Regional Variation in the Prevalence of Undernutrition and its Correlates Among Under Five-Year Children in North India

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Abstract

Background: Undernutrition is an important public health problem affecting one-third of under five-year-old children in India. **Objectives:** To assess the nutritional status of under five-year-old children along with child feeding practices. **Materials and Methods:** We adopted a systematic sampling procedure to carry out this community-based, cross-sectional study in all the districts of Haryana. Data was collected on socioeconomic and demographic particulars along with anthropometric measurements. Analysis was done using SPSS Windows 23. **Results:** The overall prevalence of stunting, underweight, and wasting was 34%, 27.5%, and 11%, while that of severe undernutrition was 11%, 8%, and 3%, respectively. The odds of underweight were significantly higher among children of the Muslim religion, children of scheduled caste, children of illiterate mothers, lower per capita income, HHs without electricity, landless HHs, low birth weight, no ANC care, and those early ages at complementary feeding. Stunting was significantly higher among children whose mothers were illiterate, children whose fathers were laborers, among landless HHs, with no separate kitchen and lower birth weight, while wasting was higher among children of Muslim religion, children of scheduled caste, with no sanitary latrine facility, low-birth-weight children and early initiation of complementary feeding. **Conclusions:** Undernutrition is observed to be associated with religion, community, education of mother, per capita income, land holding status, birth weight, and age at complementary feeding. Thus, improving maternal nutrition can improve birth weight, improving maternal knowledge about child feeding, and the household's socio-economic status may improve the nutritional status of children.

Keywords: Conceptual framework, IYCF, nutritional status, stunting, underweight, wasting

Introduction

Undernutrition has been an important public health concern in India despite increased food production and supplementary feeding programs in operation for the last four decades. Globally, there are about 88 million underweight, 144 million stunted, and 47 million wasted children. Out of these children, every third child is from India.[1] As per the NFHS-5 report, the prevalence of stunting, underweight, and wasting is 36%, 32%, and 19%, respectively, among under five-year-old children in India.[2]

Undernutrition not only affects physical development but also affects the mental and psychological development of the child. The stunted children are more likely to have diminished cognitive and physical development, and poor educational outcomes in later childhood and adolescence,[3] their productive capacity is reduced because of poor health, and they are at increased risk of chronic diseases such as diabetes in later life.[4] Undernutrition is directly or indirectly associated with increased morbidity and mortality and is responsible for at least 45% of all deaths annually among under five-year-old children Globally.[5]

There are several factors contributing to a child's nutritional status. Maternal nutrition during pregnancy is an important factor as undernourished women at the time of conception contribute to poor birth outcomes such as low birth weight (LBW), increasing morbidity, and subsequent childhood malnutrition and neonatal mortality.[6] Maternal malnutrition accounts for 25–50% of intrauterine growth restriction (IUGR) in South Asia.[7] Infections and infestation during infancy and childhood also contribute to child undernutrition and

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Access this article online

Quick Response Code:

Website:
www.ijcm.org.in

DOI:
10.4103/ijcm.ijcm_616_22

increased morbidity. Apart from this, child feeding practices during infancy and early childhood play an important role in maintaining the nutritional status of children.

Sustainable development goals by the United Nations have set the target for achieving nutrition by eliminating all forms of malnutrition by 2030. To achieve these goals, the Government of India has initiated the National Nutrition Mission (Poshaan Abhiyaan) in 2018.[8]

Haryana is a northern state in India and is a major industrial hub. It is also the third-largest exporter of IT software in India. The agriculture industry is also one of the major industries in Haryana.[9] In spite of being an industrial state and agriculture production, undernutrition is still high in Haryana.

The present study was carried out to assess infant and young child feeding (IYCF) practices among young children and undernutrition among under five-year-old children in Haryana state.

MATERIALS AND METHODS

Ethical approval and consent: We had obtained ethical approval from the Institutional Ethical Committee of ICMR-National Institute of Nutrition, Hyderabad, and sought necessary approval from the district administration (DWCD) of Haryana. The written informed consent was taken from the mothers covered in the study.

Study design, setting, and sample size

We adopted systematic sampling procedure to carry out this community-based, cross-sectional study in all the districts of Haryana.

For calculating the sample size, we considered a 40% prevalence of underweight among under five-year-old children from a previous study,[10] with 5% absolute precision and 95% confidence interval, and a design effect of 2, a sample size of 738 (appr. 800) children per region was required.

N = P*Q (1.96 * 1.96)/0.05 * 0.05,

N = 0.4 * 0.6 (3.8416)/0.0025,

N = 0.921984/0.0025, N = 369 * 2 = 738 ~ 800.

For sub-set analysis, we had covered more children in each division.

Selection of village and households

The required sample was collected from 50 AWC villages in each region/division which were selected based on proportion to the size of AWC village in each district and 20 households (HHs) from each village. Anganwadi centre (AWC) village was divided into five areas and from each area, the first household was selected randomly, and then four HHs having at least one under five-year-old child were covered.

Data collection

We collected data using a pretested proforma by locally recruited staff who were trained and standardized in survey methodologies. We collected information from all the selected households on household socio-economic and demographic particulars. Anthropometric measurements were taken for all the children. Height was measured using a stadiometer/infantometer (up to the nearest 1 mm) and SECA weighing scale for weight (up to the nearest 100 g) by following standard procedure.[11]

We also collected information on fortnight morbidities such as diarrhea, acute respiratory infections, and fever.

IYCF practices: Information on IYCF practices such as colostrum feeding, exclusive breastfeeding till 6 months, initiation of breastfeeding, and complementary feeding (CF) were obtained from the mothers of <12-month-old children.

The information on the birth weight of the children was obtained from the records available with the mother such as immunization card, hospital discharge card, or mother-child protection card. Children below 2.5 kg were considered as low birth weight.

Data analysis: Before entering the data in the Fox-Pro program, the data was scrutinized by the staff of the National Institute of Nutrition (NIN), Hyderabad. We used range and consistency checks to clean the data. IBM SPSS Statistics for Windows (Version 23.0) (Armonk, New York: IBM Corp) was used for descriptive and analytical statistics. Data was analyzed using a proportion test, Chi-square test, and stepwise logistic regression analysis was carried out between undernutrition as dependent and socio-demographic factors as independent variables.

The conceptual hierarchical framework developed by Mosley and Chen[12] and refined by Chopra[13] was used to study the association between undernutrition and socio-demographic risk factors. Figure 1 shows the factors controlled in a hierarchical order for undernutrition. Age and gender were considered important factors and were present in all models and at each stage, irrespective of significance level. In the first stage, distal factors such as division, religion, community, type of family, family size, education and occupation of parents, land holding, PCI, sanitary latrine, electricity, cooking fuel, and a separate kitchen
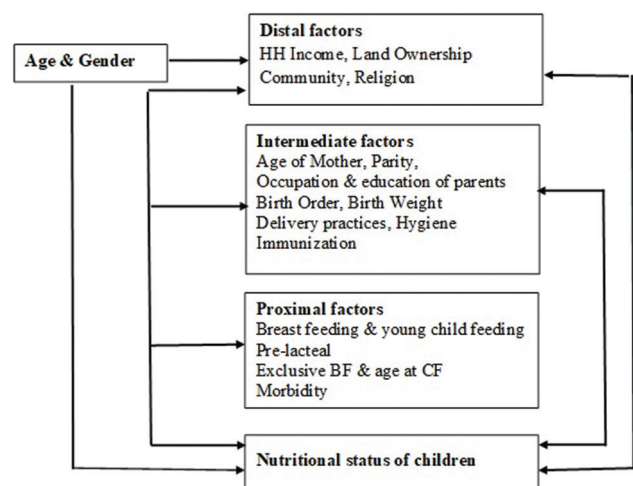
Figure 1: Conceptual hierarchical framework for undernutrition

were added. In the second stage, intermediate factors such as the number of ANCs, place of delivery, birth weight, hygienic practices of the mother, birth order, and interval were added along with age, gender, and significant distal factors. In the third stage, variables such as colostrum feeding, exclusive breastfeeding, initiation of breastfeeding and complementary feeding, and fortnight morbidities were added as described above [Figure 1].

The SD classification (WHO standards) was used to assess the nutritional status of children.[14,15] We defined underweight as "weight-for-age" <2 SD of the reference median (<Median-2SD), stunting as "height-for-age" <2 SD and wasting as "weight-for-height" <2 SD. Children who were <3 SD values of the reference median (<Median-3SD) of "height-for-age," "weight-for-age," and "weight-for-height" were classified as "severe stunting," "severe underweight," and "severe wasting," respectively.

RESULTS

Coverage particulars

We covered 4726 children (boys: 2623, girls: 2103) (Rural: 3788; Urban: 938), from 4067 households from 204 Anganwadi Centres from 21 districts. The mean age of the children was 23.15 ± 15.1 months. A total of 1294 mothers of <12 months children and 2323 mothers having 12–35-month-old children were interviewed to assess IYCF practices.

Socio-demographic and economic profile of study subjects

The majority (91%) of the HHs were belonging to Hindu religion. About 30% of the HHs belonged to SC, 34% belonged to other backward communities (OBC) and 35% to other communities. About 51% of the HHs were joint families and 32% were nuclear families. About two-thirds (64%) of houses were pucca, the proportion of which was more in Gurugram (73.5%) and low in Hissar (56%). About 10% of fathers and 20% of mothers of index children were illiterate. About 47% of fathers were engaged in labor and 41% were engaged in service/business. The mean per capita income was Rs. 2700 and was more for Rohtak (Rs. 3082) and low for Gurugram and Ambala (Rs. 2455–2472) [Table 1].

Burden of undernutrition by age groups, gender, and division

No significant difference in the prevalence of undernutrition was observed among boys and girls. The prevalence of stunting and underweight was observed to increase with age advancement and was higher among 36–59-month-old children. The overall prevalence of stunting, underweight, and wasting was 34% (CI = 32.7–35.4), 27.5% (CI = 26.2–28.7), and 11% (CI = 10.0–11.8), respectively [Figure 2].

The overall prevalence of severe stunting, severe underweight, and severe wasting was 11%, 8%, and 3%, respectively. The prevalence of stunting, underweight, and wasting was higher in Gurugram as compared to other divisions [Table 2].

Undernutrition in relation to socio-economic and demographic particulars

The prevalence of stunting and underweight was significantly ($P < 0.01$) higher among children from SC communities, among children from nuclear families, children of illiterate parents, HHs without agricultural land, and children from lower and middle income socio-economic groups. The prevalence of wasting was significantly ($P < 0.01$) higher among children whose parents were illiterate, HH without agricultural land, and children from lower socioeconomic group [Table 3].

Undernutrition vs. ANC, delivery, and IYCF practices

The prevalence of underweight and wasting was observed to be significantly ($P < 0.01$) higher among children whose mothers did not avail ANC care during pregnancy, those registered for pregnancy after 20th weeks of gestation, had home delivery, among children of low birth weight, children not exclusively breastfed up to 6 months of age and children receiving complementary feeding before 6 months of age, while stunting was higher among children whose mother did not consume or consume <100 IFA tablets during pregnancy, children with low birth weight, not having exclusive breastfeeding up to 6 months and received CF after 8 months of age [Table 4].

Factors associated with underweight, stunting, and wasting according to the conceptual hierarchical framework

In the first stage, age remains significantly associated with underweight. It was observed that children from the Hissar and Gurugram division had higher odd of underweight (OR: 1.3 CI:1.03–1.55) and (CI 1.08-1.60) as compared to other divisions. Children belonging to the Muslim religion had 2.5 (CI = 1.56–4.12) times and children belonging to SC communities had 1.4 (CI = 1.11–1.67) times higher odds of underweight as compared to children from forward communities. Children whose fathers were illiterate had 1.5 times (CI = 1.07–2.10) higher odds of underweight as compared to children whose fathers were educated above higher secondary education. The underweight was 2.36 (CI = 1.62–3.44) times higher among children of illiterate mothers and 2.2 times (1.50–3.11) times higher among children whose mothers had middle school education. The odds of underweight were 1.5 (CI = 1.17–1.90) times higher among the children belonging to 1st and 2nd income quartile groups. Children from landless HHs had 1.7 (CI = 1.15–2.47) times higher odds of underweight as compared to those possessing land [Table 5].

In the second stage, intermediate factors such as literacy status of mother, electricity, landholding, number of ANC services, and birth weight were observed to be significantly associated with underweight. The odds of underweight were 2.13 (CI = 1.06–4.27) times more among children whose mothers have not availed of ANC services during pregnancy and remains significant in the third stage also. The odds of underweight were 3.66 (CI = 2.53–5.29) times more among low-birth-weight children as compared to normal children. In the third stage, in addition to literacy status, birth weight, land holding, and ANC care, age at complementary feeding was significant. The odds of underweight were 1.7 (CI = 1.08–2.62) times more among children who started complementary feeding before 6 months of age as compared to those who started CF at 6–8 months of age.

Table 1: HHs socio-demographic particulars of study subjects					
	Ambala N=965	Gurugram N=1150	Hissar N=952	Rohtak N=1000	Pooled N=4067
Religion					
Hindu	91.4	87.5	92.4	95.3	91.5
Muslim	2.3	12.4	1.0	0.8	4.5
Sikh	6.3	0.1	6.6	3.9	4.0
Caste					
SC	33.0	30.5	34.5	24.0	30.4
BC	37.1	44.0	27.2	27.8	34.4
OC	29.9	25.5	38.3	48.2	35.1
Type of family					
Nuclear	28.8	36.9	30.6	29.3	31.6
Ext. nuclear	18.2	15.4	15.4	20.3	17.3
Joint	53.0	47.7	54.0	50.4	51.1
Family size					
1–4	22.3	21.0	20.1	22.7	21.5
5–9	65.2	63.7	68.4	66.2	65.7
≥10	12.5	15.3	11.6	11.1	12.8
Type of house					
Kutcha	4.5	3.2	2.8	3.5	3.5
Semi-pucca	30.5	23.1	41.7	36.7	32.6
Pucca	65.0	73.7	55.5	59.8	63.9
Literacy status of father					
Illiterate	9.4	11.3	11.6	7.1	9.9
1–7th class	17.2	14.1	17.2	13.3	15.4
8–12th class	60.0	59.0	55.6	60.5	58.8
Graduate	13.4	15.6	15.7	19.1	15.9
Literacy status of mother					
Illiterate	15.6	26.0	21.3	13.5	19.4
1–7th class	22.1	18.0	19.1	18.4	19.3
8–12th class	49.8	47.4	47.6	52.9	49.4
Graduate	12.4	8.6	12.0	15.2	11.9
Major occupation of father					
Labor	56.0	39.0	49.7	43.4	46.6
Agriculture	9.5	6.2	20.0	15.8	12.6
Service + business	34.5	54.8	30.3	40.8	40.8
Major occupation of mother					
Labor	4.5	3.1	6.3	3.8	4.4
Agriculture	0.1	0.3	3.2	0.8	1.0
Service + business	4.2	3.7	2.8	3.4	3.6
HW	91.2	92.9	87.7	92.0	91.0
PCI quartile					
1st (<Rs. 1198)	27.8	27.5	17.0	21.7	23.7
2nd (Rs. 1198–1786)	28.2	23.2	24.6	23.8	24.9
3rd (Rs. 1787–3000)	23.1	26.7	28.7	23.5	25.5
4th (>Rs. 3000)	20.9	22.6	29.7	31.0	25.9
Average PCI (Rs.)	2472	2455	2833	3082	2700
source of drinking water					
Bore	25.2	47.8	40.8	50.1	41.4
Tap	74.0	39.6	47.8	40.4	49.9
Others	0.8	12.6	11.4	9.5	8.8
Sanitary latrine					
Using	70.5	71.9	80.3	79.4	75.4
Not using	29.5	28.1	19.7	20.6	24.6

Contd...

Table 1: Contd...	Ambala	Gurugram	Hissar	Rohtak	Pooled
Type of cooking fuel					
Firewood	62.9	69.2	73.8	63.0	67.3
Others	37.1	30.8	26.2	37.0	32.7
Electricity					
Present	97.7	96.0	98.3	97.8	97.4
Absent	2.3	4.0	1.7	2.2	2.6
Separate kitchen					
Present	74.6	55.2	58.3	67.0	63.4
Absent	25.4	44.8	41.7	33.0	36.6

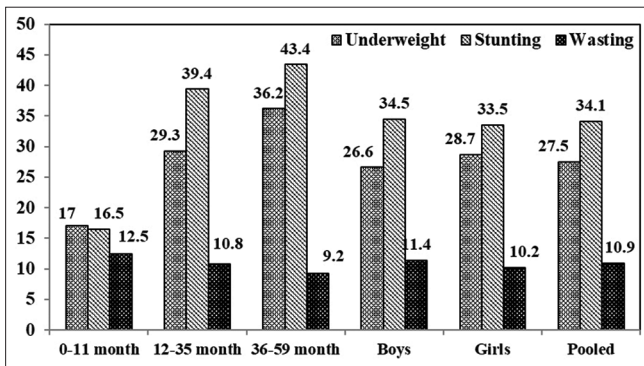HHs—households; HW—housewife; PCI—per capita income; Rs.—rupees, SC—scheduled caste; BC—backward caste; OC—other caste

Table 2: Prevalence of undernutrition according to regions

	Ambala	Gurugram	Hissar	Rohtak	Pooled
Underweight					
Severe	7.9	10.1	8.6	4.3	7.8
Moderate	19.9	21.9	19.1	17.5	19.7
Normal	72.2	68.1	72.3	78.2	72.5
Stunting					
Severe	10.0	11.5	14.9	8.3	11.2
Moderate	22.3	26.3	22.9	19.3	22.9
Normal	67.7	62.2	62.2	72.4	65.9
Wasting					
Severe	3.2	2.9	3.1	1.3	2.6
Moderate	9.0	9.0	7.6	7.2	8.3
Normal	87.8	88.0	89.3	91.5	89.1

Figure 2: Age and gender-wise prevalence of undernutrition

The odd of stunting was 1.5 times higher (1.26–1.85) among children from the Hissar division compared to other divisions. Age was significant only in the first stage with odds of 3.7 (CI = 3.07–4.37) and 3.8 (CI = 3.17–4.68) times higher among 12–35-month-old and 36–59-month-old children. The odds of stunting were 2.6 (CI = 1.94–3.53) times higher among children whose mothers were illiterate and remained significant throughout the three stages. The children from HH not having sanitary latrine had 1.2 (CI = 1.00–1.38) times higher odds of stunting as compared to children having facility sanitary latrine and 1.4 (CI = 1.14–1.62) times higher among children from landless HHs.

In the second stage, division, literacy status of mother, and birth weight were observed to be significantly associated with stunting. The odds of stunting were 3.18 (CI = 2.21–4.58) times more among low birth weight children as compared to normal children. In the third stage, age at complementary feeding was significant. The odds of stunting were low among children who had not received CF (OR 0.50; CI = 0.36–0.71) as compared to children who received CF at 6–8 months of age.

The children belonging to lower income groups had 2.03 (95% CI = 1.48–2.78) and 1.68 (95% CI = 1.23–2.29) times higher odds of wasting as compared to children from higher income groups. Sanitary latrine was significantly associated with wasting throughout three stages and the odds of wasting were 1.26 (CI = 1.03–1.57) and 1.58 (CI = 1.09–2.29) times higher among children from HH not having sanitary latrine.

In the second stage, wasting was significantly associated with PCI (quartile), sanitary latrine, and birth weight. The odds of wasting were 1.57 (CI = 1.02–3.12) times more among low-birth-weight children as compared to normal children. The birth weight remains significant in the third stage. In the third stage, exclusive breastfeeding up to 6 months of age and age at complementary feeding were significant. The odds of wasting were 2 times higher (CI = 1.42–3.0) among children who were not exclusively breastfed up to 6 months and 2.6 (CI = 1.65–4.03) times higher among children receiving complementary feeding before 6 months of age.

Discussion

The nutritional and health status of under five-year-old children is one of the important indicators for the development of a country or state. The present study reported 27%, 34%, and 11% prevalence of underweight, stunting, and wasting, respectively, which is slightly higher than the NFHS-5 figure for Haryana (22%, 28%, and 12%, respectively), but lower than the national figure (32%, 36%, and 19%, respectively).[2] The Hissar and Gurugram divisions reported the highest prevalence of undernutrition although Gurugram is an industrial area. In Gurugram, illiteracy of parents was observed more, and also availing of at least 4 ANC services, registration of pregnancy in first trimester, consumption of >100 IFA tablets, and home deliveries were observed more in Gurugram division as

Table 3: Prevalence of undernutrition according to socio-demographic particulars

	n	Underweight	Stunting	Wasting
Region				
Ambala	1140	27.8	32.3	12.2
Gurugram	1362	31.9	37.8	12.0
Hissar	1105	27.7	37.8	10.7
Rohtak	1119	21.8	27.7	8.5
Chi-square, *P*-value		31.5, 0.01	37.4, 0.01	10.3, 0.01
Area				
Rural	3788	27.7	33.8	10.7
Urban	938	26.8	35.1	11.8
Chi-square, *P*-value		0.36, NS	0.51, NS	0.87, NS
Birth order of children				
First	1819	21.6	29.0	9.5
Second	1752	28.4	33.8	11.0
Third	703	32.7	40.5	10.8
Fourth	255	38.4	48.6	15.3
Five and above	197	42.6	41.6	17.8
Chi-square, *P*-value		79.7, 0.01	62.5, 0.01	18.1, 0.01
Birth interval				
No interval	1819	21.6	29.0	9.5
<24 months	992	33.1	40.1	9.8
≥24–35 months	922	33.2	38.4	13.6
≥36 months	993	27.7	33.2	12.1
Chi-square, *P*-value		62.0, 0.01	44.7, 0.01	12.9, 0.01
Religion				
Hindu	4288	26.9	33.8	10.6
Muslim	228	48.2	46.1	18.9
Sikh	210	18.1	27.1	7.6
Chi-square, *P*-value		59.2, 0.01	19.2, 0.01	17.5, 0.01
Caste				
SC	1518	35.4	40.2	15.4
BC	1632	29.8	36.8	10.5
OC	1576	17.7	25.4	7.1
Chi-square, *P*-value		127.2, 0.01	83.6, 0.01	55.4, 0.01
Type of family				
Nuclear	1472	37.0	42.3	14.3
Ext. nuclear	821	26.2	35.6	10.1
Joint	2433	22.3	28.6	9.1
Chi-square, *P*-value		99.3, 0.01	76.7, 0.01	25.7, 0.01
Family size				
1–4	964	31.8	36.5	14.2
5–9	3117	27.0	34.0	10.6
≥10	645	23.7	31.0	7.4
Chi-square, *P*-value		14.1, 0.01	5.27, 0.07	18.6, 0.01
Type of house				
Kutcha	158	42.4	44.3	17.1
Semi-pucca	1583	32.5	40.1	12.3
Pucca	2985	24.2	30.3	9.8
Chi-square, *P*-value		53.8, 0.01	51.5, 0.01	12.9, 0.01
Literacy status of father				
Illiterate	471	43.3	50.1	14.9
1–7th class	753	38.6	43.0	15.8
8–12th class	2768	25.4	32.2	10.0
Graduate	734	14.1	21.5	6.7
Chi-square, *P*-value		178.1, 0.01	136.3, 0.01	42.2, 0.01

Contd...

Table 3: Contd...

	n	Underweight	Stunting	Wasting
Literacy status of mother				
Illiterate	936	42.5	48.2	15.1
1–7th class	926	35.6	42.7	13.8
>8–12th class	2335	22.3	28.9	9.3
Graduate	529	10.2	16.8	5.5
Chi-square, *P*-value		247.6, 0.01	210.7, 0.01	47.2, 0.01
Major occupation of father				
Labor	2243	36.0	42.4	13.8
Agri	571	19.5	26.2	7.0
Service + business	1912	20.1	26.7	8.7
Chi-square, *P*-value		151.8, 0.01	130.1, 0.01	37.9, 0.01
Major occupation of mother				
Labor	204	35.3	44.6	18.1
Owner cultivator	45	24.4	31.1	6.7
Service + business	159	15.1	25.2	9.4
Housewife	4318	27.7	33.9	10.7
Chi-square, *P*-value		18.7, 0.01	15.9, 0.01	12.4, 0.01
PCI quartile				
1st (<Rs. 1198)	1172	36.4	41.4	15.2
2nd (Rs. 1198–1786)	1189	32.3	38.8	12.6
3rd (Rs. 1787–3000)	1185	26.9	33.7	9.7
4th (>Rs. 3000)	1180	14.6	22.5	6.1
Chi-square, *P*-value		159.4, 0.001	110.4, 0.001	55.8, 0.001
Sanitary latrine				
Using	3569	23.8	31.0	9.3
Not using	1157	39.0	43.7	15.9
Chi-square, *P*-value		100.1, 0.01	63.5, 0.01	39.6, 001
Source of drinking water				
Tube well	2016	27.0	34.4	10.4
Tap	2321	27.8	34.0	11.3
Others	389	28.5	32.9	11.3
Chi-square, *P*-value		NS	NS	NS
Type of cooking fuel				
Firewood	3176	31.3	37.3	11.6
Others	1550	19.9	27.4	9.5
Chi-square, *P*-value		66.8, 0.01	45.8, 0.01	4.7, 0.02
Electricity				
Present	4612	26.9	33.6	10.7
Absent	114	55.3	51.8	20.2
Chi-square, *P*-value		44.9, 0.01	16.2, 0.01	10.3, 0.01
Separate kitchen				
Present	2983	22.0	28.7	9.2
Absent	1743	37.1	43.4	13.9
Chi-square, *P*-value		126.5, 0.01	106.1, 0.01	24.5, 0.01
Morbidities during the previous fortnight				
No	2793	24.7	32.4	9.3
Yes	1933	31.7	36.5	11.3
Chi-square, *P*-value		27.6, 0.001	8.1, 0.001	19.1, 0.001
Hand washing practices of mother				
Yes	3107	25.2	31.5	10.1
No	522	32.3	39.0	12.5
Chi-square, *P*-value		27.8, 0.001	26.2, 0.001	6.6, 0.01

SC—scheduled caste; BC—backward caste; OC—other caste; PCI—per capita income

compared to other divisions. This rapid industrial development and increase migration of labor in this area may be the reason.

No difference was observed in the prevalence of undernutrition among both genders, similar to that observed in the NFHS-5

Table 4: Prevalence of undernutrition according to IYCF practices

	n	Underweight	Stunting	Wasting
ANC during last pregnancy				
Yes	1248	16.0	16.1	12.1
No	46	43.5	26.1	23.9
Chi-square, *P*-value		24.8, 0.01	3.52, 0.06	5.99, 0.01
No. of ANCs attended				
<4	614	17.5	16.6	12.9
≥4	634	14.7	15.6	11.4
Not availed	46	43.5	26.1	23.9
Chi-square, *P*-value		25.3, 0.01	3.46, NS	6.3, 0.04
Registration of pregnancy in weeks of gestation				
<12	834	15.6	15.8	11.7
12–20	336	15.8	16.7	12.2
>20	78	21.8	16.7	16.7
Not availed	46	43.5	26.1	23.9
Chi-square, *P*-value		26.8, 0.01	3.6, NS	7.63, 0.05
No. of IFA tablet consumed				
<100	665	18.8	17.7	12.0
≥100	469	11.7	13.0	12.2
DNK	159	25.2	21.4	15.8
Chi-square, *P*-value		18.2, 0.01	7.6, 0.02	1.75, NS
Place of delivery				
Home	162	30.9	24.7	18.0
Institution	1131	15.0	15.3	11.8
Chi-square, *P*-value		25.1, 0.01	9.1, 0.01	4.9, 0.02
Birth weight				
<2.5	220	30.0	28.6	15.5
≥2.5	898	10.7	11.4	10.1
NA	175	33.1	27.4	21.3
Chi-square, *P*-value		83.9, 0.01	55.9, 0.01	18.5, 0.01
Time of initiation of breastfeeding				
1 hr	599	15.4	15.9	12.4
1–23 hrs	492	17.3	15.2	11.4
≥24 hrs	202	21.3	21.3	16.0
Chi-square, *P*-value		3.7, NS	4.1, NS	2.7, NS
Exclusive breastfeeding				
Yes	1042	14.6	15.3	10.6
No	251	27.1	21.5	20.8
Chi-square, *P*-value		22.3, 0.01	5.71, 0.01	19.1, 0.001
Time of initiation of CF				
<6 months	171	29.2	22.8	22.9
>8 months	19	36.8	31.6	10.5
Not started	678	11.7	11.9	10.5
6–8 months	425	19.8	20.5	11.8
Chi-square, *P*-value		39.5, 0.001	23.0, 0.001	19.6, 0.001

ANC—antenatal check-ups; IFA—iron and folic acid tablets; CF—complementary feeding

and NIN study.[16] However, some other studies observed a higher prevalence among boys compared to girls[17,18] Low prevalence of undernutrition during early infancy is due to prevalent breastfeeding practices among the children, but after 6 months, there are faulty feeding practices such as delayed initiation of complementary feeding, quality, and quantity in terms of dietary diversity and minimum acceptable diet is low among the growing children. As the children start growing from infancy to childhood, they become increasingly independent of their parents and come in contact with the environment through crawling and walking, which makes them at increased risk of acquiring infection and thus prone to undernutrition, especially in less hygienic conditions.

The high prevalence observed among children from Muslim religion is mostly attributed to high rate of illiteracy among fathers (35.5%) and mothers (71.5%), access to physical facilities such as sanitary latrine (61%), high birth order (≥4, 37%), lower per capita income (mean PCI Rs. 1510 vs Rs. 2625 among

Table 5: Stepwise adjusted stepwise logistic regression analysis for undernutrition

	Stage 1	Stage 2	Step 3
	Underweight (OR, CI)		
Division			
Ambala	1.18, 0.96–1.45		
Gurugram	1.31, 1.08–1.60		
Hissar	1.27, 1.03–1.55		
Rohtak	1.0		
Age			
0–11 months	1.0		
12–35 months	2.23, 1.86–2.66		
36–59 months	2.74, 2.24–3.34		
Religion			
Hindu	1.80, 1.23–2.62		
Muslim	2.53, 1.56–4.12		
Others	1.0		
Caste			
SC	1.36, 1.11–1.67		
BC	1.20, 1.00–1.46		
OC	1.0		
Literacy status of father			
Illiterate	1.50, 1.07–2.10		
1–7th class	1.48, 1.09–2.02		
8–12th class	1.23, 0.95–1.60		
Graduate	1.0		
Literacy status of mother			
Illiterate	2.36, 1.62–3.44	2.81, 1.49–5.03	2.97, 1.57–5.63
1–7th class	2.16, 1.50–3.11	1.89, 0.98–3.50	2.01, 1.05–3.82
>8–12th class	1.57, 1.12–2.18	1.17, 0.65–2.10	1.17, 0.64–2.11
Graduate	1.0	1.0	1.0
PCI quartile			
1st	1.49, 1.17–1.90		
2nd	1.47, 1.17–1.87		
3rd	1.36, 1.08–1.70		
4th	1.0		
Electricity			
Present	1.0	1.0	
Absent	1.84, 1.23–2.75	2.15, 1.03–4.48	
Separate kitchen			
Present	1.0		
Absent	1.15, 0.98–1.35		
Cooking fuel			
Firewood	1.19, 1.01–1.40		
Others	1.0		
Possession of land			
Landless	1.26, 1.04–1.52	1.61, 1.11–2.35	1.69, 1.15–2.47
Landholders	1.0	1.0	1.0
Birth weight			
Not known		2.58, 1.71–3.91	2.50, 1.64–3.79
<2.5		3.66, 2.53–5.29	3.58, 2.46–5.21
≥2.5		1.0	
ANC number			
Not availed		2.13, 1.06–4.27	2.25, 1.12–4.51
<4		0.90, 0.65–1.25	0.93, 0.67–1.30
≥4		1.0	1.0

Contd...

Table 5: Contd...			
	Stage 1	**Stage 2**	**Step 3**
	Underweight (OR, CI)		
Age at initiation of CF			
<6 months			1.68, 1.08–2.62
>8 months			1.86, 0.66–5.22
Excl. BF			0.52, 0.37, 0.75
6–8 months			1.0
	Stunting		
Division			
Ambala	1.09, 0.90–1.32	1.35, 0.82–2.21	1.28, 0.78–2.10
Gurugram	1.47, 1.22–1.77	1.41, 0.90–2.21	1.43, 0.91–2.25
Hissar	1.52, 1.26–1.85	1.93, 1.23–3.03	2.01, 1.27–3.17
Rohtak	1.0	1.0	1.0
Age			
0–11 months	1.0		
12–35 months	3.66, 3.07–4.37		
36–59 months	3.85, 3.17–4.68		
Literacy status of mother			
Illiterate	2.62, 1.94–3.53	2.07, 1.18–3.63	2.06, 1.17–3.63
1–7th class	2.33, 1.73–3.12	1.21, 0.68–2.14	1.27, 0.71–2.26
>8–12th class	1.57, 1.21–2.03	0.90, 0.54–1.51	0.89, 0.52–1.50
Graduate	1.0	1.0	1.0
Occupation of father			
Labor	1.36, 1.15–1.60		
Agriculture	1.05, 0.82–1.36		
Business + service	1.0		
Sanitary latrine			
Present	1.0		
Absent	1.17, 1.00–1.38		
Possession of land			
Landless	1.36, 1.14–1.62		
Landholders	1.0		
Separate kitchen			
Present	1.0		
Absent	1.21, 1.04–1.41		
Birth weight			
Not known		2.28, 1.49–3.48	2.10, 1.37–3.23
<2.5		3.18, 2.21–4.58	3.16, 2.19–4.58
≥2.5		1.0	
Age at initiation of CF			
<6 months			1.07, 0.68–1.68
>8 months			1.36, 0.48–3.86
Not started			0.50, 0.36–0.71**
6–8 months			1.0
	Wasting		
Age			
0–11 months	1.0		
12–35 months	0.86, 0.70–1.07		
36–59 months	0.66, 0.50–0.86		
Religion			
Hindu	1.35, 0.79–2.28		
Muslim	2.58, 1.37–4.88		
Others	1.0		

Contd...

Table 5: Contd...

	Stage 1	Stage 2	Step 3
	Wasting		
Caste			
SC	1.77, 1.36–2.29		
BC	1.16, 0.89–1.52		
OC	1.0		
PCI quartile			
1st	2.03, 1.48–2.78	2.41, 1.35–4.30	2.40, 1.34–4.30
2nd	1.68, 1.23–2.29	1.90, 1.07–3.35	1.97, 1.11–3.48
3rd	1.35, 1.0–1.86	1.67, 0.94–2.95	1.73, 0.97–3.07
4th	1.0	1.0	1.0
Family size			
1–4	1.0		
5–9	0.72, 0.58–0.90		
≥10	0.47, 0.33–0.68		
Sanitary latrine			
Present	1.0	1.0	1.0
Absent	1.26, 1.03–1.57	1.61, 1.11–2.33	1.58, 1.09–2.29
Birth weight			
Not known		1.76, 1.12–2.76	1.65, 1.05–2.95
<2.5		1.57, 1.02–3.12	1.55, 1.01–2.40
≥2.5		1.0	1.0
Age at initiation of CF			
<6 months			2.58, 1.65–4.03
>8 months			1.06, 0.71–1.56
Not started			0.89, 0.19–4.04
6–8 months			1.0
Exclusive breastfeeding up to 6 months			
Yes			1
No			2.06, 1.42–3.00

PCI—per capita income; ANC—antenatal check-ups; IFA—iron and folic acid tablets; CF—complementary feeding; OR—odds ratio; CI—confidence interval

Hindus and Rs. 4051 among Sikh), more home deliveries (45%), low ANC care seeking behavior, and low hygienic practices. High prevalence among scheduled caste children may be due to lower economic status and less use of sanitary latrine (62%). A similar observation was reported by others.[18]

The literacy status of mothers is an important and independent risk factor for undernutrition. Although no exact mechanism is known, literate mothers have good knowledge about child caring and feeding, more health-seeking behavior for illness, are mostly involved in income-generating activities, have the knowledge to manage with minimum resources, and have more child-centered caring practices. Also, educated women are involved in income-generating activities sometimes jobs; married to men with higher education; and lives in better surroundings, which have influence on child health and survival.[19] Johri *et al.* and Abuya *et al.* in their study observed a significant association between mother literacy and nutritional status of children.[20,21]

The birth weight of newborns is mostly associated with undernutrition. Low birth weight among infants is mostly due to the undernutrition of the mother during pregnancy. A healthy mother is a prerequisite for a healthy baby. Several studies showed a positive association between low birth weight and with nutritional status of children.[22-24]

Antenatal care services during pregnancy were observed to be associated with underweight which is similar to other studies.[18] The mothers who had not availed of ANC services were at more risk of delivering LBW babies and thus undernutrition among children. This may be due to mothers not receiving any ANC services such as iron and folic acid supplementation, supplementary feeding, and nutrition advice during pregnancy.

Age at complementary feeding among infants was observed significantly associated with underweight and wasting. Those initiating CF before 6 months of age were at higher risk as compared to those initiating CF at 6–8 months of age. During the first 6 months, breast milk is sufficient to meet the caloric requirement of a child. Immediately after 6 months, mothers' milk is not sufficient for the growing child and CF has to be initiated immediately. Most of the studies did not observe any association with feeding practices.[17,18] A study by Koya *et al.* observed higher odds of wasting among children who were given supplementary feeding before 6 months of age as compared to exclusively breastfed children[25] similar to our study.

Conclusions and Recommendations

The prevalence of underweight, stunting, and wasting was 27%, 34%, and 11%, respectively, and was high in Hissar and Gurugram divisions. The odds of underweight were observed high among children from the Muslim religion, children belonging to Scheduled caste, children from lower per capita income HHs, children of illiterate mothers, among landless HHs, and among children from HHs without sanitary latrine facilities. Also, low birth weight and age at CF were observed to be associated with undernutrition. So, improving sanitation, hygiene, maternal education, and nutritional status, improving socio-economic status and IYCF practices might help in reducing undernutrition among children.

Limitation: As it is a cross-sectional study, recall bias is a major limitation as most of the information about income, and IYCF practice was received from the respondent (mother); however, some of the information was verified from the records. The dependent variable such as height and weight was measured by trained staff. Birth weight was verified from the card or AWC record. Immunization was cross-checked from the records available with the mother.

Conflicts of interest

There are no conflicts of interest.

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