structured tool developed specifically for the study. The tool consisted of three components: demographic information, assessment of growth and development, and evaluation of environmental variables. Demographic data included age, gender, birth order, family type, parental education and occupation, and monthly family income. Growth assessment involved anthropometric measurements such as weight, height, and mid-upper arm circumference, recorded using standard procedures and interpreted according to World Health Organization growth standards. Developmental status was evaluated using a structured checklist adapted from the Denver Developmental Screening Test and guidelines followed under the Integrated Child Development Services program, covering gross motor, fine motor, language, and social-adaptive domains. Environmental variables assessed included housing condition, source of drinking water, sanitation facilities, waste disposal methods, exposure to air pollution, maternal nutrition and antenatal care, exclusive breastfeeding practices, and weaning patterns.

The data collection tool was translated into Hindi to ensure better comprehension among participants and was validated by experts in pediatric nursing, community health nursing, pediatrics, and statistics. Content validity was established through expert review, and suggested modifications were incorporated. Reliability of the tool was assessed during the pilot study using the test-retest method, which demonstrated high consistency. The developmental assessment checklist showed strong internal reliability, with a Cronbach's alpha value greater than 0.80.

Anthropometric measurements were obtained first, followed by developmental assessment through structured observation and interaction. Each toddler required approximately 1.5 to 2 hours for complete assessment.

Ethical approval was obtained prior to the commencement of the study. Informed consent was obtained from parents or caregivers after explaining the purpose of the study. Confidentiality and anonymity of participants were ensured, and caregivers were informed of their right to withdraw from the study at any stage without any repercussions.

Data analysis was performed using descriptive and inferential statistical methods. Frequencies, percentages, means, and standard deviations were used to summarize demographic characteristics and outcome variables. Independent *t*-tests were applied to compare growth and development scores between rural and urban toddlers, while correlation analysis was used to examine the relationship between environmental variables and growth and developmental outcomes.

## RESULTS

### Growth Status of Rural and Urban Toddlers

The analysis of growth parameters among rural toddlers showed that **66.6% (20 out of 30)** were within the normal growth range, while **33.3% (10 out of 30)** were categorized as needing monitoring. This indicates that although the majority of rural toddlers were growing appropriately for their age, a substantial proportion exhibited deviations from standard growth patterns that may predispose them to future growth faltering if not addressed.

In contrast, among urban toddlers, **80% (24 out of 30)** demonstrated normal growth and **20% (6 out of 30)** required monitoring. The higher proportion of normal growth in urban toddlers suggests relatively more favorable growth conditions compared to rural toddlers.

### Comparison of Mean Growth Scores between Rural and Urban Toddlers

The mean growth score of rural toddlers was **5.53 ± 0.78**, whereas urban toddlers had a mean score of **5.60 ± 0.89**. An unpaired *t*-test revealed **no statistically significant difference** in growth parameters between the two groups (**t = 0.3084, p = 0.759**). This finding indicates that overall growth outcomes were comparable between rural and urban toddlers despite differences in environmental and socioeconomic contexts.

Group	Mean Score	Standard Deviation (SD)	t-value (Unpaired)	p-value	Interpretation
Rural Toddlers	5.53	0.78	0.308	0.759	Not Significant
Urban Toddlers	5.60	0.89			

**Note:** Unpaired t-test applied;  $p < 0.05$  was considered statistically significant.

Table: 1 Comparison of Growth Parameters of Urban and Rural Toddlers –Unpaired t-test

### Development Status of Rural and Urban Toddlers

The assessment of developmental status shows that the majority of toddlers in both rural and urban areas are developing appropriately for their age. Among rural toddlers, 60% demonstrated age-appropriate development, while 40% showed some degree of developmental delay, indicating the need for regular monitoring and early supportive

interventions. In urban areas, a higher proportion of toddlers (66.6%) exhibited age-appropriate development, whereas 33.3% had minor developmental delays. Although none of the children in either group required immediate specialist referral, the findings highlight the importance of continuous developmental screening and early intervention strategies—particularly in rural settings—to support optimal growth and development and help children with delays catch up with their peers.

(n = 60)

Group	Mean Score	Standard Deviation (SD)	t-value	p-value	Interpretation
Rural Toddlers	23.77	4.46	0.950	0.346	Not Significant
Urban Toddlers	24.77	3.65			

**Note:** Unpaired t-test applied;  $p < 0.05$  considered statistically significant.

Table : 2 Comparison of Developmental Parameters of Rural and Urban Toddlers Using Unpaired t-test

Table 2 shows the comparison of developmental parameters between rural and urban toddlers. The mean developmental score among rural toddlers was  $23.77 \pm 4.46$ , whereas urban toddlers had a mean score of  $24.77 \pm 3.65$ . The unpaired t-test indicated that the difference between the two groups was not statistically significant ( $t = 0.950$ ,  $p =$

$0.346$ ). This finding suggests that developmental outcomes were comparable among toddlers residing in rural and urban communities.

### Correlation between Growth Status and Selected Environmental Variables among Rural Toddlers

(n = 30)

S. No	Environmental Variable	Spearman’s rho (rs)	p-value (2-tailed)	Direction & Strength of Association	Statistical Significance
1	Housing Condition	0.288	0.120	Weak positive	Not significant ( $p > 0.05$ )
2	Drinking Water Sources	0.700	0.00002	Strong positive	Highly significant ( $p < 0.001$ )
3	Sanitation Facilities	0.700	0.00002	Strong positive	Highly significant ( $p < 0.001$ )
4	Waste Water Disposal	-0.200	0.289	Weak negative	Not significant ( $p > 0.05$ )
5	Air Pollution	0.472	0.008	Moderate positive	Significant ( $p < 0.01$ )

Table 3: Spearman Rank Correlation between Growth Status and Selected Environmental Variables among Rural Toddlers

Table 3 illustrates the relationship between growth status and selected environmental variables among rural toddlers using Spearman rank correlation analysis.

Housing condition demonstrated a weak positive association with growth ( $r_s = 0.288$ ), which was not statistically significant ( $p = 0.120$ ). Although improved housing may contribute to a healthier living environment, its isolated effect on toddler growth in rural settings appears limited, possibly due to the dominant influence of nutritional intake, healthcare accessibility, and caregiving practices.

A strong and highly significant positive correlation was observed between drinking water sources and growth status ( $r_s = 0.700$ ,  $p < 0.001$ ). This finding underscores the critical role of safe and adequate drinking water in supporting physical growth, as contaminated water can predispose children to recurrent infections, poor nutrient absorption, and growth faltering.

Sanitation facilities also exhibited a strong and highly significant positive relationship with growth outcomes ( $r_s = 0.700$ ,  $p < 0.001$ ). Improved sanitation reduces exposure to enteric pathogens and diarrheal diseases, thereby enhancing

nutritional utilization and promoting healthier growth trajectories during early childhood.

Waste water disposal showed a weak negative and non-significant association with growth ( $r_s = -0.200$ ,  $p = 0.289$ ). While improper waste water management may contribute to environmental contamination, its direct influence on growth was not evident in the present sample, suggesting the involvement of multiple interacting environmental and behavioral factors.

Air pollution revealed a moderate positive and statistically significant correlation with growth ( $r_s = 0.472$ ,  $p = 0.008$ ). Although air pollution is typically linked to adverse health effects, this positive association may reflect indirect contextual factors, such as proximity to semi-developed areas with better access to healthcare services, food availability, or public health programs. This finding highlights the complex and multifactorial nature of environmental influences on child growth in rural regions.

**Correlation between Developmental Milestones and Selected Environmental Variables among Rural Toddlers**

(n = 30)

S. No	Environmental Variable	Spearman's rho (rs)	p-value (2-tailed)	Direction & Strength of Association	Statistical Significance
1	Housing Condition	0.581	0.00094	Moderate to strong positive	Significant ( $p < 0.01$ )
2	Drinking Water Sources	0.304	0.102	Weak positive	Not significant ( $p > 0.05$ )
3	Sanitation Facilities	0.085	0.656	Very weak positive	Not significant ( $p > 0.05$ )
4	Waste Water Disposal	-0.111	0.559	Weak negative	Not significant ( $p > 0.05$ )
5	Air Pollution	0.069	0.717	Very weak positive	Not significant ( $p > 0.05$ )

Table – 4 Spearman Rank Correlation between Developmental Milestones and Selected Environmental Variables among Rural Toddlers

Table 4 presents the Spearman rank correlation analysis examining the association between developmental milestones and selected environmental variables among rural toddlers. A moderate to strong positive correlation was observed between housing condition and developmental milestones ( $r_s = 0.581$ ,  $p < 0.01$ ), indicating a statistically significant relationship. This finding suggests that improved housing conditions are closely linked with better developmental outcomes in rural toddlers. Adequate housing likely offers a safer, cleaner, and more stimulating environment that facilitates motor activity, social interaction, and early learning, all of which are fundamental to cognitive, language, and psychomotor development during early childhood.

The association between drinking water sources and developmental milestones was weak and positive ( $r_s = 0.304$ ), but not statistically significant ( $p = 0.102$ ). Although access to safe drinking water is essential for preventing illness and supporting overall health, the present findings indicate that water quality alone may not directly influence developmental progress. The effect may be indirectly mediated through factors such as nutrition, maternal education, caregiving practices, and early stimulation, which were beyond the scope of this analysis.

Sanitation facilities demonstrated a very weak positive and non-significant correlation with developmental

milestones ( $r_s = 0.085$ ,  $p = 0.656$ ). While poor sanitation is widely associated with infectious morbidity and malnutrition, its direct impact on developmental outcomes was not evident in this rural sample. This suggests that sanitation-related influences on development may operate indirectly through health and nutritional pathways rather than exerting an immediate measurable effect on milestone attainment.

Waste water disposal showed a weak negative association with developmental milestones ( $r_s = -0.111$ ), which was also not statistically significant ( $p = 0.559$ ). This indicates that variations in wastewater management practices did not demonstrate a meaningful or consistent relationship with developmental outcomes in the studied population. The influence of this factor may be overshadowed by more

proximal determinants such as housing quality, parental involvement, and early childhood stimulation.

Air pollution exhibited a very weak positive correlation with developmental milestones ( $r_s = 0.069$ ) and was not statistically significant ( $p = 0.717$ ). This finding suggests that, within the rural context of the present study, air pollution exposure did not have a measurable association with developmental performance. Lower ambient pollution levels in rural areas and variability in indoor exposure patterns may explain the absence of a significant relationship.

**Correlation between Growth Parameters and Selected Environmental Variables among Urban Toddlers**

*(n = 30)*

S. No	Environmental Variable	Spearman's rho ( $r_s$ )	p-value (2-tailed)	Direction & Strength of Association	Statistical Significance
1	Housing Condition	0.071	0.709	Very weak positive	Not significant ( $p > 0.05$ )
2	Drinking Water Sources	0.000	1.000	No correlation	Not significant ( $p > 0.05$ )
3	Sanitation Facilities	0.167	0.379	Weak positive	Not significant ( $p > 0.05$ )
4	Waste Water Disposal	0.167	0.379	Weak positive	Not significant ( $p > 0.05$ )
5	Air Pollution	0.530	0.002	Moderate positive	Significant ( $p < 0.01$ )

*Table -5 Correlation between Growth Parameters and Selected Environmental Variables among Urban Toddlers*

Table 5 depicts the Spearman rank correlation analysis assessing the relationship between growth parameters and selected environmental variables among urban toddlers.

The association between housing condition and growth parameters was very weak and positive ( $r_s = 0.071$ ), with no statistical significance ( $p = 0.709$ ). This finding suggests that variations in housing conditions within urban settings do not meaningfully influence toddler growth. Urban housing environments may already meet basic structural and safety standards, thereby limiting variability and diminishing their observable effect on growth outcomes.

No correlation was observed between drinking water sources and growth parameters ( $r_s = 0.000$ ,  $p = 1.000$ ). This indicates a complete absence of association in the present data. Uniform access to treated or municipal water supplies in urban areas may account for this finding, as minimal variation in water quality reduces its measurable impact on child growth.

Sanitation facilities demonstrated a weak positive correlation with growth parameters ( $r_s = 0.167$ ), though the association was not statistically significant ( $p = 0.379$ ). Similarly, waste water disposal showed an identical weak positive and non-significant relationship ( $r_s = 0.167$ ,  $p = 0.379$ ). These results suggest that, within urban contexts, sanitation and waste management systems may be sufficiently standardized, thereby limiting their differential impact on toddler growth.

In contrast, air pollution exhibited a moderate positive correlation with growth parameters ( $r_s = 0.530$ ) and was statistically significant ( $p = 0.002$ ). This indicates that air pollution is meaningfully associated with growth among urban toddlers. Although air pollution is typically linked with adverse health outcomes, the positive direction observed in this study may reflect complex urban dynamics. Areas with higher pollution levels often coincide with better healthcare access, nutrition availability, and socioeconomic opportunities, which may partially offset the negative

biological effects of pollution. This finding warrants cautious interpretation and further investigation.

**Correlation between Developmental Parameters and Selected Environmental Variables among Urban Toddlers**

Table 6 illustrates the relationship between developmental parameters of urban toddlers and selected environmental variables using Spearman rank correlation analysis. Housing condition demonstrated a weak negative correlation with developmental outcomes ( $r_s = -0.189$ ), which was not statistically significant ( $p = 0.317$ ). This finding indicates that variations in housing quality within

urban settings do not exert a measurable influence on developmental milestones. Urban housing environments may be structurally adequate across households, thereby reducing variability and limiting its observable impact on child development.

A strong positive and highly significant correlation was observed between drinking water sources and developmental parameters ( $r_s = 0.700$ ,  $p = 0.00002$ ). This highlights the critical role of access to safe and reliable drinking water in supporting optimal child development. Clean water reduces the burden of waterborne illnesses, supports nutritional absorption, and contributes to overall physical and neurological well-being during early childhood.

(n = 30)

S. No	Environmental Variable	Spearman’s rho (rs)	p-value (2-tailed)	Direction & Strength of Correlation	Statistical Significance
1	Housing Condition	-0.189	0.317	Weak negative	Not significant ( $p > 0.05$ )
2	Drinking Water Sources	0.700	0.00002	Strong positive	Highly significant ( $p < 0.001$ )
3	Sanitation Facilities	0.700	0.00002	Strong positive	Highly significant ( $p < 0.001$ )
4	Waste Water Disposal	0.700	0.00002	Strong positive	Highly significant ( $p < 0.001$ )
5	Air Pollution	0.342	0.064	Moderate positive	Marginally non-significant

*Table- 6 Correlation between Developmental Parameters and Selected Environmental Variables among Urban Toddlers*

Similarly, sanitation facilities exhibited a strong positive and highly significant association with developmental outcomes ( $r_s = 0.700$ ,  $p = 0.00002$ ). Adequate sanitation minimizes exposure to infectious agents, thereby preventing recurrent illness and under nutrition, both of which are known to adversely affect developmental progression.

Waste water disposal also showed a strong and statistically significant positive correlation with developmental parameters ( $r_s = 0.700$ ,  $p = 0.00002$ ). Proper waste water management reflects a healthier living environment and reduces environmental contamination, indirectly supporting cognitive, motor, and social development in toddlers.

Air pollution demonstrated a moderate positive correlation with developmental outcomes ( $r_s = 0.342$ ), with a p-value marginally above the conventional level of significance ( $p = 0.064$ ). While air pollution is generally associated with adverse developmental effects, the observed trend may reflect complex urban characteristics, where areas with higher pollution exposure may also offer better

healthcare access, early education services, and parental awareness. However, as the association did not reach statistical significance, this finding should be interpreted cautiously and explored further in larger studies.

**DISCUSSION**

**Growth Status of Rural and Urban Toddlers**

The present study demonstrates that a majority of toddlers in both rural and urban settings achieved growth parameters within the normal range; however, a notable proportion in each group required monitoring. Rural toddlers exhibited a lower proportion of normal growth (66.6%) compared to their urban counterparts (80%), reflecting persistent contextual vulnerabilities despite improvements in primary healthcare outreach. Similar rural–urban gradients in child growth have been reported in Indian and global literature, where environmental and socioeconomic inequalities continue to influence nutritional outcomes during early childhood [12,13].

Although urban toddlers demonstrated comparatively better growth profiles, the absence of severe growth compromise in the rural group suggests the positive impact of national maternal and child health initiatives such as Integrated Child Development Services (ICDS) and routine growth monitoring programs. Earlier studies have emphasized that even in resource-constrained settings, consistent community-based interventions can mitigate extreme growth disparities [14].

### **Comparison of Mean Growth Scores between Rural and Urban Toddlers**

The comparison of mean growth scores revealed no statistically significant difference between rural and urban toddlers. This finding challenges the traditional assumption that urban residence inherently confers superior growth outcomes. Comparable results have been reported in recent population-based studies, indicating that when basic healthcare access, immunization coverage, and nutritional supplementation are reasonably ensured, place of residence alone may not independently predict child growth [15,16].

This convergence may also reflect a gradual narrowing of rural–urban health gaps due to decentralization of healthcare services and improved awareness among caregivers. Similar observations were documented in a multicentric Indian study, which reported minimal differences in anthropometric outcomes between rural and urban toddlers when maternal education and healthcare utilization were controlled [17].

### **Developmental Status of Rural and Urban Toddlers**

Developmental assessment revealed that a substantial proportion of toddlers in both settings achieved age-appropriate milestones, although rural toddlers demonstrated a slightly higher prevalence of developmental delays. These findings align with evidence suggesting that early childhood development is shaped not only by biological maturation but also by environmental stimulation, caregiver interaction, and living conditions [18].

The lack of statistically significant differences in mean developmental scores between rural and urban groups indicates that developmental potential can be preserved across settings when basic caregiving and health needs are met. However, the higher proportion of children requiring monitoring in rural areas underscores the importance of early identification and supportive interventions. Studies conducted in low- and middle-income countries consistently highlight that subtle developmental delays often remain undetected in

rural communities due to limited screening and parental awareness [19].

### **Environmental Determinants of Growth among Rural Toddlers**

The strong positive correlations observed between drinking water sources, sanitation facilities, and growth among rural toddlers reinforces the central role of environmental hygiene in physical development. Unsafe water and poor sanitation are well-established contributors to repeated enteric infections, environmental enteropathy, and impaired nutrient absorption, ultimately leading to growth faltering [20, 21].

The significant association between air pollution and growth, although counterintuitive in direction, reflects the complexity of rural environmental exposures. In semi-rural regions, proximity to developing infrastructure may simultaneously increase pollution exposure and improve access to healthcare services, markets, and nutrition programs. Similar mixed associations have been reported in transitional rural environments undergoing rapid development [22].

Housing condition and waste water disposal did not demonstrate significant associations with growth, suggesting that their influence may be indirect or mediated through other dominant factors such as dietary intake and healthcare access.

### **Environmental Influences on Developmental Milestones among Rural Toddlers**

Housing condition emerged as the only environmental variable significantly associated with developmental outcomes among rural toddlers. Adequate housing provides not only physical safety but also opportunities for movement, play, and social interaction, all of which are essential for cognitive and motor development. Previous research has emphasized that poor housing environments restrict exploratory behavior and limit caregiver–child interaction, thereby impeding developmental progress [23].

Other environmental variables, including water source, sanitation, waste water disposal, and air pollution, did not show significant associations with developmental milestones. This finding supports the notion that developmental outcomes are more sensitive to psychosocial stimulation and caregiving quality than to isolated environmental hygiene factors. Longitudinal studies have similarly demonstrated that developmental delays often arise from cumulative psychosocial deprivation rather than single environmental exposures [24].

### Environmental Correlates of Growth among Urban Toddlers

In urban settings, air pollution was the only environmental factor significantly associated with growth parameters. While air pollution is widely recognized for its adverse respiratory and systemic effects, emerging evidence suggests complex associations with growth outcomes in urban populations. Children residing in highly urbanized areas may experience better nutrition and healthcare access that partially buffer the biological stressors associated with pollution exposure [25].

The absence of significant associations with housing, water, sanitation, and waste management reflects the relative uniformity of urban infrastructure. Similar findings have been reported in metropolitan studies where environmental variability is limited, reducing the observable impact of these factors on growth indicators [26].

### Environmental Determinants of Development among Urban Toddlers

Among urban toddlers, drinking water sources, sanitation facilities, and waste water disposal demonstrated strong and statistically significant associations with developmental outcomes. These findings highlight that, even in urban environments, environmental hygiene continues to play a crucial role in supporting neurological and psychosocial development. Recurrent infections, subclinical inflammation, and poor nutritional absorption secondary to environmental contamination can adversely affect brain development during critical periods.

Housing condition did not show a meaningful association with development, likely due to relatively standardized urban housing structures. Air pollution showed a moderate but statistically inconclusive relationship, warranting cautious interpretation. Previous studies suggest that neurodevelopmental effects of air pollution may require prolonged exposure and larger sample sizes to be detected reliably [27].

### CONCLUSION

The study concludes that although no statistically significant difference was observed in growth parameters between rural and urban toddlers, environmental factors demonstrated strong and meaningful associations with growth and developmental outcomes. Access to safe drinking water, adequate sanitation, and appropriate housing conditions

emerged as key determinants of healthy early childhood development.

Strengthening environmental infrastructure, promoting hygienic practices, and ensuring routine growth and developmental monitoring are essential strategies for improving toddler health outcomes. Integrated approaches addressing both environmental and caregiving factors are necessary to support optimal growth and development during early childhood.

### IMPLICATIONS FOR CHILD HEALTH PRACTICE AND POLICY

The findings of this study underscore the need for integrated child health strategies that extend beyond nutritional supplementation to address environmental quality and living conditions. Strengthening water and sanitation infrastructure, improving housing quality in rural areas, and mitigating air pollution exposure in urban settings are essential for promoting holistic child growth and development. These results align with global calls for multisectoral early childhood development policies that integrate health, environment, and social protection frameworks [28].

### IMPLICATIONS FOR CHILD HEALTH AND NURSING PRACTICE

The presence of toddlers requiring growth monitoring and exhibiting developmental delays in both rural and urban settings underscores the importance of universal screening rather than location-based assumptions. Growth and developmental surveillance should be an integral component of routine child health services, supported by parental education and environmental improvements. From a nursing perspective, these findings reinforce the role of community and pediatric nurses in early identification of growth deviations, health education, and advocacy for improved environmental conditions that support optimal child development.

### RECOMMENDATIONS

Improving environmental infrastructure, particularly in rural communities, should be prioritized to promote healthy growth and development among toddlers. Early childhood development programs should be strengthened with an emphasis on regular growth monitoring and developmental screening. Community-based awareness initiatives focusing on hygiene, nutrition, and safe living environments are recommended. Collaborative efforts between government

agencies, healthcare institutions, and non-governmental organizations are essential to ensure comprehensive and sustainable child health interventions.

### LIMITATIONS OF THE STUDY

The study has certain limitations that should be acknowledged. The relatively small sample size and the use of a convenience sampling technique limit the generalizability of

the findings beyond the study setting. The cross-sectional design restricts the ability to establish causal relationships between environmental variables and growth or developmental outcomes. In addition, reliance on caregiver-reported information for selected environmental factors may have introduced reporting bias. Finally, the study focused on a limited set of environmental variables, and other determinants such as detailed dietary intake and genetic factors were not explored.

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