Status of Health of Under-5 Children in Four Metro Cities in India: A Comparative Analysis Using the Latest NFHS Data

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ABSTRACT: This paper investigates the Status of Health of Under-5 Children of Four Metro Cities in India and finds its relationship with socio-demographic variables. The Fourth National Family Health Survey (NFHS-4) data has been used for finding the health status of children. The sample size for (0-59)-month children is 2215 in four metro cities and 60488 in all India urban areas. The paper considers Height-for-age, Weight-for-age, Weight-for-height, Hemoglobin level, BMI as the health-related variables and birth order, family size, mother's education (for awareness), wealth index of the household, sex of child as the socio-demographic variables, which are assumed to affect health of under-5 children well. About 55 % of under-5 children in urban India is anemic. Among the four metros, Delhi records the highest percentage of severely anemic under-5 children, followed by Mumbai, Kolkata and Chennai. As per Body Mass Index (BMI) Mumbai tops among the four metro cities. Chennai occupies the second position while Kolkata is at par with all India urban and Delhi fall below that level. The logistic regression reveals significant positive impacts of wealth and mother's education on the child's growth in terms of height and weight though there are some variations in the values of the coefficients at all India urban areas and in Metro cities under consideration. Also, birth order adversely affects the growth of child.

INTRODUCTION

Studies on health and healthcare have assumed a new dimension with plenty of studies coming on diverse aspects on status of health and healthcare across time and place (Paine, '78; Desai *et al*., 2010; Park, 2011; Bharati *et al*., 2017). The treatment of status of health is different for different age groups (Short and Mollborn, 2015). A considerable number of studies have been conducted on the regional health issues in India. While very few studies have been made only on urban areas in India, no study relating to the comparison of health status of children in different metro cities in India has so far been found in the literature. The status of health is expected to be better in urban areas because of available healthcare

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opportunities and better nutritional intake due to higher economic level (Yesudian, '88; Bharati *et al*., 2020). Anemia is very much prevalent among 6- to 59-month-old children in India. Bharati *et al*. (2020) showed that in 2015-16, proportion of children in such age-group with anemia was 53.2% in urban areas as against 57.2% in rural areas. Metro cities also are in the limelight for reduced under-5 child death and rising life expectancy at birth, which is due to better education of mother in cities than in rural areas. Along with it, various health care measures have been seen to be administered in a better way in urban areas than in rural areas (Paine, '78). However, some studies have raised doubt about the better status of health of urban children especially in metros in comparison to rural areas, where a large section of population and children suffer from malnutrition and so is the case for mothers there (Haque *et al*., 2014; Rodes, 2015). It is thus pertinent to examine the status of health of under-5 children in four metro cities in India. It is also important to check the reasons for the observed deficiency in health status that would help in framing proper policy guideline.

Now there are six metro cities in India after the declaration of Bengaluru and Hyderabad. But for the present study, we have considered Delhi (North West, North, North East, East, New Delhi, Central, West, South West, South together), Kolkata, Mumbai (Mumbai Suburban Mumbai together) and Chennai only. Also, a comparison is made with the phenomenon at all India urban level.

DATA AND METHODOLOGY

This study is based on the latest NFHS 4 data which corresponds to 2015-16. Information pertains to height, weight, anemia, birth order, age of mother, educational status, wealth and various civic facilities have been used for the purpose of analysis. The sample sizes for (0-59)-month children are60488 in all India urban areas and 2215 in four metro cities with 1468, 179, 331 and 237 respectively for Delhi, Kolkata, Mumbai and Chennai Metro cities. We have a large sample size in Delhi compared to other three cities. This is because the surrounding areas were taken for Delhi which were designated as North-East Delhi, North Delhi etc. whereas such nomenclatures were not available for the other three metro cities.

The mean levels of HAZ, WAZ and hemoglobin in four metros are better than that of all India urban while the mean value of WHZ is worse than that of all India level (Table 1). Also, there is significant inter-metro cities variation in all these indicators of health.

TABLE 1
Mean level of HAZ, WAZ, WHZ, Haemoglobin across 4 metro cities and All India urban

Area	No. of Under-5 Children	Mean HAZ	Mean WAZ	Mean WHZ	Mean Hb	Mean BMIZ
Delhi	1468	-.969	-1.456	-1.077	10.24	-.90
Kolkata	179	-.714	-1.169	-.90	10.59	-.773
Mumbai	331	-.715	-1.373	-1.154	10.38	-1.093
Chennai	237	-.779	-1.006	-.581	10.90	-.437
Four Metros	2215	-.888	-1.368	-1.017	10.38	-.865
All India Urban	60488	-1.081	-1.439	-.963	10.68	-.7811

Distribution of children aged below 5 years have been described in respect of height for age Z-score (HAZ), weight for age Z-score (WAZ), weight for height Z-score (WHZ) and BMI for age Z-score taking the categories below normal, normal and above normal. As per the WHO recommended method, a Z-score of HAZ, WAZ and WHZ less than -2 is considered as stunted, underweight and wasted respectively for under-5 children[1]. On the other hand, a Z-score above 2 in all the above three cases indicated all, overweight and overweight respectively (Table 2).

TABLE 2
WHO-Standard criteria for HAZ, WAZ and WHZ to identify growth of under-5 children

Z-Score	Growth Indicators			
	Height-for- age(HAZ)	Weight-for-age(WAZ)	Weight-for-height(WHZ)	BMI-for Age(BMIZ)
Above 3	*See note 1*	*See note 2*	*Obese*	*Obese*
Above 2			*Overweight*	*Overweight*
Above 1			*Possible risk of Overweight*	*Possible risk of Overweight*
			(See note 3)	*(See note 3)*
0 (Median)				
Below -1				
Below -2	*Stunted(see note 4)*	*Underweight*	*Wasted*	*Wasted*
Below -3	*Severely stunted*	*Severely underweight*	*Severely Wasted*	*Severely Wasted*
	(see note 4)	*(see note 5)*		

Note 1. A child in this range is very tall. Tallness is rarely a problem, unless it is so excessive that it may indicate an endocrine disorder such as a growth-hormone-producing tumor. Refer a child in this range for assessment if you suspect an endocrine disorder (e.g. if parents of normal height have a child who is excessively tall for his or her age).

Note 2. A child whose weight-for-age falls in this range may have a growth problem, but this is better assessed from weight-for-length/height or BMI-for-age.

Note 3. A plotted point above 1 shows possible risk. A trend towards the 2 z-score line shows definite risk.

Note 4. It is possible for a stunted or severely stunted child to become overweight.

Note 5. This is referred to as very low weight in IMCI training modules. (Integrated Management of Childhood Illness, In-service training. WHO, Geneva, 1997).

Source: WHO, https://www.who.int/childgrowth/training/module_c_interpreting_indicators.pdf; (accessed on 08-01-2020)

Status of anemia based on hemoglobin level has been grouped as anemic if the hemoglobin level is less than 11 g/dl, otherwise the child is non-anemic.

In order to have bivariate relation between various health indicators namely HAZ, WAZ, WHZ, BMIZ and Status of Anemia with the explanatory variables, namely birth order of child, wealth index, HH size and Mother's education; we have grouped the explanatory variables appropriately.

Households, based on wealth index, are categorized into poorest, poor, middle income, richer and richest as presented in NFHS data. Households, in respect of mothers' education, are grouped into no education, primary, secondary and higher education. Household size has been grouped into household size d" 3, 4, 5 and e" 6 members. Mother's level of education, wealth index, household size and birth order are thought to influence the status of health of under-5 children in the metro cities in India.

Each bivariate table is subject to chi-square test to see whether there exists a relation between the health indicator and the corresponding explanatory variable. We had taken some more explanatory variables, but did not take these variables into consideration because of lack of sufficient relations between them. In some cases, t-tests have been carried to compare the significance of mean differences.

In order to see the simultaneous effect of the socio-demographic variables, we have carried out logistic regression of the binary variables of the health indicators on the socio-demographic variables. The stunted/ underweight/wasted children are put in one group with value 1 and other children are given the value 1.

RESULTS

Out of 55931 effective samples of under-5 aged children at all India urban areas, overall, 26.2 % is found to have stunted growth, 33.3 % are underweight and 17.3 % are wasted. The corresponding proportions in the four metros are found to be 23.9 %, 32.1 % and 18.3 % respectively (Table 3). Therefore, though proportion of children under 5 years of age group are less in case of stunted growth and underweight, it is slightly higher in case of waste children as compared to all India urban category. Whereas, the proportion of overweight children is more in four Metros in comparison to all India urban by all the three criteria.

TABLE 3
Distribution of under-5 children in urban areas of India with respect to height for age, weight for age and weight for height Z-values

Group	HAZ_Group		WAZ_Group		WHZ_Group	
	N	Percent	N	Percent	N	Percent
			Delhi			
Below Normal	286	24.5	375	32.1	201	32.0
Normal	845	72.3	784	67.0	965	67.1
Above Normal	38	3.2	10	0.9	11	0.9
Total	1169	100.0	1169	100.0	1177	100.0
			Kolkata			
Below Normal	28	18.1	47	30.5	27	17.5
Normal	122	79.3	100	64.9	122	79.3
Above Normal	4	2.6	7	4.6	5	3.3
Total	154	100.0	154	100.0	154	100.0
			Mumbai			
Below Normal	58	21.9	94	35.5	60	22.6
Normal	188	70.9	165	62.2	198	74.4
Above Normal	19	7.2	6	2.3	8	3.0
Total	265	100.0	265	100.0	266	100.0
			Chennai			
Below Normal	56	27.6	60	29.6	42	20.7
Normal	130	64.0	138	67.9	148	72.9
Above Normal	17	8.4	5	2.5	13	6.4
Total	203	100.0	203	100.00	203	100.00
			All Four Metros			
Below Normal	428	23.9	576	32.1	330	18.3
Normal	1285	71.7	1187	66.3	1433	79.6
Above Normal	78	4.4	28	1.6	37	2.1
Total	1791	100.0	1791	100.0	1800	100.0
			All India Urban			
Below Normal	14659	26.2	18635	33.3	9681	17.3
Normal	39455	70.5	36715	65.6	45283	80.8
Above Normal	1817	3.3	581	1.1	1090	1.9
Total	55931	100.0	55931	100.0	56054	100.0

Among the four metro cities, Chennai has the highest proportion of stunted children (27.5 %), followed by Delhi (24.5), Mumbai (21.8 %), whereas Kolkata has the lowest (18.1 %) in proportion. The proportion of underweight children is the highest in Mumbai (35.5 %), followed by Delhi (32.0 %), while in Kolkata and Chennai the figures are 30.6 and 29.5 respectively. In weight-for-height category also, Kolkata registered the lowest figure with 17.6 % and Delhi recorded the highest figure with 32.0 %.

In case of wasted children, proportions of Delhi and Chennai are much higher than all India urban, while in case of underweight children, the proportion in Mumbai is much above the all India urban figure. Kolkata recorded lower figures in all the three criteria as compared to all India urban results. In case of overweight children, the proportion is the highest in Chennai (6.4 %), which is followed by Kolkata (3.26 %) and Mumbai (2.99 %). These values are much higher than all India urban figure of 1.94 %. However, proportion of overweight children in Delhi is comparatively less (merely 0.88 %).

TABLE 4
Distribution of under-5 children according to the level of anemia and BMI in All India urban and four metro cities

	All India Urban		4 MetrosTogether		Delhi		Kolkata		Mumbai		Chennai	
						Anemia						
	N	%	N	%	N	%	N	%	N	%	N	%
Anemic	123964	56.2	991	60.2	626	60.7	79	59.0	176	65.4	110	51.9
Not Anemic	96514	43.8	656	39.8	406	39.3	55	41.0	93	34.6	102	48.1
Total	220478	100.0	1647	100.0	1032	100.0	134	100.0	269	100.0	212	100.0
						BMI						
Below Normal	9868	17.6	329	18.4	193	16.6	27	17.6	65	24.3	44	21.7
Normal	44511	79.4	1398	78.3	953	82.0	119	77.8	193	72.0	133	65.5
Above Normal	1701	3.0	59	3.3	16	1.4	7	4.6	10	3.7	26	12.8
Total	56080	100	1786	100.0	1162	100.0	153	100.0	268	100.0	203	100.0

Table 4 gives distribution of under-5 children according to the level of anemia and BMI in all India urban and four metro cities. At all India urban level, prevalence of anemic children under-5 is 56.2 %, while the figure is 60.2 % in the four metro cities. Among those four metros, Mumbai recorded the highest prevalence of anemic under-5 children (65.4%), followed by Delhi (60.7%), Kolkata (59.0%) and Chennai (51.9%). Except Chennai, all the three other metro cities recorded the prevalence of anemic children more than that of all India level.

In terms of Body Mass Index (BMI) also Mumbai tops the list with 24.3 % of children under-5 years of age being undernourished. This is much above the all India average of 17.6 % and the four metro cities (18.4%). Chennai occupies the second position with 21.7 % undernourished children while Kolkata is at per with all India urban figure of 17.6 % and Delhi fall below that with 16.6 % (Table 3).

We have also found the Cross-tabulations between HAZ, WAZ and WHZ groups which are not shown here. The diagonal frequencies in these cross-tables are found to be more than the off-diagonal frequencies. This means that the three measures are positively related. Grouping of children with respect to one criterion will be more or less similar to the grouping of children with the other two criteria. This is true for children of both all India urban and four metro cities.

Cross tabulation of HAZ, WAZ and WHZ scores with Birth order as presented in Table 5 reveals that percentage of stunted, underweight and wasted children increases with the increase of birth order both at all India urban and four metro areas. Proportion of above normal height children, which is very small, also declines with the order of birth. Chi-Square test for each cross-tabulation shows that the relation between birth order and the Z scores are significant, which implies that these variables are not independent for any of these.

TABLE 5
HAZ, WAZ and WHZ groups vs. birth order group cross-tabulation for All India urban and four metro cities

All India Urban	Four Metro Cities							
Birth Order	1	2	≥ 3	Total	1	2	≥ 3	Total
				HAZ				
Under	5138	4616	4379	14133	145	157	114	416
	(23.0)	(25.9)	(33.1)	(26.5)	(19.5)	(27.3)	(29.2)	(24.3)
Normal	16401	12617	8483	37501	559	403	265	1227
	(73.5)	(70.8)	(64.2)	(70.3)	(75.0)	(70.0)	(67.8)	(71.7)
Above	770(3.5)	589(3.3)	358(2.7)	1717(3.2)	41(5.5)	16(2.8)	12(3.1)	69(4.0)
Total	22309	17822	13220	53351	745	576	391	1712
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
χ^2 value	441.8, Significant at 1 % level.				22.4, Significant at 1 % level.			
				WAZ				
Under	6739	6052	5248	18039	202	200	161	563
	(30.2)	(34.0)	(39.7)	(33.8)	(27.1)	(34.7)	(41.2)	(32.9)
Normal	15304	11575	7880	34759	526	369	227	1122
	(68.6)	(64.9)	(59.6)	(65.2)	(70.6)	(64.1)	(58.1)	(65.5)
Above	266	195	92	553	17	7	3	27
	(1.2)	(1.1)	(0.7)	(1.0)	(2.28)	(1.2)	(0.8)	(1.6)
Total	22309	17822	13220	53351	745	576	391	1712

	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
χ^2 value	345.1, Significant at 1 % level.				27.2, Significant at 1 % level.			
				WHZ				
Under	3768	3168	2412	9348	123	108	82	313
	(16.9)	(17.8)	(18.2)	(17.5)	(16.5)	(18.7)	(20.6)	(18.2)
Normal	18066	14318	10693	43077	603	459	311	1373(79.8)
	(80.9)	(80.2)	(80.5)	(80.6)	(80.8)	(79.6)	(78.1)	(78.1)
Above	501	365	173	1039	20	10	5	35
	(2.2)	(2.0)	(1.3)	(1.9)	(2.7)	(1.7)	(1.3)	(2.0)
Total	22335	17851	13278	53464	746	577	398	1721
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
χ^2 value	48.9, Significant at 1 % level.				5.8, Significant at 5 % level.			

Note: Figures in the parentheses represent percentage to total.

TABLE 6
Independent variable t-test between HAZ/WAZ/WHZ score and birth order at All India urban level and four metro cities

		All Urban		For Stunted/Underweight/Wasted		
Birth Order Group	1 vs. 2	1 vs. $\geq$3	2 vs. $\geq$3	1 vs. 2	1 vs. $\geq$3	2 vs. $\geq$3
			All India Urban			
HAZ Score	6.60 (.000)	22.06 (.000)	15.28 (.000)	0.282(.778)	5.355(.000)	5.011(.000)
WAZ Score	7.82 (.000)	22.53 (.000)	14.69 (.000)	0.475(.635)	7.532(.000)	6.883(.000)
WHZ Score	4.11 (.000)	8.98 (.000)	5.043 (.000)	-2.068(.039)	-2.413(.016)	-.473(.637)
			Four Metro Cities			
HAZ Score	4.322 (.000)	5.764 (.000)	1.996 (.046)	-.854(.394)	-.859(.391)	-.013(.990)
WAZ Score	4.146 (.000)	7.025 (.000)	3.471 (.001)	-1.093(.275)	0.488(.626)	1.554(.121)
WHZ Score	1.536 (.125)	3.957 (.000)	2.533 (.011)	-0.698(.486)	-0.912(.363)	-.291(.771)

Note: Figures in the parentheses are the corresponding p-values.

The results of independent variable t-test of the mean Z-scores between the consecutive birth orders (between birth orders 1 vs. 2, 1 vs $\geq$3 and 2 vs. $\geq$3) at all India urban and four metro cities are given in Table 6. In all the cases in all India urban sectors the differences are found to be significant but for Stunted/Underweight/ Wasted children the differences of the mean scores are significant for HAZ and WAZ scores and 1 vs $\geq$3 and 2 vs. $\geq$3 only. However, in four metro cities among the Stunted/Underweight/Wasted children the differences of the mean scores are not found to be significant. This is possibly due to small sample size.

A cursory look at the Table 7 reveals declining mean HAZ, WAZ and WHZ Scores with birth order of the children under-5 at all India urban level and also in the 4 metro cities. Thus, it is a clear indication that the status of health of children decreases as birth order increases.

TABLE 7
Birth order wise mean values of HAZ, WAZ and WHZ scores of under-5 children at All India urban and four metro cities

Birth Order	1st Child		2nd Child		3rd or Higher Order Child	
	N	Mean	N	Mean	N	Mean
			All India Urban			
HAZ Score	22309	-0.960	17822	-1.061	13220	-1.334
WAZ Score	22309	-1.338	17822	-1.433	13220	-1.635
WHZ Score	22335	-0.918	17851	-0.968	13278	-1.036
			Four Metro Cities			
HAZ Score	745	-0.639	576	-1.031	391	-1.228
WAZ Score	745	-1.146	576	-1.444	391	-1.709
WHZ Score	746	-0.907	577	-1.014	398	-1.208

Table 8 reveals that percentage of stunted and underweight children of under-5 age group decreases with the value of wealth index in case of all India urban. In case of four metro cities also, the picture is

more or less same except for the cases where there are small sample sizes. Also, the proportion of wasted under-5 children decreases with the rise in wealth index at all India level, but has haphazard movement for the four metro cities. In all cases at all India level, the Chi-Square statistics are found to be significant at one % level of significance by two-tailed tests. So, there is a significant negative impact of wealth on stunted and underweight percentages. Except for WHZ scores, the proportion of normal children clearly rises as wealth index rises. This is more or less true for metro cities also.

TABLE 8
Cross-tabulation of HAZ, WAZ and WHZ groups vs. wealth index for All India urban and four metro cities

Wealth Group		Poorest	Poorer	Middle	Richer	Richest	Total	Poorest	Poorer	Middle	Richer	Richest	Total
				All India Urban						Four Metro Cities			
HAZ	Under	1205	2224	3377	4324	3672	14802	5	30	93	150	153	431
		(44.3)	(37.8)	(31.8)	(25.5)	(18.6)	(26.4)	(41.7)	(30.0)	(32.3)	(27.6)	(18.1)	(24.1)
	Normal	1449	3525	6952	12127	15242	39295	6	63	185	369	659	1282
		(53.3)	(60.0)	(65.5)	(71.0)	(77.2)	(70.3)	(50.0)	(63.0)	(64.2)	(67.8)	(77.8)	(71.6)
	Above	65	130	290	509	840	1834	1	7	10	25	35	78
		(2.4)	(2.2)	(2.7)	(3.0)	(4.2)	(3.4)	(8.3)	(7.0)	(3.5)	(4.6)	(4.1)	(4.4)
	Total	2719	5879	10619	16960	19754	55931	12	100	288	544	847	1791
		(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0	(100.0)	(100.0)	(100.0)	(100.0	(100.0)
χ^2				value1668.0, Significant at 1 % level						38.9, Significant at 1 % level			
				All India Urban						Four Metro Cities			
WAZ	Under	1459	2639	4167	5629	4939	18833	6	48	121	195	214	584
		(53.7)	(44.9)	(39.2)	(33.2)	(25.0)	(33.7)	(50.0)	(48.0)	(42.0)	(35.8)	(25.3)	(32.6)
	Normal	1248	3210	6379	11155	14518	36510	6	48	164	339	622	1179
		(45.9)	(54.6)	(60.1)	(65.8)	(73.5)	(65.3)	(50.0)	(48.0)	(56.9)	(62.3)	(73.4)	(65.8)
	Above	12	30	73	176	297	588	0	4	3	10	11	28
		(0.4)	(0.5)	(0.7)	(1.0)	(1.5)	(1.0)	(0.0)	(4.0)	(1.0)	(1.8)	(1.3)	(1.6)
	Total	2719	5879	10619	16960	19754	55931	12	100	288	544	847	1791
		(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
χ^2				value1668.1, Significant at 1 % level.						54.3, Significant at 1 % level			
				All India Urban						Four Metro Cities			
WHZ	Under	586	1191	1948	2917	3162	9804	1	17	69	107	138	332
		(21.4)	(20.2)	(18.3)	(17.2)	(16.0)	(17.5)	(8.3)	(16.8)	(23.7)	(19.6)	(16.2)	(18.4)
	Normal	2119	4637	8541	13736	16115	45148	11	82	221	421	696	1431
		(77.4)	(78.6)	(80.1)	(80.9)	(81.5)	(80.5)	(91.7)	(81.2)	(75.9)	(77.3)	(81.8)	(79.5)
	Above	33	73	167	333	496	1102	0	2	1	17	17	37
		(1.2)	(1.2)	(1.6)	(1.9)	(2.5)	(2.0)	(0.0)	(2.0)	(0.3)	(3.1)	(2.0)	(2.1)
	Total	2738	5901	10656	16986	19773	56054	12	101	291	545	851	1800
		(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
χ^2 value				149.7, Significant at 1 % level.						16.9, Significant at 5 % level			

Note: Numbers in the parentheses represent percentage to total.

The picture becomes clearer when we take the mean Z scores (Table 9). The mean scores clearly decrease as wealth index rises at all India level, but it is not so vivid for four metro cities. Even in four metro cities the mean scores are clearly much less among richer and the richest children than in other children. ANOVA gives significant result in all cases except for WHZ in four metro cities.

TABLE 9
HAZ, WAZ and WHZ mean scores of under-5 children by family income groups for All India urban and four metro cities

	Poorest	Poorer	Middle	Richer	Richest	Overall	ANOVA (F, Sig.)
				All India Urban			
HAZ	-1.74	-1.48	-1.28	-1.08	-.76	-1.08	501.8
	(2719)	(5879)	(10619)	(16960)	(19754)	(55931)	(.000)
WAZ	-1.97	-1.78	-1.62	-1.43	-1.17	-1.44	569.7
	(2719)	(5879)	(10619)	(16960)	(19754)	(55931)	(.000)
WHZ	-1.17	-1.12	-1.04	-.95	-.85	-.96	98.8
	(2738)	(5901)	(10656)	(16986)	(19773)	(56054)	(.000)
				Four Metro Cities			
HAZ	-1.19	-1.06	-1.19	-1.02	-.67	-.89	7.51
	(12)	(100)	(288)	(544)	(847)	(1791)	(.000)
WAZ	-1.58	-1.60	-1.66	-1.42	-1.21	-1.37	8.51
	(12)	(100)	(288)	(544)	(847)	(1791)	(.000)
WHZ	-1.15	-1.17	-1.19	-.97	-.97	-1.01	2.37
	(12)	(101)	(291)	(545)	(851)	(1800)	(.051)

Note: Figures in the parentheses are corresponding observations.

From Table 10 we find that, as mother's education increases, the percentage of stunted, underweight and wasted children decrease, and the percentages of normal and overweight children increase. The trends are very much clear for all India urban children and somewhat clear for the four metro cities, especially for reasonably large samples. The Chi-Square test statistic is significant for all the cases except for WHZ scores of four metro cities. The trends are clearer if we look at their mean scores (Table 11). The mean scores have distinct increasing pattern as mother's education increases, which means that the level of health of children has a positive relation with mother's level of education. Mother's education has thus pronounced effect on the status of health of under-5 children.

TABLE 10
Cross-tabulation of HAZ, WAZ and WHZ groups vs. education level of mothers for children of All India urban and four metro cities

Education		No education	Primary	Secondary	Higher	Total	No education	Primary	Secondary	Higher	Total
					All India Urban					Four Metro Cities	
HAZ	Under	3710	2152	6937	1707	14506	85	73	203	66	427
		(39.7)	(35.0)	(24.4)	(15.8)	(26.5)	(33.7)	(35.8)	(22.4)	(16.3)	(24.1)
	Normal	5401	3872	20589	8613	38475	159	127	667	316	1269
		(57.8)	(62.9)	(72.3)	(79.7)	(70.2)	(63.1)	(62.2)	(73.5)	(77.8)	(71.7)
	Above	228	131	946	484	1789	8	4	37	24	73
		(2.4)	(2.1)	(3.3)	(4.5)	(3.3)	(3.2)	(2.0)	(4.1)	(5.9)	(4.1)
	Total	9339	6155	28472	10804	54770	252	204	907	406	1769
		(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
χ^2 value			1799.6, which is significant at 1 % level.					46.4, which is significant at 1 % level.			
					All India Urban					Four Metro Cities	
WAZ	Under	4386	2631	9170	2327	18514	117	83	292	88	580
		(47.0)	(42.7)	(32.2)	(21.5)	(33.8)	(46.4)	(40.7)	(32.2)	(21.7)	(32.8)
	Normal	4899	3477	19019	8284	35679	130	118	604	310	1162
		(52.5)	(56.5)	(66.8)	(76.7)	(65.1)	(51.6)	(57.8)	(66.6)	(76.3)	(65.7)
	Above	54	47	283	193	577	5	3	11	8	27
		(0.6)	(0.8)	(1.0)	(1.8)	(1.1)	(2.0)	(1.5)	(1.2)	(2.0)	(1.5)
	Total	9339	6155	28472	10804	54770	252	204	907	406	1769
		(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
χ^2 value			1741.4, which is significant at 1 % level.					51.7, which is significant at 1 % level.			
					All India Urban					Four Metro Cities	
WHZ	Under	1881	1192	4889	1682	9644	53	36	168	70	327
		(20.0)	(19.3)	(17.2)	(15.6)	(17.6)	(20.7)	(17.5)	(18.5)	(17.2)	(18.4)

	Normal	7408	4889	23055	8808	44160	200	169	723	324	1416
		(78.8)	(79.2)	(80.9)	(81.5)	(80.5)	(78.1)	(82.0)	(79.4)	(79.8)	(79.6)
	Above	114	92	558	317	1081	3	1	19	12	35
		(1.2)	(1.5)	(2.0)	(2.9)	(2.0)	(1.2)	(0.5)	(2.1)	(3.0)	(2.0)
	Total	9403	6173	28502	10807	54885	256	206	910	406	1778
		(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
χ^2 value		162.1, which is significant at 1 % level.					6.5, which is not significant.				

Note: Numbers in the parentheses represent percentage to total.

TABLE 11
Mean scores of under-5 children of different categories of mother's education for All India urban

	No Education	Primary	Secondary	Higher	Total	ANOVA (F value, Sig.)
			All India Urban			
HAZ	-1.56(9339)	-1.41(6155)	-1.03 (28472)	-.62(10804)	-1.08 (55931)	573.9(.000)
WAZ	-1.83 (9339)	-1.71 (6155)	-1.40(28472)	-1.0554 (10804)	-1.44(55931)	587.3(.000)
WHZ	-1.13(9403)	-1.09 (6173)	-.95(28502)	-.7980 (10807)	-.96(56054)	41.9(.000)
			Four Metro Cities			
HAZ	-1.34(252)	-1.33(204)	-.86(907)	-.49(406)	-.89(1791)	20.6(.000)
WAZ	-1.79(252)	-1.65(204)	-1.37(907)	-.99(406)	-1.37(1791)	25.8(.000)
WHZ	-1.22(256)	-1.09(206)	-1.05(910)	-.80(406)	-1.02 (1800)	7.2(.000)

Note: Figures in the parentheses are corresponding observations.

In order to have bi-variate cross-tabulation of different health indicators with household size, households are divided into 4 groups with number of members 3, 4, 5 and 6 or more (largest). Table 12 reveals that the proportions of stunted, underweight and wasted children under-5 increase and the proportion of normal children declines as family size moves from 3 to 6 and above at all India urban level. Proportion of overweight children also declines marginally. The Chi-square value is also significant at one percent level of significance. This feature is not so pronounced in four metro cities.

TABLE 12
HAZ, WAZ and WHZ groups vs. HH size cross-tabulation for All India urban

		HH Size (All India Urban)				HH Size (Four Metro Cities)					
	3	4	5	e" 6	Total	3	4	5	e" 6	Total	
HAZ	Under	1110	2767	2892	8033	14802	43	85	82	221	431
		(23.5)	(26.2)	(27.4)	(26.7)	(26.5)	(25.2)	(22.9)	(22.8)	(24.9)	(24.1)
	Normal	3442	7468	7332	21053	39295	116	260	263	643	1282
		(72.8)	(70.6)	(69.4)	(70.0)	(70.3)	(67.8)	(70.1)	(73.1)	(72.3)	(71.6)
	Above	177	337	349	971	1834	12	26	15	25	78
		(3.7)	(3.2)	(3.30)	(3.2)	(3.3)	(7.0)	(7.0)	(4.2)	(2.8)	(4.4)
	Total	4729	10572	10573	30057	55931	171	371	360	889	1791
		(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
χ^2 value		29.8, which is significant at 1 % level.				15.1, which is significant at 5 % level.					
WAZ	Under	1461	3520	3692	10160	18833	53	109	119	303	584
		(30.9)	(33.3)	(34.9)	(33.8)	(33.7)	(31.0)	(29.4)	(33.1)	(34.1)	(32.6)
	Normal	3216	6932	6758	19604	36510	113	255	232	579	1179
		(68.0)	(65.6)	(63.9)	(65.2)	(65.3)	(66.1)	(68.7)	(64.4)	(65.1)	(65.8)
	Above	52	120	123	293	588	5	7	9	7	28
		(1.1)	(1.1)	(1.2)	(1.0)	(1.1)	(2.9)	(1.9)	(2.5)	(0.8)	(1.6)
	Total	4729	10572	10573	30057	55931	171	371	360	889	1791
		(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
χ^2 value		28.6, which is significant at 1 % level.				10.3, which is not significant.					
WHZ	Under	828	1841	1874	5261	828	29	65	68	170	332
		(17.5)	(17.4)	(17.7)	(17.5)	(17.5)	(17.0)	(17.5)	(18.8)	(19.0)	(18.4)
	Normal	3802	8544	8487	24315	3802	138	299	283	711	1431
		(80.3)	(80.6)	(80.1)	(80.7)	(80.3)	(80.7)	(80.4)	(78.4)	(79.4)	(79.5)
	Above	104	211	230	557	104	4	8	10	15	37
		(2.2)	(2.0)	(2.2)	(1.9)	(2.2)	(2.3)	(2.2)	(2.8)	(1.7)	(2.1)
	Total	4734	10596	10591	30133	4734	171	372	361	896	1800
		(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
χ^2 value		6.4, which is not significant.				2.3, which is not significant.					

Note: Figures in the parentheses represent percentage to total.

We have further reduced the explanatory variables namely, Sex, Birth Order, Wealth, Household Size and Mother's Education into two groups in order to see the simultaneous effect of these variables on the status of health of children. The status of health in terms of BMIZ, HAZ, WAZ and WHZ are also divided into two groups to get a clear-cut picture of the regression results. The first group is underweight/ stunted/wasted children taking value '0' and the second group consists of rest of the children, who are normal or overweight taking value '1'.

In order to reduce the set of explanatory variables, we have found the bivariate contingency table for each combination of heath indices and the explanatory variables and carried out the χ^2 test to see whether the explanatory variable should be included in the logistic regression. Table 13 shows the significance (p-values) of Pearson's χ^2 tests of bivariate contingency table of health indices with the explanatory variables sex, birth order, wealth, household size and mother's education, which were ultimately taken in the regression model. It is clear from the table that mother's education and wealth index have significant relation with all the health indices, whereas sex, birth order and household size have significant effect on some of the health indices for all India urban children. Thus, mother's education and wealth index are the two most important factors for the health status of under-5 children. However, because of small sample size, the results of the χ^2 tests were not so conspicuous for the children of the four metro cities. In order to make the four equations comparable, we have included all these five variables in each of the four regressions.

TABLE 13
Significance (p-values) of Pearson's χ^2 tests of bivariate contingency table of health indices with sex, birth order, wealth, household size and mother's Education

	Sex	Birth Order 2-Group	Wealth Index 2-Group	HH Size 2-Group	Mother's Education 2-Group
	All India Urban				
BMIZ2Grp	0.002	0.345	0.000	0.593	0.000
HAZ2Grp	0.160	0.000	0.000	0.000	0.000
WAZ2Grp	0.520	0.000	0.000	0.001	0.000
WHZ2Grp	0.000	0.013	0.000	0.714	0.000
	Four Metro Cities				
BMIZ2Grp	0.956	0.679	0.865	0.428	0.634
HAZ2Grp	0.163	0.012	0.124	0.854	0.000
WAZ2Grp	0.056	0.000	0.007	0.143	0.000
WHZ2Grp	0.785	0.144	0.531	0.385	0.549

We have carried out the logistic regression of the health indices on the explanatory variables, namely, Sex, Birth Order, Wealth Index, Household Size and Mother's Education (Table 13). The summary result of the contingency tables as shown in Table 12 is more or less reflected in the results of the logistic regressions (Table 14). In case of all India urban children, mother's education and wealth index have been found to have significant influence on the health status of the children in all the four regressions. More specifically the effect is negative, implying that as level of wealth or mother's education rise, then the chance of becoming underweight/wasted/ stunted become less. All the significant coefficients, except the coefficient associated with sex, have expected signs. Note that positive coefficients imply that status of health decreases, i.e., the risk of underweight/wasted/stunted increase due to increase of the value of the variable and opposite is the case when the value of the coefficient becomes negative. Thus, wealth index and mother's education are beneficial for health of children, whereas birth order and household size are not so. Observe that, even for four metro cities, we have got two cases where the coefficient of mother's education as significant.

TABLE 14
Results of logistic regression of the health indices on sex, birth order, wealth index, household size and mother's education

	All India Urban							
Explanatory Variables	BMIZ		HAZ		WAZ		WHZ	
	B	Sig.	B	Sig.	B	Sig.	B	Sig.
Sex	.066	.019	.008	.745	-.049	.029	.063	.025
Birth Order	.011	.750	.146	.000	.073	.007	.011	.753
Wealth Index	-.092	.002	-.338	.000	-.304	.000	-.104	.000
HH Size	.027	.418	.078	.005	.048	.067	.009	.775
Mothers Education	-.073	.018	-.480	.000	-.433	.000	-.113	.000
	Four Metro Cities							
Explanatory Variables	BMIZ		HAZ		WAZ		WHZ	
	B	Sig.	B	Sig.	B	Sig.	B	Sig.
Sex	.033	.846	-.219	.140	-.318	.023	-.006	.969
Birth Order	.333	.116	-.112	.540	.233	.175	.318	.121
Wealth Index	.054	.764	-.116	.462	-.247	.095	-.112	.529
HH Size	-.281	.156	.324	.061	.156	.334	.045	.820
Mothers Education	-.054	.775	-.461	.005	-.333	.032	.113	.548

Note: The constant term is not shown. Sex: M=1 & F=0, Health Indices: Underweight/Wasted/ Stunted=0 & Else=1.

DISCUSSION AND CONCLUSION

As per the outcome on the status of under-5 children in the four metro cities, Chennai tops the list with stunted children, followed by Delhi, Mumbai and then Kolkata. Concentration of underweight children is the highest in Mumbai, followed by Delhi, Kolkata and Chennai. In weight-for-height category also, Kolkata registered the least while Delhi recorded the highest. In case of wasted children, concentration in Delhi and Chennai are much higher than all India urban, while in case of underweight children proportion in Mumbai is much above the all India urban figure. Kolkata recorded lower figures in all three criteria as compared to all India urban results. On the other hand, proportion of above normal growing children of under-5 age group is significantly higher in Chennai and Mumbai as compared to all India urban, and it is much lower in Kolkata. In case of weight for age, proportion of above average growth in Kolkata is much higher than all India urban group. Chennai and Mumbai also recorded much higher percentages However, proportion of overweight children in Delhi is comparatively less.

The studies on health status of under-5 children in Metro cities in India are rare. Aggarwal *et al*. (2008) assessed child health in metropolitan cities of India. But their study was limited to only slum areas of the metro cities. Rastogi and Dwivedi (2014) found the prevalence of stunted, underweight and wasted under-5 children in non-slum Delhi as 38.6%, 25.0% and 16.5% and in slum areas as 50.7%, 35.2% and 14.8% respectively. In our case the corresponding figures are 24.5%, 32.1% and 32.0%. Rastogi and Dwivedi (2014), however, used the third round of NFHS data, whereas we have used NFHS-4 data and for all under-5 children. Thus, it is not possible to get the exact change unless we know the proportion of slum and non-slum under-5 children. One thing is clear, the heights have improved much, since the percentage of stunted children in NFHS-4 is much less than both non-slum and slum children of NFHS-3. Percentage of underweight children has possibly remained more or less same. Since heights have improved, the percentage of wasted children shows an increase over the ten-year period. The feature is same as Delhi for Kolkata in all the cases of stunted, underweight and wasted children. The percentages in Chennai remained more or less same in NFHS-4 compared to NFHS-3. In case of Mumbai the feature is same as Delhi for stunted and wasted children, but the percentages of underweight children remained more or less unchanged.

When we look at the anemic condition of children, we see that about 55 % of under-5children in urban India are anemic. At all India urban level, proportion of severe anemic under-5 children are much lower than in four metro cities. This percentage is surprisingly above 60 % in the four metro cities. Among those four metros, Delhi recorded the highest percentage of severely anemic under-5 children, while there is not a single severe anemic in such group of children in Kolkata. Mumbai has the highest percentage of

anemic under-5 children, followed by Delhi, Kolkata and Chennai recorded the lowest percentage even below that of all India urban level.

The logistic regression result reveals significant positive impact of wealth and mother's education on the child's growth in terms of height and weight though there are some variations in the values of the coefficients at all India urban areas and in Metro cities under consideration. The family size and birth order do not show much significant influence on the growth of children in the logistic regression though the bivariate contingency tables of birth order with the status of health showed significant negative influence.

NOTES

1. https://www.who.int/childgrowth/training/module_c_interpreting_indicators.pdf ; accessed on 08-01-2020.

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