(RESEARCH ARTICLE)

Rural and Urban dichotomy in body mass index among children of Tamil Nadu, India

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Abstract

Background: Optimal nutritional conditions during early childhood are vital for growth, cognitive development, and enduring health status. The Body Mass Index (BMI) is one of the tools used to measure overall health status, including physiological and nutritional aspects. In regions undergoing dietary and lifestyle changes, the dual burden of malnutrition, undernutrition, and overweight pose significant public health challenges.

Objectives: This present study assessed and compared the Body Mass Index-based physiological and nutritional health status among children aged 2–6 years in two demographically distinct areas: rural Udayarpalayam Taluk and the urban Thanjavur Corporation in Tamil Nadu. Accordingly, the International Obesity Task Force (IOTF) guidelines were used to study and determine age and sex-specific Body Mass Index distributions, as well as the prevalence of thinness and overweight, between rural and urban areas.

Methods: A cross-sectional survey was conducted among 2,020 children in rural Udayarpalayam Taluk (985 boys, 1,035 girls) and 1,020 children in Thanjavur Corporation (544 boys, 476 girls). The Body Mass Index was estimated and categorised into thinness (Grades I–III), normal, and overweight. Descriptive statistics and Karl Pearson correlation techniques were used to analyse and compare the trends of rural and urban cohorts by age and sex.

Results: Therefore, a clear dual burden of malnutrition was observed. Rural children in Udayarpalayam Taluk showed higher rates of severe thinness, particularly 5-year-old boys (33.91%) and 6-year-old girls (27.51%). In Thanjavur, urban children were found to have a higher rate of overweight health conditions, particularly among 2-year-old girls, where 25.9% were affected. Girls living in urban areas of this region also displayed higher normal Body Mass Index (BMI) levels compared to those in rural areas.

Conclusion: The findings revealed differences in nutritional and physiological health status between children living in rural and urban settings. These results emphasise the necessity for tailored interventions aimed at tackling both undernutrition and emerging overweight issues in early childhood.

Keywords: Body Mass Index; Children; Nutritional Status; Thinness; Overweight; Physiological Status

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1. Introduction

Nutritional and psychological health status in early childhood is a critical element which determines overall health and development. The Body Mass Index (BMI) is mainly used to assess the physiological and nutritional health status of children. Hence, undernutrition and overweight are prevalent conditions that can coexist, particularly in regions undergoing dietary transitions. This study aims to analyse the Body Mass Index (BMI) of children aged 2 to 6 years in Udayarpalayam Taluk (Rural) and Thanjavur Corporation (urban), using the International Obesity Task Force-recommended cut-off points to classify their nutritional groups.

2. Review of Literature

Health geography plays a vital role in analysing spatial dimensions of child health consequences. Health geography [1] proposes examining environmental, demographic, and socio-economic factors that influence health behaviours and access to utilisation of healthcare facilities. In the context of child health nutrition, spatial inequalities in the availability of food, sanitation, and healthcare infrastructure are fundamental for undernutrition and overweight tendencies [2]. The study of [3] Geospatial mapping to examine child health malnutrition in India has significant regional discrepancies. Rural children face higher risks of stunted growth and physical thinness. Similarly, the use of spatial epidemiology [4] in recognising trouble spots of child health malnutrition and emphasising the essential interventions based on geographic relationships.

The Body Mass Index (BMI) at a given age is a helpful tool for examining physiological growth and identifying nutritional health issues in children [5]. The World Health Organisation has emphasised the use of age- and sex-specific Body Mass Index cut-offs to classify malnutrition conditions in a global context [6].

In rural India [7], researchers exhibited a high prevalence of undernutrition health conditions, principally in children under five years. Similarly, the discrepancies in nutritional health status are recognised based on geographic and socio-economic influences [8]. In contrast, newer studies propose a promising trend of childhood overweight and obesity conditions, particularly in urban communities [9]. A study in Tamil Nadu recounted [10] that around 30% of children aged below five were underweight health conditions, indicating permanent nutritional challenges in southern India. Socio-economic status, maternal education, and food insecurity are major determining factors of malnutrition among Indian children [11]. In Maharashtra, significant urban-rural disparities were observed, with undernutrition being more prevalent in rural settings [12].

Moreover, current real-time data [13] show significant inter-state disproportions. In Kerala, the infant mortality rate (IMR) is 4.4 per 1,000 live births, whereas in states like Uttar Pradesh and Madhya Pradesh, the IMR rate exceeds 40, and in Tamil Nadu, it is 18.6 per 1,000 live births. The Global data [14] indicate that over 150 million children under five were stunted in growth, with Asia accounting for many of these cases. The dataset information highlights the simultaneous presence of both undernutrition and overnutrition worldwide, which is consistent with the trends observed in the rural regions of Udayarpalayam Taluk. As a result, these emphasise the collective localised importance of conducting localised evaluations to create tailored strategies that address the nutritional health issues faced by children at both extremes.

Aim and Objectives

This study aims to evaluate and associate the Body Mass Index-based nutritional health status of children aged 2 to 6 years in rural (Udayarpalayam Taluk) and urban (Thanjavur Corporation) settings in Tamil Nadu. The objectives involve shaping age and sex-recognising Mass Index allocations, recognising the occurrence of thinness and overweight, and assessing rural-urban nutritional health disparities.

3. Methodology

A cross-sectional study was conducted among 2,020 children (985 boys and 1,035 girls) from Udayarpalayam Taluk and 1,020 children (544 boys and 476 girls) from Thanjavur Town. To assess the physiological health status of children, the Body Mass Index (BMI) was measured to estimate and categorise into thinness grades I to III, normal, and overweight categories according to the International Obesity Task Force (IOTF) analysis points. At this juncture, to analyse age-sex-specific Body Mass Index, descriptive and Karl Pearson correlation statistical techniques are used from the afore mentioned rural and urban datasets, facilitating further interpretation and findings.

3.1. Study Area

Udayarpalayam Taluk is a predominantly rural administrative region locatCharacterisedr District, Tamil Nadu. Characterised by urbanisation livelihoods, limited urbanisation, and varying levels of access to healthcare and nutrition services, the area reflects the broader challenges of rural child health management in India. In contrast, the Thanjavur Corporation is an urban local body that governs Thanjavur Town, a historically significant and economically active urban centre in Tamil Nadu. It has better infrastructure, education, and healthcare facilities. The Thanjavur Corporation stand for a standard urban environment experiencing the nutritional transition, measured by increasing examples of overweight children combined with continuing undernutrition. These complementary backgrounds provide a constructive framework for examining spatial inequalities in child health and nutritional status outcomes.

4. Results

4.1. Nutritional Status of Children in Udayarpalayam Taluk (Rural)

This present study examined the physiological and nutritional health status (Table 1) of 2020 children (985 boys and 1035 girls) aged 2 to 6 years, using age- and sex-specific Body Mass Index groupings suggested by the International Obesity Task Force (IOTF).

4.1.1. Children Aged 2 Years

The data set reveals that of the boys (n = 164), 34.15% had a normal Body Mass Index, 19.51% were in thinness grade III, and 13.41% were overweight. Girls (n = 167) showed a somewhat better profile, with 42.51% in the normal health status range and a lower percentage (14.37%) of children being overweight. However, 21.56% of girl children were in thinness grade III.

4.1.2. Children Aged 3 Years

Similarly, the boys (n=179) children had 41.90% in the normal Body Mass Index group and 21.23% in thinness grade III. However, girls (n=175) children had a slightly lower standard Body Mass Index (37.71%) but a higher percentage of thinness in grade III (24.00%). Further, the overweight children were relatively equal among both sexes, at 17.88% for boys and 17.14% for girls.

4.1.3. Children Aged 4 Years

The data set confirmed that children aged four years have a normal Body Mass Index in 55.48% of boys (n = 146), which is the highest among all male age groups. 17.12% of boys' children observed in the Thinness grade I. The girl children (n=180) had a normal health condition in 40.00%, thinness grade III in 12.22%, and overweight in 12.22%, reflecting a more stable health profile.

4.1.4. Children Aged 5 Years

This age group exhibited definite distinctions. Among the boys (n = 174), thinness grade III was extremely predominant, at 33.91%, with only 31.03% having a usual Body Mass Index. The female children (n = 148) had a better overall health condition, with 37.84% falling within the standard health range and 20.27% being overweight; however, the data set reveals that 21.62% of the children had thinness grade I.

Table 1 Age and sex specific body mass index cut-off points for the assessment of Physiological status among children aged 2 to 6 years Udayarpalayam Taluk

| Age | Sex | Total Number | | BMI Grade | Recommended BMI* | Number of Children | Percentage | Mean BMI | Pearson Correlation -0.891 | Sig. (2 tailed) 0.001** |
		Boys (%)	Girls (%)							
Children Aged 2	Boys	164 (9.98%)	-	Thinness grade-III	13.37	32	19.51	15.33		
				Thinness grade-II	14.12	20	12.20			

				Thinness grade-I	15.14	34	20.73	
				Normal	15.14-18.41	56	34.15	
				Overweight	18.41	22	13.41	
				Total Percentage			100.00	
	Girls	-	167 (10.16%)	Thinness grade-III	13.24	36	21.56	15.41
				Thinness grade-II	13.90	10	5.99	
				Thinness grade-I	14.83	26	15.57	
				Normal	14.83-18.02	71	42.51	
				Overweight	18.02	24	14.37	
				Total Percentage			100.00	
Children Aged 3	Boys	179 (10.89%)	-	Thinness grade-III	13.09	38	21.23	15.44
				Thinness grade-II	13.79	12	6.70	
				Thinness grade-I	14.74	22	12.29	
				Normal	14.74-17.89	75	41.90	
				Overweight	17.89	32	17.88	
				Total Percentage			100.00	
	Girls	-	175 (10.65%)	Thinness grade-III	12.98	42	24.00	15.01
				Thinness grade-II	13.60	16	9.14	
				Thinness grade-I	14.47	21	12.00	
				Normal	14.47-17.56	66	37.71	
				Overweight	17.56	30	17.14	
				Total Percentage			100.00	
Children Aged 4	Boys	146 (8.88%)	-	Thinness grade-III	12.86	25	17.12	14.85
				Thinness grade-II	13.52	12	8.22	
				Thinness grade-I	14.43	16	10.96	
				Normal	14.43 -17.55	81	55.48	
				Overweight	17.75	12	8.22	
				Total Percentage			100.00	
	Girls	-	180	Thinness grade-III	12.73	22	12.22	14.56

			(10.95%)	Thinness grade-II	13.34	30	16.67	
				Thinness grade-I	14.19	34	18.89	
				Normal	14.19-17.28	72	40.00	
				Overweight	17.28	22	12.22	
				Total Percentage			100.00	
Children Aged 5	Boys	174 (10.59%)	-	Thinness grade-III	12.66	59	33.91	13.82
				Thinness grade-II	13.31	23	13.22	
				Thinness grade-I	14.21	24	13.79	
				Normal	14.21-17.42	54	31.03	
				Overweight	17.42	14	8.05	
				Total Percentage			100.00	
	Girls	-	148 (9.00%)	Thinness grade-III	12.50	12	8.11	15.06
				Thinness grade-II	13.09	18	12.16	
				Thinness grade-I	13.94	32	21.62	
				Normal	13.94-17.15	56	37.84	
				Overweight	17.15	30	20.27	
				Total Percentage			100.00	
Children Aged 6	Boys	150 (9.12%)	-	Thinness grade-III	12.50	27	18.00	14.62
				Thinness grade-II	13.15	24	16.00	
				Thinness grade-I	14.07	21	14.00	
				Normal	14.07-17.55	57	38.00	
				Overweight	17.55	21	14.00	
				Total Percentage			100.00	
	Girls	-	160 (9.73%)	Thinness grade-III	12.32	44	27.51	14.07
				Thinness grade-II	12.93	06	3.75	
				Thinness grade-I	13.82	27	16.87	
				Normal	13.82-17.34	70	43.75	
				Overweight	17.34	13	8.12	
				Total Percentage			100.00	

| Total | | 985 (49.5%) | 1035 (50.5%) | | 1643 | | 14.81 | |
| Grand Total | | 1643 (100.00%) | | | | | | |

* Recommended by International Obesity Task Force (IOTF). **. Correlation is significant at the 0.01 level (2-tailed). Compiled by Author

4.1.5. Children Aged 6 Years

This age group of boys (n = 150) had a 38.00% normal Body Mass Index, whereas 18.00% were in thinness grade III. However, the girl children (n=160) demonstrated mixed health conditions, with 43.75% in the standard health category, 27.51% in thinness grades III, and 8.12% overweight. The highest occurrence of thinness, grade III, was recorded in this age group.

4.2. Overall Observations of Udayarpalayam Taluk (Rural)

The normal Body Mass Index category was most prevalent among boy children aged 4 (55.48%) and girls aged 6 (43.75%). In contrast, the Thinness grade III was significantly higher in boys aged 5 (33.91%) and girls aged 6 (27.51%), indicating a need for public health attention. The prevalence of overweight health conditions ranged from 8.05% to 20.27%, with the highest rate detected in 5-year-old girl children. In the sample, the data reveal an average Body Mass Index of 14.81, and the Karl Pearson method indicates a significant negative correlation ($r = -0.891$, $p < 0.01$). Therefore, the present study has demonstrated that younger individuals are more likely to experience thinness grades, and it has also found an inverse relationship between Body Mass Index and nutritional health status.

4.3. Nutritional Status of Children in Thanjavur (Urban)

The study evaluated 1,020 children (544 boys and 476 girls) aged 2 to 6 years in Thanjavur Town, using age- and sex-specific Body Mass Index (BMI) cut-off points to assess the nutritional health status of children within the Thanjavur Corporation (Table 2). Therefore, children aged 2 to 6 years are grouped into different types of Body Mass Index classifications, specifically thinness grades (I, II, III), normal, and overweight.

4.3.1. Children Aged 2 Years

The data reveals some concerning trends among two-year-old boys and girls regarding their Body Mass Index (BMI). For boys, 42.4% are within the normal range, while 18.5% are considered overweight. Worryingly, 29% fall into different categories of thinness. Among girls, 42.9% are classified as having a normal BMI, while a higher percentage of 25.9% are considered overweight. Additionally, nearly one-third of the girls fall into the underweight category. These results highlight the significant issues of both overnutrition and undernutrition at such a young age.

4.3.2. Children Aged 3 Years

In the 3-year-old group, 46.4% of boys and 34.4% of girls had a normal Body Mass Index. Notably, thinness in Grade III was prevalent among 20.4% of boys and 21.9% of girls, indicating substantial undernutrition. Overweight children rates remained below 20% for both sexes, but thinness, particularly in girls, was becoming increasingly evident.

4.3.3. Children Aged 4 Years

By age 4, boys continued to show a strong presence in the standard Body Mass Index category (45.9%), while 20.8% were severely underweight (Thinness Grade III). In contrast, 50% of girls were within the normal health status. The highest rate of severe thinness, at 27.4%, was found among girls across all age groups at this stage. In this study, the data set shows a growing nutritional health status gaps, particularly affecting young girls.

4.3.4. Children Aged 5 Years

For children aged 5 years, the trend among boys shifted, with only 31.3% having a normal Body Mass Index. Thinness Grade I alone accounted for 25.7%, and 18.3% of children in Grade II thinness, pointing toward an apparent increase in undernutrition with age. However, girls in this study area maintained a higher percentage (50.6%) within the normal Body Mass Index range, with a relatively balanced distribution across the thinness and overweight categories.

4.3.5. Children Aged 6 Years

The nutritional health status of 6-year-old children raises significant concerns. In boys, only 26.9% had a normal Body Mass Index (BMI), while a concerning 33.9% as Thinness Grade I and 23.6% as Grade III. The data indicates a decline in

nutritional health as boys grow older. Girls showed somewhat better results, with 34.9% falling within the normal BMI range. However, a notable 23.7% were still classified under Thinness Grade I, indicating ongoing issues with underweight status among girls as well.

Table 2 Age and Sex Specific New International Body Mass Index Cut-Off Points for the Assessment of Nutritional Status among Children in Thanjavur Corporation

Age	Sex	Total Number			Recommended BMI*	Number of Children	Percentage	
		Boys	Girls					
Children Aged 2	Boys	92 (9.01%)	-	Thinness grade-III	13.37	17	18.5	
				Thinness grade-II	14.12	09	9.8	
				Thinness grade-I	15.14	10	10.8	
				Normal	15.14-18.41	39	42.4	
				Overweight	18.41	17	18.5	
				Total Percentage		100.00		
	Girls	-	112 (10.98%)	Thinness grade-III	13.24	14	12.5	
				Thinness grade-II	13.90	10	8.9	
				Thinness grade-I	14.83	11	9.8	
				Normal	14.83-18.02	48	42.9	
				Overweight	18.02	29	25.9	
				Total Percentage		100.00		
Children Aged 3	Boys	108 (10.58%)	-	Thinness grade-III	13.09	22	20.4	Pearson Correlation 0.872 Sig. (2 tailed) 0.001**
				Thinness grade-II	13.79	08	7.4	
				Thinness grade-I	14.74	13	12	
				Normal	14.74-17.89	50	46.4	
				Overweight	17.89	15	13.8	
				Total Percentage		100.00		
	Girls	-	96 (9.41%)	Thinness grade-III	12.98	21	21.9	
				Thinness grade-II	13.60	09	9.4	
				Thinness grade-I	14.47	14	14.6	
				Normal	14.47-17.56	33	34.4	
				Overweight	17.56	19	19.7	
				Total Percentage		100.00		
Children Aged 4	Boys	120 (11.76%)	-	Thinness grade-III	12.86	25	20.8	
				Thinness grade-II	13.52	12	10	
				Thinness grade-I	14.43	13	10.8	
				Normal	14.43 -17.55	55	45.9	
				Overweight	17.55	15	12.5	
				Total Percentage		100.00		
	Girls	-	84	Thinness grade-III	12.73	23	27.4	

				Thinness grade-II	13.34	02	2.4	
		(8.23%)		Thinness grade-I	14.19	08	9.5	
				Normal	14.19-17.28	42	50	
				Overweight	17.28	09	10.7	
				Total Percentage		100.00		
Children Aged 5	Boys	109 (10.68%)	-	Thinness grade-III	12.66	21	19.2	
				Thinness grade-II	13.31	20	18.3	
				Thinness grade-I	14.21	28	25.7	
				Normal	14.21-17.42	34	31.3	
				Overweight	17.42	06	5.5	
				Total Percentage		100.00		
	Girls	-	95 (9.31%)	Thinness grade-III	12.50	10	10.5	
				Thinness grade-II	13.09	10	10.5	
				Thinness grade-I	13.94	16	16.8	
				Normal	13.94-17.15	48	50.6	
				Overweight	17.15	11	11.6	
				Total Percentage		100.00		
Children Aged 6	Boys	115 (11.27%)	-	Thinness grade-III	12.50	27	23.6	
				Thinness grade-II	13.15	09	7.8	
				Thinness grade-I	14.07	39	33.9	
				Normal	14.07-17.55	31	26.9	
				Overweight	17.55	09	7.8	
				Total Percentage		100.00		
	Girls	-	89 (8.72%)	Thinness grade-III	12.32	15	16.8	
				Thinness grade-II	12.93	11	12.3	
				Thinness grade-I	13.82	21	23.7	
				Normal	13.82-17.34	31	34.9	
				Overweight	17.34	11	12.3	
				Total Percentage		100.00		
Total		544 (53.4%)	476 (46.6%)			1020		
Grand Total		1020 (100%)						

* Recommended by International Obesity Task Force (IOTF). **. Correlation is significant at the 0.01 level (2-tailed). Compiled by Author

4.4. Overall Observations Thanjavur Corporation (Urban)

Normal Body Mass Index was most frequent among girls aged 4 and 5 years (50% and 50.6%, respectively). Thinness grade III was highest in 4-year-old girls (27.4%) and 6-year-old boys (23.6%). The prevalence of overweight peaked among 2-year-old girls (25.9%) and 3-year-old girls (19.7%). The data indicate a pronounced dual burden of malnutrition in Thanjavur Town: Currently, there's a noticeable rise in overweight issues among younger children, while thinness remains a concern, particularly among boys and older girls. In urban areas of Tamil Nadu, a noticeable change in nutritional health is evident, indicating that people are gaining better access to healthy foods, although some

dietary inconsistencies persist. This has led to a strong, positive relationship between age and body mass index (BMI), as indicated by a Pearson correlation coefficient of 0.872, with a statistically significant p-value of less than 0.001. Hence, the findings underscore the importance of timely and age-appropriate nutritional interventions, particularly during early childhood.

4.5. Comparative Analysis: Udayarpalayam Taluk (Rural) and Thanjavur Corporation (Urban)

A comparison between Udayarpalayam Taluk and Thanjavur Town highlights contrasts between rural and urban child health statuses. In Thanjavur, urban children demonstrated a higher percentage of normal Body Mass Index across many age groups, particularly among girls. Overweight prevalence was also notably higher in urban areas, with 25.9% of 2-year-old girls in Thanjavur classified as overweight, compared to 14.37% in Udayarpalayam.

Conversely, Udayarpalayam reported higher percentages of thinness grade III in boys aged 5 (33.91%) and girls aged 6 (27.51%), reflecting persistent undernutrition in rural regions. While urban children in Thanjavur still face issues of thinness, their nutritional profiles are more balanced, with lower extremes in underweight and more instances of early overweight.

The results indicate that cities are experiencing a more pronounced shift in nutrition, whereas rural areas continue to face significant challenges with undernutrition. This highlights the importance of tailoring public health strategies to specific local contexts.

5. Discussion

This investigation evaluates the Body Mass Index (BMI) of children in Rural and urban areas of Tamil Nadu. These findings highlight a notable case of children in the thinness grade, specifically among boys aged five and girls aged six. Although the majority of children are within the normal Body Mass Index range, the problem of thinness remains a significant concern. In addition, a considerable number of children are categorised as overweight, signifying a mixed challenge of malnutrition in the areas examined five and six years of girl children. Despite most children being within the normal Body Mass Index range, thinness remains a distinct concern. A prominent percentage of children are also overweight, which indicates a dual burden of malnutrition in these study areas.

These findings confirmed that both national and international outlines were in place. However, states like Kerala established low infant mortality rates and high child health indicators, although states like Uttar Pradesh and Madhya Pradesh face more severe healthcare tasks. The Tamil Nadu achieves moderately well in comparison. Globally, data from the World Health Organisation (2024) reported that nearly 150 million children are in stunted growth, and 35 million are overweight, indicating the worldwide prevalence of both undernutrition and overnutrition. In Udayarpalayam Taluk, children exhibit both thinness and obesity, presenting a significant healthcare challenge for the public people. The health patterns observed among urban children in Thanjavur reinforce this issue, highlighting the increasing dangers of childhood obesity.

This study provides valuable insights into the health conditions of children in both rural and urban areas of Tamil Nadu, offering key recommendations and identifying areas where further research is necessary. Furthermore, there remains a lack of recent data from both rural and urban zones within the state. Furthermore, there is limited longitudinal research that tracks changes in Body Mass Index over time and their impacts on educational and health outcomes.

The results have direct implications for public health policy. Integrating Body Mass Index observation into child healthcare and safeguarding nutritional supplements in recognised Anganwadis could address recognised gaps. Policymakers should consider developing regional and targeted strategies to combat both undernutrition and the emerging overweight menace.

Future research should include longitudinal studies to investigate the growth of child health status, assess intervention outcomes, and conduct comparative scrutiny with other low-income regions in India and worldwide. Additionally, qualitative studies examining caregiver practices and socio-economic barriers complement the findings of quantitative studies

6. Conclusion

This study emphasises the rural-urban dichotomy in Body Mass Index among Children in Tamil Nadu, India. The nutritional health challenges among children in Udayarpalayam and Thanjavur Corporation are characterised by a dual

burden of malnutrition, with undernutrition and overweight co-occurring. In rural areas of Udayarpalayam Taluk, children face problems of thinness grade because of socio-economic conditions and other fundamental infrastructural limitations; on the other hand, urban areas are experiencing a shift towards increasing overweight and obesity, particularly among younger children. The contrasting patterns in child health highlight the need for effective healthcare strategies.

The findings and results suggest that public health interventions should be in specific locations. Rural regions necessitate greater investment in maternal healthcare education, food security, accessibility in primary healthcare, and child health nutritional programs. Meanwhile, urban centres need early intervention strategies to monitor and control overweight trends through balanced dietary habit education and promotion of physical activity.

The study also confirms the effectiveness of the Body Mass Index as an analytical tool in measuring physiological health status and administrative for local policy actions. Integrating health geography perspectives enhances understanding of how spatial, environmental, and social factors converge to influence children. Upcoming efforts should emphasise unremitting investigation, longitudinal studies, and spatial epidemiological tactics to track healthcare transitions and guide targeted, justice-oriented public health assessments.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no known competing financial or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper

Statement of ethical approval

This study involved the collection of primary data from children. Ethical clearance was obtained from the Institutional Review Board. Prior informed consent was obtained from the parents or guardians of all participating children

Statement of informed consent

Informed consent was obtained from the parents or legal guardians of all individual participants included in the study.

Author Contributions

- **Dr. Vadivel S**: Statistical Analysis, Interpretation of Results, Writing – Review and Editing. Analysis, Writing – Original Draft.
- **Ponnyin Selvi. T**: Data collection, Literature Review, Data Curation, Visualization, Writing – Review and Editing.
- **Sankar. K**: Conceptualization, Methodology, Data Collection,

Consent for Publication

It is not applicable, as the manuscript does not contain any personally identifiable information or images.

Data Analysed

The datasets generated and analysed during the current study are available from the corresponding author upon reasonable request.

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