ORIGINAL RESEARCH ARTICLE

Nutritional Status of Female Children in Comparison to Their Male Siblings in India– A Secondary Analysis of National Family Health Survey (NFHS-5) Data

Raghavendra P[1*], Usha Rani T[2], Abdul Jaleel CP[3], Surya Goud CS[4], Mahesh Kumar M[5], Raja Sriswan M[6]

[1-6]ICMR- National Institute of Nutrition, beside metro station, Tarnaka Hyderabad, India

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ABSTRACT

Introduction: As there was little literature available about gender disparities in undernutrition within household, this secondary analysis was performed on a large representative data with an objective to evaluate the Z-score differences, viz., Weight-for-age Z-score (WAZ), Height-for-age Z-score (HAZ), Weight-for-height Z-score (WHZ) and BMI-for-age Z-score (BAZ) of the Indian female under-5 children with their male siblings within same household.

Methods: Individual data of 19083 pairs of siblings was analysed from the NFHS -5 data. Differences in the Z-scores of the siblings was calculated as male's Z-score minus female's Z-score and factors influencing them were studied.

Results: The mean HAZ and WAZ scores were less than -1.4 Standard deviations (SD) for both genders – while the means of WHZ and BAZ scores were ranging between -0.67 to -0.83. The differences in Z scores were more or less distributed equally on both sides of zero, implying no disadvantage to any of the genders. The mean differences in the Z scores were minimal (-0.07 in HAZ, -0.04 in WAZ, -0.06 in WHZ and 0.01 in BAZ).

Conclusion: There was little or no difference in the mean z scores of females and male siblings and did not indicate any gender advantage or disadvantage.

Key words: Malnutrition, NFHS, gender differences, anthropometry, nutritional status, intrahousehold differences

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***Correspondence:** Raghavendra P (Email: drraghunin@gmail.com)

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Introduction

Undernutrition of under-5-year children is a major health concern in India. It not only affects the individual productivity, but impacts the national growth and development as well.[1] Wasting (low weight for height), stunting (low height for age), underweight (low weight for age) and micronutrient deficiencies are the four forms of manifestation of undernutrition.[2] Several intrinsic (age, gender, genetics, diseases) and extrinsic (household characteristics, socio-demographic, economic and political environment) factors have been linked to undernutrition. During the periods of 2006 to 2021, while there has been tremendous decline in the percentages of stunted and wasted children, substantial improvement in the national efforts is required to reach the global targets for malnutrition indicators.[3]

Gender disparity and boy preference have been associated since ages with the Indian family systems which deeply impact the growth and development of the children.[4] Gender differential aspects of malnutrition have been widely studied by many researchers linking them to family preferences for birth order as well as disproportionate allocation of household resources.[5,6] Reports from studies conducted in Northern India have stated that the birth order of the index child and the sex composition of the older sibling are important contributors to the gender bias in childhood feeding.[7] However, there exists a discrepancy in the acceptance of these theories of gender disparities. While some researchers have reported female disadvantage in the prevalence rates of stunting, a consequence of chronic malnutrition[8], several others have contradicted these reports[9,10].

There is a plausible gap in the literature on substantial data that evaluates the gender disparities in the manifestation of undernutrition within the Indian households, negating the underlying family socio-demographic factors which may skewer the results. In this context, the present analysis was carried out on the National Family Health Survey – 5 (NFHS-5) data with the objective of evaluating the differences in the nutritional status of the female Indian children under-5 years of age with their male siblings, quantitatively in terms of distances between their Z scores, viz., Weight for age Z score (WAZ), Height for age Z score (HAZ), Weight for height Z score (WHZ) and BMI for age Z score (BAZ).

Methodology

Study population and sampling design: The 5th round of NFHS (NFHS-5) was conducted from June 2019 to April 2021 by the Indian Ministry of Health and Family Welfare with the International Institute for Population Sciences as the nodal agency. The complete methodological details have been elaborated in the India Report of NFHS – 5.[11] Concisely, the study subjects were women aged 15 to 49 years, men aged 15 to 54 years and children aged 0 to 59 months. With 2011 census as the sampling frame, the study employed stratified two stage sampling. Villages in rural areas and Census Enumeration Blocks in urban areas were selected as Primary Sampling Units (PSUs) using probability proportional to size (PPS) systematic sampling. In the second stage, 22 households were randomly selected with systematic sampling from the PSUs. The ethics approval for the survey was obtained from ethics review board of International Institute of Population Sciences, Mumbai, India.[12]

Data collection: The data was collected through 4 survey schedules – Household, Woman, Man, and Biomarker – using Computer Assisted Personal Interviewing. Informed written consent for participation was obtained from the respondent before initiating the survey. It included eliciting the household demographic and health related details, and included measurements of height, weight, and haemoglobin levels for children, apart from an array of biomarkers and anthropometric measurements for the adults. Seca 874 Digital Scale was used for measurement of Weight, Seca 213 Stadiometer for height and Seca 417 Infantometer for length of the children if less than 2 years old or less than 85 cm. Multiple levels of monitoring and supervision of the fieldwork was done internally and by external agencies for quality assurance.

Statistical analysis: Individual level dataset of NFHS-5 was obtained from The Demographic and Health Surveys – the DHS program and prior permissions were sought for performing this analysis (Authorisation letter no.175759, supplementary file no.1). The file with child recodes IAKR7DFL.dta was used to fetch the data of the children under 5 years. World Health Organization (WHO) Anthro software[13] was used to derive the Weight-for-age z-scores (WAZ), Height-for-age z-score (HAZ), Weight-for-height z-scores (WHZ)and BMI-for-age z-score (BAZ). As compared to the WHO 2006 growth standards, if children had WAZ, HAZ, and WHZ less than −2, then they were classified as underweight, stunting, and wasting respectively.[14]

Calculation of wealth Index: Detailed description of arriving at the wealth index is given in the NFHS-5 report. The scoring is given based on the quantity and quality of goods that the househods own, that includes television, bicycle, car, and housing characteristics such as source of drinking water, toilet facilities, and flooring materials. Principal component analysis is then performed to derive the scores. Subsequently, wealth quintiles are compiled at national level by assigning the household score to each household member, ranking each person in the household population by their score, and then dividing the distribution into five equal categories, each with 20 percent of the population.[11]

From the main dataset, households were identified which had pairs of children with at least one male and at least one female child. When there were more than 2 children within the household, the youngest pair was selected.

From the dataset, a total of 70304 households were drawn that had any children. Out of them, 18133 had a pair of children – 1 male and 1 female. 926 pairs were drawn from the youngest 2 children in a household that had 3 children, 23 pairs from those households that had 4 children and 1 pair from a household that had 5 children (Figure -1).

STATA v14 was used for statistical analysis. A secondary dataset was generated by juxtaposing the details of the male sibling with that of the female sibling of the same household into one row so that the Z score differences of WAZ (dWAZ), HAZ (dHAZ), WHZ (dWHZ) and BAZ (dBAZ) could be calculated. All differences were calculated as the male value minus female value. So, a positive value in the difference would imply the male child being in a better nutritional status as compared to the female sibling and a negative value in the difference would imply the female child being in a better nutritional status as compared to the male sibling. Paired t-test was used to look for the statistical significance of the differences in mean Z scores between the genders and One way Analysis of variation (ANOVA) test was used for factors affecting these differences. A p-value <0.05 was considered statistically significant.

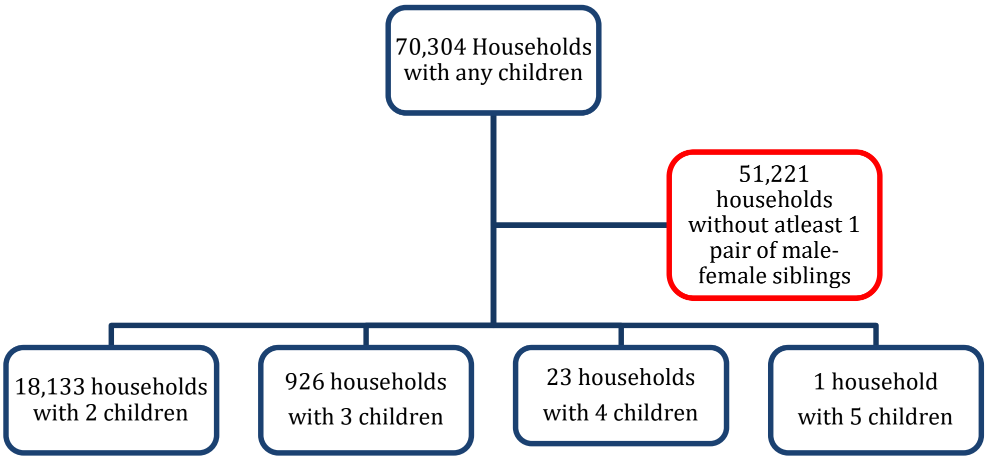

Figure 1: Distribution of pairs selected for analysis

Results

Sample Characteristics: The study sample had 19,083 pairs of siblings with a male-female combination. The sample pairs had relatively older female siblings – with nearly 24% of them above 48 months of age whereas the pairs with older male siblings had 19% of them above 48 months of age. Similarly, of the relatively younger male siblings amongst the pairs, nearly 44% of the boys and 35% of the girls were under 23 months of age. The mean age of the sample was 29.7 months, which was 27.9 months in the boys to 31.5 in the girls (Table 1).

Undernutrition in the sample: In all its forms, undernutrition was more prevalent among the male siblings than the female siblings. The difference was more pronounced in wasting, where the prevalence was 19% in boys as compared to 17% in girls. Overall, around 54% of the children had some form of the undernutrition (Table 1).

Table 1: Distribution of the pairs of samples

Characteristic	Males (%) (N = 19083)	Females (%) (N = 19083)	Total (%) (N = 38166)
Age			
0 to 23 months	8391 (44.0)	6674 (35.0)	15065 (39.5)
24 to 47 months	7127 (37.3)	7876 (41.3)	15003 (39.3)
48 to 59 months	3565 (18.7)	4533 (23.8)	8098 (21.2)
Mean age in months (±SD)	27.9(17.4)	31.5 (17.4)	29.7(17.5)
Median age in months (IQR)	27 (13, 43)	33 (17, 47)	
Undernutrition			
Underweight	6098 (32.0)	5808 (30.4)	11906 (31.2)
Stunted	7608 (39.9)	7269 (38.1)	14877 (39.0)
Wasted	3719 (19.5)	3181 (16.7)	6900 (18.1)
UW or stunted or wasted	10604 (55.6)	10095 (52.9)	20699 (54.2)

N = sample size; SD = standard deviation; IQR = Inter quartile range; UW = underweight

Table 2: Distribution of Z score differences (male – female)

Z score difference range	dHAZ (%)	dWAZ (%)	dWHZ (%)	dBAZ (%)
<-3	1326 (6.95)	352 (1.84)	871 (4.56)	872 (4.61)
-2 to -2.99	1425 (7.47)	890 (4.66)	1245 (6.52)	1248 (6.6)
-1 to -1.99	2832 (14.84)	2824 (14.8)	2828 (14.82)	2734 (14.47)
-1 to 0.01	4236 (22.2)	5641 (29.56)	4878 (25.56)	4483 (23.72)
0	39 (0.2)	77 (0.4)	56 (0.29)	51 (0.27)
0.01 to +1	4210 (22.06)	5596 (29.32)	4727 (24.77)	4701 (24.87)
+1.01 to +2	2520 (13.21)	2654 (13.91)	2599 (13.62)	2809 (14.86)
+2.01 to +3	1315 (6.89)	776 (4.07)	1108 (5.81)	1215 (6.43)
>+3	1180 (6.18)	273 (1.43)	771 (4.04)	786 (4.16)
Total	19083 (100)	19083 (100)	19083 (100)	18899 (100)

Table 3: Mean Z scores of the siblings and the mean distance between the Z scores of the siblings (male compared to female)

Characteristic	N	Male			Female			P value	ΔZ		
		Mean	SD	SE	Mean	SD	SE		Mean	SD	SE
HAZ score	19083	-1.53	1.720	0.012	-1.46	1.669	0.012	.000	-0.074	2.062	0.015
WAZ score	19083	-1.45	1.203	0.009	-1.41	1.188	0.009	.001	-0.043	1.325	0.010
WHZ score	19083	-0.83	1.510	0.011	-0.78	1.413	0.010	.000	-0.058	1.738	0.013
BAZ score	18899	-0.68	1.509	0.011	-0.67	1.413	0.010	.697	0.006	1.753	0.013
When the female is younger											
HAZ score	8084	-1.697	1.464	0.163	-1.222	1.902	0.021	.000	-0.474	2.067	0.023
WAZ score	8084	-1.483	1.110	0.012	-1.312	1.275	0.014	.000	-0.171	1.316	0.015
WHZ score	8084	-0.771	1.351	0.015	-0.823	1.580	0.018	.008	0.052	1.762	0.02
BAZ score	7997	-0.551	1.375	0.015	-0.748	1.557	0.017	.000	0.197	1.776	0.02
When the male is younger											
HAZ score	10643	-1.403	1.883	0.018	-1.638	1.443	0.014	.000	0.235	2.029	0.020
WAZ score	10643	-1.419	1.263	0.012	-1.477	1.107	0.011	.000	0.058	1.330	0.013
WHZ score	10643	-0.878	1.618	0.016	-0.737	1.265	0.012	.000	-0.141	1.728	0.017
BAZ score	10549	-0.766	1.596	0.016	-0.607	1.286	0.013	.000	-0.158	1.734	0.017
Among twins											
HAZ score	356	-1.574	1.708	0.091	-1.380	1.657	0.088	.002	-0.195	1.205	0.064
WAZ score	356	-1.586	1.377	0.073	-1.441	1.300	0.069	.013	-0.144	1.083	0.057
WHZ score	356	-0.939	1.544	0.082	-0.837	1.530	0.081	.137	-0.102	1.290	0.068
BAZ score	353	-0.865	1.536	0.082	-0.792	1.489	0.079	.289	-0.072	1.275	0.068

Table 4: Mean difference in Z scores of the siblings (male compared to female) with various factors

Factor	N	dHAZ			dWAZ			dWHZ			dBAZ			
		Mean	SD	P value	Mean	SD	P value	Mean	SD	P value	N	Mean	SD	P value
Residence														
Urban	3138	-0.089	2.000	0.67	-0.048	1.333	0.60	-0.038	1.775	0.24	3105	0.019	1.773	0.19
Rural	15945	-0.071	2.075		-0.041	1.323		-0.062	1.731		15794	-0.011	1.749	
Caste														
SC	4216	-0.037	2.034	0.000	-0.029	1.294	0.000	-0.078	1.718	0.007	4176	-0.037	1.718	0.000
ST	3994	-0.182	2.175		-0.110	1.394		-0.061	1.777		3957	-0.005	1.808	
OBC	7547	-0.051	2.028		-0.010	1.301		-0.040	1.713		7475	0.018	1.730	
Others	2574	-0.018	2.015		-0.034	1.315		-0.063	1.750		2548	-0.022	1.755	
Maternal education														
No education	4759	-0.091	2.119	0.003	-0.063	1.388	0.000	-0.087	1.755	0.712	4710	-0.032	1.771	0.533
Primary	2720	-0.164	2.092		-0.063	1.311		-0.028	1.728		2702	0.041	1.767	
Secondary	9663	-0.042	2.035		-0.023	1.302		-0.054	1.731		9566	-0.003	1.742	
Higher	1941	-0.063	2.012		-0.059	1.296		-0.055	1.744		1921	-0.025	1.746	
Religion														
Hindu	14064	-0.056	2.027	0.000	-0.038	1.304	0.000	-0.071	1.718	0.000	13930	-0.021	1.727	0.000
Muslim	2618	-0.132	2.146		-0.070	1.353		-0.050	1.802		2586	0.024	1.840	
Christian	1712	-0.137	2.201		-0.068	1.428		-0.020	1.836		1697	0.020	1.843	
others	689	-0.068	2.098		0.042	1.365		0.067	1.650		686	0.115	1.717	
Wealth index														
Poorest	5935	-0.114	2.128	0.000	-0.063	1.353	0.002	-0.081	1.758	0.169	5880	-0.012	1.778	0.415
Poor	4695	-0.087	2.055		-0.043	1.316		-0.049	1.709		4647	0.004	1.744	
Middle	3619	-0.047	2.075		-0.026	1.337		-0.059	1.725		3580	-0.011	1.729	
Richer	2960	-0.052	1.958		-0.027	1.270		-0.020	1.734		2942	0.012	1.749	
Richest	1874	0.002	2.007		-0.033	1.317		-0.072	1.777		1850	-0.034	1.752	

Z score differences among the siblings

The differences in Z scores were more or less distributed equally on both sides of zero, which implies that the differences which were towards the female siblings were as much towards the male siblings. Majority of the dHAZ (72.5%), dWAZ (88%), dWHZ (79.1%) and dBAZ (78.2%) scores ranged between -2 to +2, meaning that distance between the Z scores of the siblings were upto 2 SDs with each other (Table 2).

The mean Z scores were low for both male and females of the sample. They were more negative for the HAZ and WAZ scores – which were less than -1.4 standard deviations (SD) for both genders – while the means of WHZ and BAZ scores were ranging between -0.67 to -0.83. The differences between the Z scores of the siblings were very small and less than 0.1 SD. An attempt was made to analyse the variations in these differences as a factor of age difference between the pair when considered as a categorical variable. This was carried out for two reasons – one, because the sample had older females, and two, since age has a bearing on the nutritional status (Table 3).

When the female child of the pair was younger, the HAZ score on an average was nearly 0.5 SDs better in the female child as compared to the male child, while this difference was nearly 0.2 SDs for the WAZ score. There was a very small difference in WHZ scores, while the BAZ scores were nearly 0.2 SDs better among the male children. When the male child among the pair was younger, the HAZ score was around 0.2 SDs better in them as compared to the female child, whereas the WHZ and BAZ scores were nearly 0.15 SDs better in the female child (Table 3).

There were around 350 pairs of twins among the samples, where the age factor also could be negated to see the differences in the Z scores between the genders. Among these pairs, the mean Z scores were better among the females, with the HAZ, WAZ, WHZ and BAZ score differences being nearly 0.2, 0.15, 0.1 and 0.05 SDs respectively (Table 3).

Difference in Z scores among the categories

The differences in HAZ, WAZ, WHZ and BAZ scores did not vary much among the various categories studied i.e., place of residence, caste, religion, wealth index and maternal education. The dHAZ (-0.182) and dWAZ (-0.11) of scheduled tribes varied from the other communities where the girl child had better nutrition status among the siblings. The dHAZ was found to be higher when the mothers had primary education. Female children had better HAZ scores than their male siblings in Muslim (-0.132) and Christian families (-0.137) as compared to those belonging to Hindu (-0.056) or other religions (-0.068). Male children had better WAZ, WHZ and BAZ compared to females when they belonged to religions other than Hinduism, Islam or Christianity. The HAZ scores were better among females as compared to their male siblings when they belonged to lower wealth quintiles and moving up the quintiles, this difference kept diminishing. The differences in BAZ, WAZ and WHZ did not show any such gradient (Table 4).

Discussion

The prevalence of undernutrition in under-5 years children in India, despite a phenomenal improvement in our economy, is a matter of concern. Existence of gender bias against the girl child casts a very strong burden on the society in achieving a zero-malnutrition state. However, presence of female disadvantage in the intra-household nutritional status has not been definitively reported so far. Tarozzi have reported gender neutral situation in terms of undernutrition and anaemia in children under-5 years of age, upon analysis of nationally representative data.[15] On the other hand, female disadvantage in feeding practices have been reported by several researchers, where infant girls have been fed for shorter period of times as compared to infant boys.[5,16,17]

The present secondary analysis is an attempt at understanding the current situation of malnutrition in the parlance of gender differentials in malnutrition of more than 19,000 male-female sibling pairs drawn from NFHS-5 dataset. An intra-household comparison of nutritional status amongst the siblings has two major objectives- firstly, it negates the effects of socio-demographic environment on nutritional status, and secondly and more importantly, it brings out the possible cases of parental preferences of gender, and associated differences in the allocation of resources if any. The present analysis is probably the first such attempt at quantitative assessment of disparities in the nutritional status between the siblings from different genders of the same household.

The current secondary analysis has observed minimal differences in the nutritional statuses between the genders who hail from the household. The nutritional status of the sample drawn with the sibling criteria to include in the analysis was comparable to that of the full survey sample of NFHS-5. As in the full survey sample (NFHS-5), the prevalence of malnutrition was marginally higher among the males than females. The prevalence of undernutrition was similar to the levels reported by NFHS- 5.[11] The mean difference in all the Z scores were more or less close to zero, meaning no appreciable gender disadvantage. The reason for this can be explained by the distributions of these scores as in table 2. All the scores were distributed nearly symmetrically on the either side of zero.

The WHZ and WAZ scores of both males and females were similar to that reported in the NFHS-5 full sample, but the HAZ scores of this sub sample was more negative in both males as well as females. The dHAZ and dWAZ scores tilted slightly towards the male or the female depending on which of the siblings were younger. It is known that the Z scores tend to be less negative among younger children and the distance from normal curves deepens with age[18], which explains the findings of the current study as well. The analysis was further extended to twins which negates even the age factor between the siblings. Though there were only 350 such pairs of twins for analysis, it had clearly shown that the z scores were better among females compared to males. Similar results have been observed earlier by Alderman et al[19], Krishna et al[20] for under-5-year children, where boys had lower HAZ than girls.

Socio-demographic factors like caste, religion, wealth quintile, place of residence and maternal education did not seem to influence these differences. However, relatively substantial differences were found among Scheduled tribes in dHAZ and dWAZ scores which showed a female advantage. HAZ among females was also found to be better than their male siblings in Muslim and Christian communities, and male children were better with the dBAZ scores when they were from religions other than the three major religions of India. We did not find such a difference being reported in literature earlier. An interesting observation was that there was a decreasing female advantage in HAZ scores as they moved up on the wealth quintiles. Or rather, it may be seen as a decreasing gender disparity with increasing position in the wealth quintiles. The Asian enigma was a concept put forth in the 90s which ascribed higher levels of malnutrition among women and children due to the discriminations that the women face especially in Southeast Asia.[21] The present study finds results contrasting to this concept.

Improved sex ratio at birth can provide a plausible explanation to this minimised gender disparity in the nutritional status of the siblings. As reported in the Sample Registration System (SRS) bulletin (2020), for every 1,000 boys born in the country in the period 2018-20, 907 girls were born, which is higher compared to earlier data in 2005 (876 girls per 1000 boys) and 2014-16 (898 girls per 1000 boys).[22] A strong and steady efforts on behalf of the governments to curb sex selection and pro-girl child measures such as 'sukanya samridhi' or 'beti bachao beti padhao' coupled with improved education and wealth index have also added to bridging the gender gap.[1,23] While this may not be substantial enough to reach the sustainable development goal no. 2, there seems to be a gradual shift pointing towards a demographic transition in the Indian family set up where children are becoming the focal point of the family. The presence of a large cohort of young women of childbearing age is also a contributory factor to the gender-neutral results.

While the current study provides a positive and hopeful outlook towards achieving a gender egalitarian society, there are also some limitations in the study. It included only one pair of siblings (the youngest pair) when there were multiple pairs within household, which could have affected the results. Also, scope of the study could be further expanded at pinpointing the particular age at which the differences were observed, in order to facilitate the identification of the causes.

Conclusion

There was little or no differences in the mean z scores of females and male siblings of the same household and the differences whatsoever observed were equal on both sides, without any gender advantages or disadvantages. Females tend to have a slightly better higher HAZ than their male siblings when they belonged to scheduled tribes, Muslim, Christian or poorer households. The Asian Enigma remains an enigma.

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Abbreviations

BAZ	:	BMI for age Z score
dBAZ	:	Difference in BMI for age Z score
dHAZ	:	Difference in height for age Z score
dWAZ	:	Difference in weight for age Z score
dWHZ	:	Difference in weight for height Z score
HAZ	:	Height for age Z score
NFHS	:	National Family Health Survey
PSUs	:	Primary Sampling Units
SD	:	Standard deviation
SE	:	Standard Error
SRS	:	Sample registration System
WAZ	:	Weight for age Z score
WHO	:	World Health Organization
WHZ	:	Weight for height Z score

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