Original Article

Undernutrition and associated factors among children 1-5 years of age in rural area of Haryana, India: A community based cross-sectional study

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Abstract

Background: Children under five years of age are most vulnerable to the vicious cycles of malnutrition, disease/infection and resultant disability all of which influence the present condition of a child at the microlevel and the future human resource development of the nation at the macrolevel. **Aim:** The present study was conducted to estimate the prevalence of undernutrition among under-five children; and to determine the associated factors. **Methods:** All 112 Anganwadi Centres in block Lakhan Majra were enlisted and 30 Anganwadi Centres were selected by adopting systematic random sampling. From each selected Anganwadi Centre, 20 children of 15 years of age group were selected by simple random sampling, thus, a sample of 600 children was included in the study. **Results:** Overall prevalence of undernutrition in our study was found as follows: wasted 18.4%; underweight 38.3%; stunted 41.3%. Mothers who had four or more ANC visits and IFA intake for 100 or more days had lower prevalence of wasting, stunting, and underweight than the mothers with three or less ANC visits and inadequate IFA intake. Children with a history of pre-lacteal feeding had higher prevalence of stunting, underweight, and wasting than the children with no history of pre-lacteal feeding. **Conclusion:** Every endeavor should be made to combat the outcomes of undernutrition through multipronged approach such as growth monitoring, nutritional supplementation, etc., Also, present study findings reinforce the importance of proper infant and child feeding practices and appropriate maternal care in prevention of childhood undernutrition.

Keywords: Anganwadi centers, anthropometry, exclusive breastfeeding, immunization, pre-lacteal feed

Introduction

Recently millennium development goals (MDG's) has been transformed into sustainable developmental goals (SDG's) and maternal & child health (MCH) has received attention in the last two decades as never before and; adequate nutrition has always been a definitive tool for achieving the maternal and child health targets.[1]

The necessity to improve the nutrition state of childhood is essential as current children will be future citizens. From a life-cycle perspective, the most crucial time to meet a child's nutritional requirements is in the 1000 days, as during this time, the child has increased nutritional needs for supporting rapidly occurring growth and development, having more susceptibility

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toward diseases of infectious nature, increased susceptibility toward biologically controlled programs and having total dependency for caring, nourishment, and socialization on others. Also, early childhood constitutes the most crucial period of life, when the foundations are laid for cognitive, social and emotional, language, physical/motor development, and cumulative lifelong learning.[2]

Children under five years of age are most vulnerable to the vicious cycles of malnutrition, disease/infection, and resultant disability all of which influence the present condition of a child at domestic grounds and upcoming futuristic working personnel on the bigger platform. Globally 8.8% of the population is constituted by under-five children, whereas it is 8.3% for India and approximately one in every three malnourished children of the world lives in India.[1,3,4]

Nutritional status is influenced by three broad factors, that is, food, health, and care. The food rich in desired nutrients having diversity, easy availability, and affordability; appropriate and adequate maternal and child health care services; a clean and green environment which includes safe water, sanitation, and good hygiene practices can ease to achieve the optimal nutrition state among children. The combination and relative importance of these factors differ from country to country.[5]

Poor maternal nutrition impairs fetal development and contributes to low birth weight, subsequent undernutrition. Also, after birth, a number of practices can directly lead to poor growth are inadequate breastfeeding practices such as non-exclusive breastfeeding; inappropriate complementary feeding, and others.[6,7]

The long-term undernutrition in childhood results in several consequences such as delayed motor and skill milestones; intelligent quotient on lower side, prone to behavior specific illnesses, lack of socialization characteristics, and more prone to communicable disease. Undernutrition is associated with poor school achievement and poor school performance. Reduced school attendance and educational outcome results in diminished income-earning capacity in adulthood which in turn affects economic productivity at national level. The recent literatures have reported that due to childhood undernutrition there is increased risk of cardiovascular disease, type 2 diabetes and others due to disproportionate and rapid weight gain in later years of childhood life.[8-10]

The existence of undernutrition in India is very severe and by far it is the most common cause for mortality among children. In India U5MR is 37 per 1000 live birth as per SRS 2013.The prevalence of underweight children under age 5 was an indicator to measure progress toward MDG, which aims to halve the proportion of people who suffer from hunger between the years 1990 and 2015 and for India, it implies to reduce the prevalence from 54.8% to 27.4%. Sustainable development goals (SDG) had focused to overcome any kind of malnutrition by the year 2030 along with to achieve the desired aim set at international levels for reducing stunting and wasting among children under 5 years of age by the year 2025.[11]

As the assessment of the ground reality as reflected by the statistics on nutritional status of children becomes very significant in this context, the present study was conducted in the rural area of Haryana, with primary objectives to estimate the prevalence of undernutrition among under-five children and to find the factors associated with undernutrition.

Materials and Methods

The ethical clearance was obtained from the Institutional Ethical Committee prior to the commence of study with reference letter number as Ped/14/2582-2601 dated 17.09.2014.

Study design and the participants

The present community based observational study with cross-sectional design (analytical study) was carried out in block Lakhan Majra, district Rohtak, Haryana, a rural field practice area attached to the Department of Community Medicine, Pt. B.D Sharma PGIMS, Rohtak for the purpose of teaching, training, and research activities for medical undergraduate and postgraduate students. The ethical clearance was obtained from the Institutional Ethical Committee prior to the commence of study with reference letter number as Ped/14/2582-2601 dated 17.09.2014. The study was conducted over a period of 12 months from October 2015 to September 2016. Children in the age group 15 years, registered at respective anganwadi centers and residing in the study area for more than 6 months, were included in the study along with their mothers.

Lakhan Majra block is located at 29° latitude and 76° longitudes. The population of block was 1,06,935 as on March 31, 2014 (according to annual household survey conducted by multipurpose health workers serving in the area). All the villages of the block are being covered under Integrated Child Development Services (ICDS) Scheme. Each anganwadi under this scheme covers a population of 8001000. Active support and help of health workers and anganwadi workers were taken in contacting and motivating the study population which made them more cooperative and the non-responders were minimized.

The sample size for present study was calculated as 550 by considering the prevalence of underweight among under-five children in rural areas of Haryana as 41% approximately as per National Family Health Survey-3, 20052006, with confidence level of 95% and 10% relative allowable error by applying the following formula: $n=(Z^{1a/2})^2 \times p\,(1p)/d^2$; where Z = standard normal variate for level of significance [at 5% type I error ($P < 0.05$), $Z = 1.96$ for 2-sided test], a = level of significance (0.05), P = prevalence (proportion- 41%), d = relative allowable error (10%), n = sample size. Although the calculated

sample size came out to be 550, but a sample of 600 study participants was included for the study.[12]

All 112 anganwadi centere in block Lakhan Majra were enlisted. Out of these 112 anganwadi centres, 30 anganwadi centres were selected by adopting systematic random sampling procedure giving due representation to study area. Prior permission of District Programme Officer (DPO), Rohtak, was obtained after explaining the aims and objective of study to involve respective anganwadi centers.

From each selected anganwadi centre a list of 1-5 years of age children was prepared using anganawadi registers and 20 children were selected by simple random sampling from the prepared list. Thus, a sample of 600 children was included in the study. In case, the desired number of study subjects was not available in any anganwadi area, subsequent anganwadi population was included in the study.

Study tools

Data were collected from children's mother on pre-designed, pre-tested, and semi-structured schedule by the interview technique by the investigator himself. The investigator conducted house-to-house visits, contacted the mother and children; informed written consent was taken from all the mothers before initiating the interview and mothers were explained the purpose of the study. They were ensured of full confidentiality and privacy during study.

A pilot study was done in 50 children in the age group of 1-5 years to test the feasibility of the survey and reliability of schedule. The schedule covered demographic information, breastfeeding practices, socio-cultural and economic factors, and anthropometric data. After taking preliminary information at the child's home, children were called at the anganwadi centers along with their mother and were subjected to anthropometric measurements. Those houses found locked or any child not found at three consecutive home visits at an interval of one week apart were labeled as non-responders and excluded from study; and for the replacement of non-responders, simple random sampling was done on the remaining children of the corresponding anganwadi centers.

Socioeconomic status of study population was assessed using UdaiPareek socioeconomic scale (SES) for rural areas.Weight was measured by calibrated Salter's weighing scale with minimum clothing and without shoes. Height was measured by Stadiometer. Recumbent length was measured using an Infantometer in the case of children less than the age of 2 years or child length less than 85 cm (NCHS) or 87 cm (WHO) and for children who cannot stand.[13]

Mothers were advised regarding food practices and their queries were answered. The subjects who were found to have the disease which cannot be controlled at the peripheral level were referred to PGIMS, Rohtak for further intervention to benefit the subject on ethical grounds, though it was not a part of the study.

Statistical methods

Collected data were entered in the MS Excel spreadsheet, coded appropriately and later cleaned for any possible errors. Analysis was carried out using SPSS (Statistical Package for Social Studies) for Windows version 20.0. During data cleaning, more variables were created so as to facilitate association of variables. Clear values for various outcomes were determined before running frequency tests.

The Z-score value-based WHO Child Growth Standards (2006) as an indicator of nutritional status of children was calculated individually using WHO Anthro software (version 3.2.2, 2011).[14,15] Categorical data were presented as percentages (%). Pearson's Chi square test was used to evaluate differences between groups for categorized variables. All tests were performed at a 5% level of significance; thus, an association was significant if the *P* value was less than 0.05. Confidentiality of the data pertaining to study subject was maintained.

Results

In present study the prevalence of wasting was 18.4% (moderate wasting being 12.7% and severe wasting being 5.7%). The prevalence of underweight was 38.3% (moderate underweight being 27.1% and severe underweight being 11.2%). The prevalence of stunting was 41.3% (21.0% were moderately stunted and 20.3% were severely stunted). Prevalence of wasting among boys and girls was 19.0% and 17.5%, respectively; prevalence of underweight among boys and girls was 36.8% and 40.3%, respectively; prevalence of stunting among boys and girls was 39.2% and 44.2%, respectively.

Table 1 shows inverse relation between prevalence of undernutrition and educational status of mother; also, mothers who had 4 or more ANC visits, had lower percentages of children with wasting (11.4%), stunting (29.2%), and underweight (30.1%). Similarly, it was observed that as the IFA during pregnancy intake increases, there is decrease in the prevalence of under-nutrition. Prevalence of undernutrition (except wasting) was statistically significantly higher in children who were delivered at home in comparison to those born at institution.

Table 2 depicted that children with higher birth order (3 or more) and with low birth weight were having higher percentages of wasting, stunting, and underweight. The prevalence of wasting (20.9%), stunting (49.2%), and underweight (44.2%) was much higher among the children who were fed with pre-lacteals at the time of birth. It was also observed that exclusive breast feeding had a protective role against undernutrition it was statistically significant.

From Table 3, it can be clearly made out that the children in whom the complimentary feedings were started in between 6 and

Table 1: Association between nutritional status of children and mother education and antenatal care

Characteristics	Wasting		Stunting		Underweight	
	Yes (*n*=110)	No (*n*=490)	Yes (*n*=248)	No (*n*=352)	Yes (*n*=230)	No (*n*=370)
	Frequency (%)		Frequency (%)		Frequency (%)	
Mother's education						
Illiterate (*n*=151)	31(20.5)	120 (70.5)	89 (58.9)	62 (41.1)	77 (51.0)	74 (49.0)
Primary and middle school (*n*=240)	48 (20.0)	192 (80.0)	95 (39.6)	145 (60.4)	95 (39.6)	145 (60.4)
High and senior secondary school (*n*=139)	22 (15.8)	117 (74.2)	42 (30.2)	97 (69.8)	45 (32.4)	94 (67.6)
Graduate, Diploma and above (*n*=70)	9 (12.9)	61 (87.1)	22 (31.4)	48 (68.6)	13 (18.6)	57 (81.4)
Test of significance	χ^2=2.926, df=3, *p*=0.405		χ^2=29.525, df=3, *p*=0.000		χ^2=24.049, df=3, *p*=0.000	
ANC visits						
0-3 (*n*=364)	83 (22.8)	281 (77.2)	179 (49.2)	185 (50.8)	159 (43.7)	205 (56.3)
4 or more (*n*=236)	27 (11.4)	209 (88.6)	69 (29.2)	167 (70.8)	71 (30.1)	165 (69.9)
Test of significance	χ^2=12.344, df=1, *p*=0.000		χ^2=23.472, df=1, *p*=0.000		χ^2=11.197, df=1, *p*=0.001	
IFA tablet/syrup intake (in Days)						
None (*n*=197)	59 (29.9)	138 (70.1)	126 (64.0)	71 (36.0)	118 (59.6)	79 (40.4)
150 (*n*=140)	33 (23.6)	107 (76.4)	78 (55.5)	62 (44.5)	76 (54.1)	64 (45.9)
51100 (*n*=36)	8 (22.2)	28 (77.8)	14 (38.3)	22 (61.7)	10 (27.8)	26 (72.2)
>100 (*n*=227)	10 (4.4)	217 (95.6)	30 (13.2)	197 (86.8)	26 (11.5)	201 (88.5)
Test of significance	χ^2=50.950, df=3, *p*=0.000		χ^2=127.965, df=3, *p*=0.000		χ^2=59.1, df=3, *p*=0.000	
Place of delivery						
Institution (*n*=449)	76 (16.9)	373 (83.1)	165 (36.7)	284 (63.3)	157 (35.0)	292 (65.0)
Home (*n*=151)	34 (22.5)	117 (77.5)	83 (55.0)	68 (45.0)	73 (48.3)	78 (51.7)
Test of significance	χ^2=2.358, df=1, *p*=0.125		χ^2=15.467, df=1, *p*=0.000		χ^2=8.555, df=1, *p*=0.003	

Table 2: Association between nutritional status of children and birth characteristics

Characteristics	Wasting		Stunting		Underweight	
	Yes (*n*=110)	No (*n*=490)	Yes (*n*=248)	No (*n*=352)	Yes (*n*=230)	No (*n*=370)
	Frequency (%)		Frequency (%)		Frequency (%)	
Birth order						
1-2 (*n*=485)	85 (17.5)	400 (82.5)	195 (40.2)	290 (59.8)	173 (35.7)	312 (64.3)
3 or more (*n*=115)	25 (21.7)	90 (88.3)	53 (46.1)	62 (53.9)	57 (49.6)	58 (50.4)
Test of significance	χ^2=1.1, df=1, *p*=0.294		χ^2=1.326, df=1, *p*=0.250		χ^2=7.593, df=1, *p*=0.006	
Pre-lacteal feeds given						
Yes (*n*=364)	76 (20.9)	288 (79.1)	179 (49.2)	185 (50.8)	161 (44.2)	203 (55.8)
No (*n*=236)	34 (14.4)	202 (85.6)	69 (29.2)	167 (70.8)	69 (29.2)	167 (70.8)
Test of significance	χ^2=4.006, df=1, *p*=0.045		χ^2=23.472, df=1, *p*=0.000		χ^2=13.616, df=1, p=0.001	
Exclusive breast feeding (for 6 months)						
Yes (*n*=384)	58(15.1)	326 (84.9)	130 (33.8)	254 (66.2)	118 (30.7)	266 (69.3)
No* (*n*=204)	50 (24.5)	154 (75.5)	111 (54.4)	93 (45.6)	107 (52.4)	97 (47.6)
Test of significance	χ^2=7.866, df=1, *p*=0.005		χ^2=23.343, df=1, *p*=0.000		χ^2=26.673, df=1, *p*=0.000	
Birth weight*	**Yes (*n*=90)**	**No (*n*=410)**	**Yes (*n*=187)**	**No (*n*=313)**	**Yes (*n*=176)**	**No (*n*=324)**
<2.5 kg (*n*=138)	46 (33.2)	92 (66.8)	77 (55.7)	61 (44.3)	70 (50.7)	68 (49.3)
>2.5 kg (*n*=362)	44 (12.1)	318 (87.9)	110 (30.3)	252 (69.7)	106 (29.2)	256 (70.8)
Test of significance	χ^2=30.554, df=1, *p*=0.000		χ^2=27.236, df=1, *p*=0.000		χ^2=20.122, df=1, *p*=0.000	

(Figures in parentheses show percentages). *100 mothers were unaware of their children weight

9 months of age had the lowest percentage of wasting (14.8%), stunting (35.9%), and underweight (31.7%). Similarly, it was observed that children who were bottle fed had higher prevalence of wasting stunting and underweight. While taking the age of introduction of bottle feeding into consideration, it was observed that earlier the age of introduction of bottle feeding among infants, there was more percentages of children having poor nutritional status.

Discussion

In our study wasting, stunting, and underweight rates declined in children as there was advance in the educational status of mothers. Educated mother understands the growth needs of child, and actively seeks nutritional advice and counseling. Similar studies by Hasan *et al.*, Dabar *et al.*, and Devi *et al.*, have shown that children of mothers with secondary or higher education

Table 3: Association between nutritional status of children and complimentary feeding and bottle feeding

Complimentary feeding introduction age (months)	Wasting		Stunting		Underweight	
	Yes (*n*=108)	No (*n*=480)	Yes (*n*=241)	No (*n*=347)	Yes (*n*=225)	No (*n*=363)
	Frequency (%)		Frequency (%)		Frequency (%)	
1-6 (*n*=204) *	47 (23.0)	169 (77.0)	99 (48.5)	117 (51.5)	96 (47.0)	108 (43.0)
6-9 (*n*=356)	53 (14.8)	303 (85.2)	128 (35.9)	228 (64.1)	113 (31.7)	243 (67.5)
>9 (*n*=28)	8 (28.6)	20 (71.4)	14 (50.0)	14 (50.0)	16 (57.1)	12 (42.9)
Test of significance	χ^2=6.52, df=2, *p*=0.038		χ^2=6.64, df=2, *p*=0.036		χ^2=17.301, df=2, *p*=0.000	
Bottle fed	**Wasting**		**Stunting**		**Underweight**	
	Yes (*n*=110)	No (*n*=490)	Yes (*n*=248)	No (*n*=352)	Yes (*n*=230)	No (*n*=370)
	Frequency (%)		Frequency (%)		Frequency (%)	
Yes (*n*=230)	64 (27.8)	166 (72.2)	126 (54.8)	104 (45.2)	129 (56.1)	101 (43.9)
No (*n*=370)	46 (12.4)	324 (87.6)	122 (33.0)	248 (67.0)	101 (27.3)	269 (72.7)
Test of significance	χ^2=22.448, df=1, *p*=0.000		χ^2=27.822, df=1, *p*=0.000		χ^2=49.731, df=1, *p*=0.000	
Initiation of bottle feeding (months)**	**Wasting**		**Stunting**		**Underweight**	
	Yes (*n*=64)	No (*n*=166)	Yes (*n*=126)	No (*n*=104)	Yes (*n*=129)	No (*n*=101)
	Frequency (%)		Frequency (%)		Frequency (%)	
0-6 (*n*=88)	29 (33.0)	59 (67.0)	55 (62.5)	33 (37.5)	63 (71.6)	25 (28.4)
6-12 (*n*=120)	32 (26.7)	88 (73.3)	64 (53.3)	56 (46.7)	63 (52.5)	57 (47.5)
>12 (*n*=22)	3 (13.6)	19 (86.4)	7 (31.8)	15 (68.2)	3 (13.6)	19 (86.4)
Test of significance	χ^2=3.438, df=2, *p*=0.179		χ^2=6.901, df=2, *p*=0.032		χ^2=25.312, df=2, *p*=0.000	

(Figures in parentheses show percentages).*Excludes 12 children who were not breast fed.**370 children not bottle fed.

were at lower risk of childhood malnutrition when compared with children of mothers with no education.[16-18]

In our study mothers who had ANC visits 4 or more had lower percent of children with as compared to mothers who had 3 or less ANC visits. The study of Bhavsar *et al.*, showed that ANC visits were significantly associated with malnutrition status of children. From above findings, it can be concluded that appropriate number of the ANC visits are associated with the better health status of the child because on ANC visits the mother is actively provided nutritional counseling and education with special emphasis on sufficient weight gain and adequate dietary intake during pregnancy.[19]

Similarly, it was observed in our study that mothers who had adequate IFA intake during pregnancy had the lowest prevalence of children with wasting, stunting, and underweight than mothers who did not consumed IFA. IFA intake during pregnancy decreases the chance of being low birth weight because it increases the maternal blood hemoglobin which provides adequate oxygenation to fetal tissues to encourage normal fetal growth.[6]

While taking children birth weight into consideration, it was observed in present study that wasting, stunting, and underweight rates were higher among children who had history of LBW as compared to children with normal birth weight. HUNGaMA survey showed the prevalence of underweight among children with low birth weight as 49.9% while that among children with a normal weight was 33.5%. Odds ratio calculated to observe the association between low birth weight and undernutrition in the studies of David *et al.*, and Basit *et al.*, was 10.8 (95% CI: 4.5325.64.), and 5.55 (95% CI: 1.9915.43), respectively.[20-22]

In present study children with higher birth order (three or more) or children belonging to a family size of three or more, had higher prevalence of wasting, stunting, and underweight. Similar findings were observed in studies of Dabar *et al.* and Hoq *et al.*, where higher birth order was significantly associated with malnutrition. As the family size increases there is division of resources (dietary resources), overcrowding, and poor care of children which increases the chances of children to suffer from undernutrition.[17,23]

In present study the prevalence of wasting, stunting, and underweight was higher among the children who were fed with pre-lacteals during their infancy as compared to children who were not fed with pre-lacteals feeds and this difference was statistically significant. Gupta *et al.*, calculated OR as 0.6 for children who had no history of pre-lacteal feeding and undernourished and Devi *et al.*, showed that odds of malnutrition were more among children who were given pre-lacteals ($P < 0.05$). Giving pre-lacteal feed is a deep-rooted custom in India, as is evident in a plethora of studies. Pre-lacteal feeds are given because it is believed that they act as laxatives or as a means of clearing the meconium. Unfortunately, the mothers are not aware that the pre-lacteal feeds can be a source of contamination. Honey, which was used as pre-lacteal food among infants, is now not recommended below the age of 1 year because of the risk of infection by *Clostridium botulinum*.[18,24]

While taking exclusive breast feeding into consideration, it was observed in the present study that the prevalence of wasting, stunting, and underweight was significantly lower among children who were exclusively breast fed than children who were

not exclusively breast fed. A higher odd of being undernourished if children were not exclusively breast fed compared to the children who were exclusively breast fed was observed in studies of David *et al.*, (OR: 6.27) and Dodos *et al.* (OR: 1.9). An important correlate of child nutritional status is nutrient intake, which in turn depends on the nature and duration of feeding (including breastfeeding) practices. Feeding practices are especially critical during the first few days and months of an infant's life, since growth is faster and protection against illnesses and infections is most needed during this crucial period. Ideally, a baby should be put to the mother's breast immediately after birth.[21,25]

In our study wasting, stunting, and underweight prevalence was higher among children where complimentary feeding was initiated at an early stage of infancy, that is, <6 months of age. Premature introduction of foods other than breast milk greatly increases the risk of infection in the small infant, and this sets in motion the process of malnutrition. It also puts the infant at greater risk of malnutrition, since weaning diets are often inadequate in India.

It was observed in present study that children who were bottle fed had higher prevalence of wasting, stunting and underweight in contrast to children who were not bottle fed, that is, wasting, stunting and underweight and similar association was observed in study of Singhal *et al.*, where bottle feeding rate was higher among children with malnutrition. Bottle feeding is a source for gastrointestinal infections which leads to macro and micronutrient deficiency.[26]

Conlcusion

In our study, the Lakhan Majra Block acted as sentinel site and it was revealed that underweight and stunting rates were falling in very high prevalence category and wasting rate was in critical category according to WHO prevalence cut-off values for the public health significance. Every endeavor should be made to combat the outcomes of undernutrition through multipronged approach such as growth monitoring, nutritional supplementation, and nutritional rehabilitation, early diagnosis and treatment of morbidity, also present study findings reinforce the importance of proper infant and child feeding practices, appropriate maternal care, and female literacy in prevention of childhood undernutrition; and all these in the long run will improve the nutrition status of children.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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