Original Article

The Catch-Up Growth in Stunted Children: Analysis of First and Second India Human Development Survey Data

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Abstract

Context: Change in stunting as the children grow older is rarely found in published literature. **Aims:** The present paper compares the change in the prevalence of stunting among children as they grow from 0–4 years to 7–11 years. **Settings and Design:** The present paper is a secondary analysis of India Human Development Survey-I (IHDS-I) (2005) and IHDS-II (2012) data for Kerala. **Methods and Materials:** In total, 411 children of age 0–4 years and 390 children of age 7–11 years with anthropometric measurements were included in the present study, respectively, from IHDS-I and IHDS-II. **Statistical Analysis Used:** The statistical analyses were done using SPSS 21.0. The prevalence of stunting was estimated. Bivariate and multivariate analyses were performed using the Pearson Chi-square test. **Results:** The prevalence of stunting among children has been drastically reduced (50.4% to 20.3%) while growing older from 0–4 years to 7–11 years. **Conclusions:** More than half of the stunted children below 5 years regained normal growth, as they grow older.

Keywords: Change in prevalence, India Human Development Survey, Kerala, stunting, under-five children

Introduction

Stunting is an indicator of chronic undernutrition in the early growth and development of children.[1] Stunting is defined as "the percentage of children, aged 0–59 months, whose height-for-age is below minus two standard deviations (moderate and severe stunting) and minus three standard deviations (severe stunting) from the median of the World Health Organization (WHO) Child Growth Standards."[1] The consistently poor nutritional status of children in many states of India is a subject of discussion for many years.[2] Reports suggest that the state of Kerala, an exception in terms of better performance in human development, is also not performing when it comes to the nutritional status of children.[3-5] The National Nutrition Monitoring Bureau (NNMB) (2012) reported that the prevalence of stunting, underweight, and wasting among children aged between 0 and 5 years in Kerala were 27%, 24%, and 15%, respectively.[6] According to the National Family Health Survey-4 (2017), the prevalence of stunting, underweight, and wasting were 19.7%, 16.1%, and 15.7%.[7] The reduction in annual average of the three indicators since NFHS-2 (1992-93) was below 1%.[7,8] Even though these rates found to be the best in India, one-fifth of the children are still below the accepted levels of height gain. Nevertheless, they are higher than the "trigger levels" of 15%, 20%, and 5%, respectively, for stunting, underweight, and wasting as the per WHO.[9] The reports are showing higher prevalence of undernutrition and neonatal and infant deaths among tribal groups in Kerala.[10]

The present study uses the India Human Development Surveys (IHDS) conducted in two time periods for the purpose of comparison among children. The IHDS conducted in 2005 and 2012 among the same study samples (83%), provides an advantage for comparison as in a prospective cohort study.[11,12] It looked into increase or decrease in the stunting rates as the children had grown from 0–4 years to 7–11 years in Kerala.

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Subjects and Methods

IHDS-I (2005) and IHDS-II (2012) conducted by the Inter-university Consortium for Political and Social Research (ICPSR) with the support of National Institutes of Health. The ICPSR is a joint venture of the National Council of Applied Economic Research and the University of Maryland. Data were accessed from these two surveys for analysis.[11] IHDS-I collected data from 215,754 persons of 41,554 households in 1503 villages and 971 urban neighborhoods across India, except Lakshadweep and Andaman Nicobar Islands. In IHDS-II, 83% of the IHDS-I households were reinterviewed and 2134 new households added a fresh, constituting 215,754 persons from 42,152 households. Both the surveys followed the standard protocols for data collection.[11,12]

In Kerala, IHDS covered 12 out of 14 districts, except Kasaragod and Wayanad. IHDS-I collected data from 7981 participants, including 3910 males (49%) and 4071 females (51%). There were550 under-five children in the total sample, of which 411 children had anthropometric measurements done.[11] IHDS-II included 6780 participants, including 3215 males and 3565 females and out of 509 children between 7 and 11 years, 390 had anthropometric measurements. The children of age 8–11 years were categorized into below average, average, and above average by their teachers in the IHDS-II. Cognitive skills mainly short reading, writing, and arithmetic knowledge tests were also conducted.[11]

The analysis was done using SPSS Statistics for Windows Version 21.0 (International Business Machines Corporation-IBM Corp., Armonk, New York). The prevalence of stunting was separately estimated for under-five children in IHDS-I and children of age 7–11 years in IHDS-II based on the Z-score of height-for-age of WHO reference population.[9] The WHO classifies stunting among children below 5 years into mild, moderate, and severe as described in Table 1.

The caste and religion were merged as one variable. Educational status, annual household income, and annual household per capita expenditure were categorized. The poverty status was in two categories, namely, below poverty line (BPL) and above poverty line (APL) following 2005 standards.[11] Associations were analyzed using the Pearson Chi-square test and binary logistic regression. Associations with a $P = 0.05$ was considered as statistically significant.

Table 1: World Health Organization classification of stunting among children

Stunting classification	Height for the age of the child[14]
Mild	Between -1 and -2 SD from the median Z-score (of the reference population)
Moderate	Between -1 and -2 SD from the median Z-score
Severe	Less than -3 SD from the median Z-score

SDs: Standard deviations, WHO: World Health Organization

Results

Change in prevalence of stunting among children between India Human Development Survey-I and India Human Development Survey-II

There is a significant reduction in the prevalence of stunting among children, as they grow older from 0– 4 years to 7–11 years between two surveys [Table 2]. The combined prevalence of moderate and severe stunting was 50.4% and 20.3%, respectively, in IHDS-I and IHDS-II.

Determinants of stunting among children in India Human Development Survey-I and India Human Development Survey-II

Tables 3 and 4 depict the sociodemographic and economic determinants of stunting among children in both the surveys and Table 5 shows the results of multivariate analysis. More stunting among girls was reported in the IHDS-I, and it was high among boys in IHDS-II, but the association was not statistically significant. In both surveys, caste/religion and highest education of female adult were significantly associated with stunting in bivariate analysis. The children from the Muslim community were more vulnerable to stunting in both the surveys. The prevalence of stunting among under-five children decreased as women's education increased. However, regression analysis showed no such associations. Poverty was a significant determinant of stunting in IHDS-I, but not in IHDS-II. There was considerable increase in the annual household income and monthly per capita expenditure between the periods of two surveys. The annual household income showed significant positive association with stunting in IHDS-II, even after adjusting for other factors. Children from BPL households were found to be more stunted that those from APL households in both surveys. However, this association could not be proved in IHDS-I after adjusting for other variables.

Cognitive development among children (8–11 years) and stunting

The children of age 8–11 years were categorized into below average, average, and above average by their teachers. Basic reading, arithmetic, and writing tests were given to children and categorized into different categories based on their performance. The present study tried to find whether there is any cognitive delay in stunted children compared to normal children and the results are shown in Table 6.

Discussion

Change in the prevalence of stunting in both surveys

As shown in the results, the prevalence of stunting had reduced from 50% to 20% in IHDS-II. This figure is also closely in agreement with NNMB-2012 stunting prevalence among children of age group 5–10 years with 23.0%.[6] It indicates that the more than half of the stunted children regained their growth in 7-year period between two surveys. This catch-up growth in the early adolescence stage has been reported by

Table 2: Change in the prevalence of stunting among children between India Human Development Survey-I and India Human Development Survey-II

Age (completed years), (*n*)	IHDS-I, *n* (%)			Age (completed years) (*n*)	IHDS-II, *n* (%)		
	Moderate	Severe	Total		Moderate	Severe	Total
0 (48)	0	3 (6.3)	3 (6.3)	7 (90)	14 (15.6)	5 (5.6)	19 (21.2)
1 (82)	11 (13.4)	35 (42.7)	46 (56.1)	8 (73)	2 (2.7)	4 (5.5)	6 (8.2)
2 (98)	15 (15.3)	43 (43.9)	58 (59.2)	9 (76)	9 (11.8)	11 (14.5)	20 (26.3)
3 (95)	12 (12.6)	44 (46.3)	56 (58.9)	10 (65)	8 (12.3)	6 (9.2)	14 (21.5)
4 (88)	12 (13.6)	32 (36.4)	44 (50.0)	11 (86)	11 (12.8)	9 (10.5)	20 (23.3)
Total (411)	50 (12.2)	157 (38.2)	207 (50.4)	Total (390)	44 (11.3)	35 (9.0)	79 (20.3)

IHDS: India Human Development Survey

Table 3: Sociodemographic factors and stunting among children

Variables	IHDS-2005			IHDS-2012		
	Number of subjects (*n*)	Prevalence of stunting among children below 5 years, *n* (%)	*P*	Number of subjects (*n*)	Prevalence of stunting among children below 5 years, *n* (%)	*P*
Rural/urban						
Rural	262	133 (50.8)	0.838	125	23 (18.4)	0.314
Urban	149	74 (49.7)		265	56 (21.1)	
Sex						
Males	230	112 (48.7)	0.487	208	48 (23.1)	0.087
Females	181	95 (52.5)		151	31 (17.0)	
Caste/religion						
Forward castes	53	24 (45.3)	0.021*	40	6 (15.0)	0.016*
Other backward class	107	49 (45.8)		100	20 (20.0)	
Scheduled caste/scheduled tribe	41	21 (51.2)		35	5 (14.3)	
Muslims	125	78 (62.4)		155	43 (27.7)	
Christians	85	35 (41.2)		60	5 (8.3)	
Highest education of the adult female in the household (≥21 years)						
No school education	5	3 (60.0)	0.048*	2	2 (100.0)	0.011*
Primary school (1-4)	8	2 (25.0)		5	1 (20.0)	
Secondary school (5-10)	242	136 (56.2)		215	46 (21.4)	
Higher secondary (11-12)	68	29 (42.6)		80	20 (25.0)	
Graduate and above	88	37 (42.0)		88	10 (11.4)	
Highest education of the adult male in the household (≥21 years)						
No school education	2	1 (50.0)	0.713*	4	1 (25.0)	0.426*
Primary school (1-4)	19	7 (36.8)		24	6 (25.0)	
Secondary school (5-10)	268	133 (49.6)		205	43 (21.0)	
Higher secondary (11-12)	48	26 (54.2)		57	6 (10.6)	
Graduate and above	53	29 (54.7)		54	10 (18.5)	

*Fisher's exact test. IHDS: India Human Development Survey

many studies across the world.[13-16] However, these findings are not generalizable, given that the socioeconomic and cultural characteristics of Kerala widely vary from rest of the country.

The determinants of stunting among children between 2005 and 2012

It has to be noted that the variables that were significantly associated with stunting in IHDS-I and IHDS-II were not the same. The prevalence of stunting among children from the rural and urban areas were almost similar in two surveys; however, in the second survey, children from urban areas were slightly more stunted than rural children. The recent NFHS survey (2015–2016) showed the same finding as children from urban areas of Kerala are more stunted than their rural counterparts (19.8% vs. 19.5%).[7] More prevalence of stunting among boys in IHDS-II could be explained by the biological reasons that the pubertal growth of girls starts at a younger age than boys, and this will help them to catch up their growth a little earlier than boys.[17] The prevalence of stunting was high among children from Muslim community in both surveys showing a comparatively slower recovery. Stunting among children from

Table 4: Economic factors and stunting among children

Variables	Number of subjects (*n*)	Prevalence of stunting among children below 5 years, *n* (%)	*P*	Number of subjects (*n*)	Prevalence of stunting among children below 5 years, *n* (%)	*P*
Poverty status						
Below poverty line	126	73 (57.9)	0.043	32	9 (28.1)	0.254
Above poverty line	285	134 (47.0)		358	70 (19.6)	
Annual income of the household (Rs.)						
≤100,000	335	167 (49.9)	0.704	113	32 (28.3)	0.013
>100,000	76	40 (52.6)		277	47 (17.0)	
Annual per capita consumption expenditure						
≤15,000	370	191 (51.6)	0.140	81	14 (17.3)	0.536
>15,000	41	16 (39.0)		309	65 (21.0)	

IHDS: India Human Development Survey

Table 5: Determinants of stunting among children - results of multivariate analysis

Variable name	2005		2012	
	Unadjusted OR (95% CI)	Adjusted OR (95% CI)	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Rural/urban				
Rural	1	1	1	1
Urban	0.957 (0.640-1.431)	0.821 (0.511-1.321)	1.188 (0.692-2.039)	0.648 (0.352-1.193)
Sex				
Males	1	1	1	1
Females	1.164 (0.788-1.719)	1.185 (0.775-1.811)	0.684 (0.414-1.132)	0.695 (0.392-1.232)
Caste/religion				
Forward castes	1	1	1	1
Other backward class	1.021 (0.527-1.977)	1.028 (0.512-2.064)	1.417 (0.523-3.838)	1.545 (0.530-4.5000)
Scheduled caste	1.269 (0.560-2.872)	1.106 (0.466-2.624)	0.944 (0.261-3.412)	0.729 (0.190-2.792)
Muslims	2.005 (1.046-3.844)*	1.811 (0.893-3.676)	2.176 (0.853-5.550)	2.078 (0.752-5.746)
Christians	0.846 (0.423-1.690)	0.735 (0.354-1.526)	0.515 (0.146-1.819)	0.430 (0.116-1.589)
Highest education of the adult female in the household (≥21 years)				
Up to 10 years of schooling	1	1	1	1
>10 years of schooling	0.593 (0.397-0.887)*	0.600 (0.358-1.005)**	0.768 (0.463-1.274)	1.107 (0.571-2.146)
Highest education of the adult male in the household (≥21 years)				
Up to 10 years of schooling	1	1	1	1
>10 years of schooling	0.797 (0.506-1.255)	2.030 (1.148-3.589)*	0.616 (0.333-1.140)	0.730 (0.357-1.492)
Poverty status				
Below poverty line	1	1	1	1
Above poverty line	1.552 (1.016-2.370)*	1.420 (0.848-2.379)	0.592 (0.261-1.342)	0.217 (0.058-0.812)*
Annual income of the household (Rs.)				
≤100,000	1	1	1	1
>100,000	1.118 (0.679-1.840)	1.392 (0.779-2.487)	0.517 (0.309-0.866)*	0.486 (0.256-0.921)*
Annual per capita consumption expenditure (Rs.)				
≤15,000	1	1	1	1
>15,000	0.600 (0.310-1.160)	0.534 (0.243-1.176)	1.275 (0.674-2.412)	2.022 (0.738-5.542)

*P<0.05, **P=0.052. OR: Odds ratio, CI: Confidence interval

scheduled castes reduced to one-fourth of the prevalence in the first survey in 2005–14.3% in 2012. This finding is similar to that of a study from West Bengal showing children of Muslim community and scheduled caste category were more stunted.[18] Both IHDS-I and II had poor representation of scheduled tribes for making any meaningful interpretations. There is a general reduction of stunting in all strata of the society during the period from 2005 to 2012. Similar to other studies in the past, there was a significant association of stunting with education of women in IHDS-I.[19,20] Although it highlights the importance of the women's role in ensuring adequate nutrition for their children, this association was not seen in IHDS-II. The most

Table 6: Cognitive development among children and stunting

Category	Cognitive merit of the child, *n* (%)					*P*
	Below average		Average		Above average	
Stunting status						
No stunting (222)	4 (1.8)		162 (73.0)		56 (25.2)	0.942
Stunting (51)	1 (2.0)		38 (74.5)		12 (23.5)	
Category	**Reading skills**					***P***
	Cannot read	**Read letters**	**Words**	**Paragraph**	**Story**	
Stunting status						
No stunting (215)	1 (0.5)	15 (7.0)	36 (16.7)	71 (33.0)	92 (42.8)	0.240*
Stunting (49)	2 (4.1)	2 (4.1)	8 (16.3)	18 (36.7)	19 (38.8)	
Category	**Arithmetic skills**					***P***
	Numbers		**Subtractions**		**Division**	
Stunting status						
No stunting (214)	52 (24.3)		116 (54.2)		46 (21.5)	0.163
Stunting (49)	8 (16.3)		34 (69.4)		7 (14.3)	
Category	**Writing skills**					***P***
	Cannot write		**1-2 mistakes**		**No mistakes**	
Stunting status						0.900*
No stunting (207)	13 (6.3)		76 (36.7)		118 (57.0)	
Stunting (47)	2 (4.3)		18 (38.3)		27 (57.4)	

*Fisher's exact test. IHDS: India Human Development Survey

plausible reason could be that unlike in the past, most of the women are exposed to health and nutrition-related information through various sources such as Integrated Child Development Services and Accredited Social Health Activists and the revolutionary social media. Therefore, it would be better to assess the awareness among women specifically related to the health and nutrition of children rather than the number of years of schooling. It is evident that the annual income and monthly per capita consumption of almost all households had been increased over the 7 years. The number of households belonged to BPL reduced substantially. Kerala is reported to have the highest per capita income in the country and it might be reflecting in these findings.[21] The annual income showed a significant positive association with stunting proving that the increase in income reduces poverty which, in turn, contribute to optimum growth of children.[22]

Conclusion

The results of the present study show that children who are stunted at their younger ages may regain their growth in their later development stages, specifically during early adolescence, if provided with sufficient socioeconomic and environmental conditions to exploit this window of opportunity.

Limitations of the study

This survey did not have adequate representation from tribal children, even though they are the most vulnerable groups in the state of Kerala. IHDS-II had 83% of the original samples of IHDS-I. The authors did not do a one-to-one follow-up of children in both surveys, and therefore, the results would merit as that of a systematically done prospective cohort study.

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Conflicts of interest

There are no conflicts of interest.

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