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Malnutrition and associated factors among rural children between 1 to 3 years of age residing in Saharanpur district, Uttar Pradesh, India

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Abstract

In the world, malnutrition is a leading communal health problem at the childhood stage. It is a dramatic indicator of poor socio-economic status. Developing countries are highly affected by malnutrition. The purpose of the present study is to assess the incidence of malnutrition amongst the children belonging to rural areas of the Saharanpur district, Uttar Pradesh, aged 1-3 years, and its association with socio-demographic factors. About 800 children were involved in the present cross-sectional investigation, using multi-stage sampling. The socio-demographic shreds of evidence were collected using a self and well-structured questionnaire. Children were screened using anthropometric measurements. The WHO Anthro Plus 1.0.4 software was used to convert the weight, height, and age (months) of children into height-for-age (stunted), weight-for-age (underweight), and weight-for-height (wasted). The statistical significance was declared at a p-value <0.05 with 95% confidence intervals in the final model. The overall prevalence of malnutrition was 39.7; 14%, 21%, and 4.7% being the prevalence of underweight, stunted, and wasted children, respectively. No significant association was found between gender and anthropometric indices (underweight, stunted, and wasted) of children. Malnutrition was high among rural children aged 1-3 years in Saharanpur. The factor affecting underweight was age, while the educational status and occupation of mothers, fathers' occupation, children's age, and caste were the factors affecting stunting. Factors affecting wasting were the educational status and occupation of mothers, fathers' educational status and occupation, and caste.

Keywords: Anthropometric measurements, Malnutrition, Nutritional assessment, Prevalence, Stunting, Undernutrition, Wasting

Introduction

A child's health and status of nutrition serve as an index of national investment for its future manpower development. The consequences of child malnutrition are enormous and intertwined with the development of society. Malnutrition affects the child's growth, both physical and cognitive and vulnerability to infections and severity of diseases is increased while having adverse implications on social and economic growth indirectly. Preschoolers are included in the most susceptible group of any community. Children's health is sensitively indicated by their nutritional status. Childhood growth is utilized as an indicator of adequate health, nutritional

status, and development of a child worldwide. Chronic undernutrition results in serious health impairment that leads to reduced quality of life (Renuka et al, 2011).

It is currently recognized as a prevalent health-related problem worldwide. As a matter of fact, malnutrition makes children susceptible for the whole lifetime to adverse and permanent impairment in the body. It is related to the above 41% of deaths occurring every year in developing countries in 6 to 24 months aged children which total around 2.3 million. World Health Organization (WHO) has reported that 54% of overall childhood deaths to have a direct or indirect association with malnutrition (Akorede and Abiola, 2013). Auspiciously, a decreasing tendency of severe acute malnutrition could seem in India (Deaton and Dréze, 2009). Nevertheless, moderate malnutrition remains ubiquitous. As per National Family Health Survey (NFHS-5, 2019-21), prevalence of "stunting (length for age < -2 SD), wasting (weight for length < -2 SD) and underweight (weight for age < -2 SD) is 35%, 19.3% and 32%" respectively under five years children.

Causes of malnutrition are diverse with faulty feeding as the most common cause (WHO and UNICEF, 2009). Appropriate knowledge about exclusive breastfeeding and complementary feeding is essential, especially in mothers and this depends largely on the status of education of a mother and a family's socioeconomic status. Educational awareness and information pertaining to the feeding of infants and taboos about feeding in mothers play a significant role against malnutrition. Rural mothers are usually less educated, have lower socioeconomic status and face difficulty in retrieving information related to breastfeeding when compared to urban mothers (Ashwini et al, 2016).

Optimum feeding practices for infant comprises introducing breastfeeding within the 60 min of birth, special breastfeeding for the early six months, and continued breastfeeding for 2 years along with proper complementary feeding. According to the national data, in Uttar Pradesh, only 46 percent of 6-9 months old children consume solid/semi-solid foods in addition to breast milk **(**Gupta et al, 2015). Advancement in the improvement of "Infant and Young Child Feeding" (IYCF) practices in the developing world has shown to be extremely slow due to numerous factors including poverty and deprived conditions related to hygiene (Park, 2011). Saharanpur, a resource-poor district of one of the backward states (UP) of India has hardly received attention from a nutritional viewpoint. Rural areas are the repository of illiteracy, poverty, child morbidity and mortality. The present investigation was undertaken to evaluate the nourishing status of 1-3 years old rural children and evaluate the proportion of malnourished children.

Materials and Methods

Study area and population: This was a cross-sectional community-based study conducted from January 2019 to October 2020. To determine the sample size, Slovin's formula (Galero-Tejero, 2011) was used. All the children boys and girls of age 1-3 years were the source population. Multi-stage sampling was used to select 800 children from 18 anganwadis of Muzaffarabad block of Saharanpur district, Uttar Pradesh, India, aged 1-3 years including both boys (n=428) and girls (n=372). Children who were registered in anganwadis and aged 1-3 years were included in the study, while children with any malformations or deformities and having any congenital or metabolic disease influencing the growth were excluded.

Data collection: Approval was taken from Data Protection Officer (D.P.O), Vikas Bhawan, Uttar Pradesh. The information regarding children was collected by written consent form of children mothers. The data on the socio-demographic profile of children including age, sex, religion, caste, type of family, number of family members, educational status of parents, their occupation, family income, etc was collected using a well-designed and pretested questionnaire. The questionnaire and consent form were organized in Hindi language and then it was transformed into their native language during data collection by interview technique.

Measurements: Anthropometric measurements (height, weight and MUAC) were taken. Weight of the children aged 1-2 years was measured using a salter's spring balance and an electronic bathroom weighing scale was used for the children above 2 years. The scale was fixed at zero during all measurement. A stadiometer was used to measure the height of 1-2 year aged children and the initial reading was fixed at around 0.5 cm. In the case of less than 2 year aged children, an infantometer was used to measure the recumbent length (WHO, 2008). While taking measurements head, shoulder, buttocks and heels of the children were attached to the vertical surface. MUAC was taken with the help of fiberglass tape. This tape consists of 3 colors; red colour indicates severe acute malnutrition (<11.5 cm), the yellow colour indicates moderate acute malnutrition (11.5-12.5 cm) and the green colour indicates the normal nutritional status (> 12.5 cm) (Bergonzoli and Echeverri, 2019). For uniformity in clinical screening, prevalence-based data are usually reported by a cut-off value, often represented by less than -2 and greater than +2 Z- scores. The global WHO data based on child growth and malnutrition commonly uses a Z-score cut-off of less than minus two (<-2) SD to categorize low weight-for-age, low height-for-age and low weight-for-height as moderate, and less than minus three (<-3) SD to signify severe undernutrition. WHO Anthro Plus 1.0.4 software package was used to determine Z-scores or SD from the height and weight of the children (Blossner et al, 2009).

Data analysis: After collecting the information, all the data were transferred into a data sheet using SPSS. Then all data were classified, coded, and analyzed. Anthropometric data of the present study was analyzed using WHO AnthroPlus 1.0.4. Statistical measures like frequency, percentage, mean and standard deviation (SD) were applied to derive valuable conclusions where necessary. Frequency and percentage were calculated for the subjects concerning their demographic variables. The null hypothesis that there is no association between the socio-demographic characteristic of family and the nutritional status of aged 1-3 year children was tested. P-value < 0.05 was considered as significant. The Chi-square test was applied to evaluate the significant association between malnutrition and socio-demographic factors.

Results

Socio-demographic profile: Socio-demographic profile of the studied population is shown in the **figure 1**. The mean age of children was 23.58±7.01 months. All the subjected children (800) were from different age groups such as 1-2 year age (413, 51.6%) and 2-3 years age (387, 48.7 %) groups. Among all participants, 428 (53.5%) and 372 (46.5%) were males and females, respectively. Children were mostly from the Muslim community (n=420) and 378 were from the Hindu community. Most of the children belonged to the other backward classes (OBC). Around 64.5% of mothers were illiterate, 27% had an education of the primary level and the residual (8.5%) had a higher education level (intermediate and college). Around 51.5% of fathers were illiterate and only 12.7% were educated up to the secondary level. The majority (93%) of mothers were housewives, whereas, 50.5% of fathers were self-working and 15.6% were not working anywhere. A majority (64%) of children were living in a house divided into both *kaccha* and a well *pucca* house. Around 18.12% of children were living in the *pucca* house and 17.87% of children were in the *kaccha* house.

The maximum (67.2%) children were from the nuclear family, whereas, 24.1% of children were from joint families and only 8.6% of them were from extended family. More than half (53.7%) of the children were non-vegetarians, 37.5% were lacto-vegetarians and 8.7% were lacto ovo-vegetarians. Other data related to the mother's delivery were also collected like assistant at the time of delivery, place of delivery, frequency of breastfeeding in a day, and initiation of complementary feeding. The majority (87.2%) of mothers were assisted by doctors at the time of delivery, 11.2% were assisted by a literate midwife and 0.7% were assisted by an illiterate midwife. There were only a few (0.7%) who were assisted by relatives. There were 87.6% of mothers went to government hospitals for

delivery. The retrospective data on the frequency of breastfeeding in a day was collected and it was observed that 90.6% (n=725) mothers were breastfeeding upto 10 times in a day, 4.3% (n=35) were breastfeeding 11-12 times and 5% (n=40) mothers were breastfeeding 12 times and above in a day. The majority of mothers (98.8%) initiated complementary feeding at 6-12 months, 0.8% initiated it after one year and 0.2% initiated complementary feeding between 0-6 months.

The mean anthropometric measurements of subjects are shown by the **figure 2** and the observed results are depicted in **table 1**. The mean height, weight and MUAC of the subjects aged 1-2 years was 79.9 cm, 10.8 kg and 9.3 cm respectively, whereas, the mean height, weight and MUAC of the subjects aged 2-3 years were 87.5 cm, 12.5 kg and 9.4 cm respectively.

The study showed that out of total children aged 1-3 years, the mean height (cm) weight (kg) and MUAC (cm) children were 83.2±10.85, 11.56±1.84 and 9.3±3.21 cm. The prevalence of underweight, stunting and wasting in 1-3 years aged children was 14%, 21% and 4.7% respectively. Age-wise and gender-wise distribution of children according to nutritional status are shown by the figure 3 & 4.

Table 2 presents the age and gender-wise distribution of children according to nutritional status by SD classification. In the context of gender, there was no association with underweight ($\chi2$=0.99, p=0.75), stunting ($\chi2$=3.10, p=0.07), and wasting ($\chi2$=0.50, p=0.82). A significant association was observed for underweight ($\chi2$=42.30, p=0.00) and stunting ($\chi2$=37.15, p=0.00) with respect to age. It was observed that there was no substantial association of family type as well as family monthly income with stunted, wasted and underweight children. A statistically significant association of caste was observed with stunting ($\chi2$=20.91, p=0.00) and wasting ($\chi2$=15.84, p=0.00).

In the present study, a significant association of education of mother was observed with stunted and wasted children ($\chi2$= 6.09, p=0.01, $\chi2$= 12.87, p=0.01) respectively. Underweight had no significant association (($\chi2$= 3.91, p=0.41) with the education of the mother. Stunted and wasted children was significantly associated with the occupation of mothers ($\chi2$=11.20, p=0.01, $\chi2$= 3.85, p=0.02), whereas underweight had no significant association ($\chi2$=6.78, p=0.079) with the occupation of mothers. This study also reveals that there was no significant association between stunted and underweight children and education of their fathers, but a significant association was observed between wasting ($\chi2$=9.82, p=0.04) and education of their father. Stunting ($\chi2$=8.34, p=0.00) and wasting ($\chi2$=10.44, p=0.01) were significantly associated with the father's occupation.

Table 3 shows the distribution of subjects based on MUAC classification. A significant association was observed between age and MUAC ($\chi2$=14.74, p=0.00), whereas, gender had no significant association with MUAC. Type of family and their monthly income had no significant association with MUAC, but a significant association was observed between caste ($\chi2$=141.29, p=0.00) and MUAC .The mother's's education and occupation were significantly associated with MUAC but no significant association was observed with father's education and occupation. Table 4 presents the relative risk from multinomial logistic regression for underweight, stunting and wasting by selected background characteristics. There was no association found between birth order, residence,and socio-economic status with underweight, stunting and wasting. No significance was observed with birth order, residence, socio-economic status, mother's educational status, place of delivery and birth weight.

Odds Ratio is a relative occurrence of an event or condition. If OR=1 the relative chances are equal, if OR > 1 the relative chances are greater, and if OR < 1 the relative chances are less. The OR value of children born in 3rd place indicates that there are 1.10 times more odds of becoming malnourished as compared to the children who were born in 4th place. Children residing in *Kuccha* house have 1.22 times more odds of becoming malnourished as compared to the children residing in *Pucca* house. The OR value

of mothers who were illiterate (1.68), in primary (2.14), intermediate (3.07) and higher school (3.78) have more odds of becoming malnourished as compared to mothers who have completed their college education.

Mothers who had home delivery were observed to be at higher odds of becoming malnourished as compared to mothers who delivered their babies at the government hospital. The odds ratio of Hindu and Muslim were very high which indicates very high odds of becoming malnourished as compared to Sikh.

Since age plays an important role in a child's growth the Odds Ratio are affected by age of the child. Therefore, OR have been adjusted for age and the Adjusted Odds Ratio are computed. Thus, the AOR denotes OR as if all children are of the same age.

Discussion

Most of the socio-demographic characteristics of the children align with the national and /or state data. In this study, 53.5% were boys and 46.5% girls that were randomly selected from students enrolled in anganwadis indicating a higher proportion of boys which is supported by the census (2011) data of sex ratio at birth being 940 females per 1000 males (national) and in Uttar Pradesh, there were 912 females per 1000 males (Chandramouli and General, 2011). In a study conducted by Singh et al (2016) among under 5 years of children in Uttar Pradesh, it was depicted that 56.2% of the subjects were boys and 43.8% were girls. Nearly half of the subjects (47.0%) belonged to the second born in the family and a small proportion of the total population (10.7%) were fourth born and beyond in the family. A similar study conducted among 1,783 children showed that 51.8% of the total subjects were second born in the family (Choudhary and Agarwal, 2019).

Going by the census (2011) data, 14.2% of Indians were muslims and 79.8% were hindus. Largely, the participants of this study were muslims, as this study was conducted in muslim dominated region. Prasot et al (2014) conducted a study in the rural area of Lucknow, Uttar Pradesh and revealed that 70.3% of participants were hindu. Uttar Pradesh is the highest populated state of India having 19.3% of muslim population with their proportion being high in Bahraich 33.5%, Balrampur (37.5%), Bareilly (34.5%), Bijnor (43.0%), Amroha (40.7%), Moradabad (47.1%), Rampur (50.5%), and Saharanpur 41.0% on the other hand, a previous study was done among 400 children (1-6 years) in rural areas of Lucknow, Uttar Pradesh, India revealed that nearly two-thirds (70.3%) of participants were Hindu while the rest were Muslim (Prasot et al, 2014).

Jain et al (2018) reported 5.8% prevalence of underweight whereas the national average of underweight, stunting and wasting in India (21.1%, 24.5% and 16.1%) reported by the Ministry of Health and Family Welfare (2015-16) is not closer to the prevalence observed in the current study.

Education is one of the most important resources through which women can provide appropriate care to their children. The education level of mothers has a significant impact on child feeding practices and subsequent nutritional status. Poor maternal education has been recognized as a major restraint to proper child care practices. (Tesfaye, 2009). The age of the children, the educational status of the mother were the factors that were independently associated with the children's nutritional status (Endris et al, 2017). Murarkar et al (2020) described maternal education as an important factor that affects malnutrition. The study showed that one of the risk factors of malnutrition is low maternal education in rural areas. An increase in maternal educational qualification results in a decrease in malnutrition. This was in line with the observations of our study. In the rural areas of developing countries, fathers are the major bread earners of society. Family's earnings potentially varied, depending upon the occupation of the male and female members of the family. An association with family income was there with malnutrition. The prevalence of malnutrition decreases significantly as family income increases (Mahgoub et al, 2006). These findings are in contrast with this study as in this study, it was observed that monthly income was not significantly associated with malnutrition. Apart from the above factors associated with malnutrition, other factors such as age, caste, fathers' educational status are all important determinants of malnutrition that need further

study to explore their association with malnutrition.

Conclusion

Malnutrition was high among rural children aged 1-3 years in Saharanpur, Uttar Pradesh. The nutritional status of children was not found satisfactory. The overall undernutrition was high. Gender was not significantly associated with malnutrition. Factor affecting underweight was age, while the educational status and occupation of mothers, fathers' occupation, children's age and caste were the factors affecting stunting. Factors affecting wasting were the educational status and occupation of mothers, father's educational status and occupation and caste. The results of this study can help the policymakers in supervising the anganwadi services and to motivate and awareness can be spread in people. The current study will help in revealing the critical areas of the nutritional status and determinants of malnutrition in Saharanpur, Uttar Pradesh, India.

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Conflict of Interest

The authors report no conflict of interest.

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Table 1: Mean anthropometric measurements of the subjects

Parameters	Mean±SD		All children
	Boys	Girls	
Height (cm)	84.0±9.57	82.2±12.11	83.2±10.85
Weight (kg)	11.6±11.67	11.5±1.83	11.5±1.84
MUAC (cm)	9.3±1.41	9.4±4.467	9.3±3.21

Table 2: Age-wise and gender-wise distribution of children according to nutritional status by SD classification

Underweight (Weight-for-Age)				
Age Group (Years)	**N**	**Severe (≤3SD)**	**Moderate (-3SD to-2SD)**	**Normal (≥ -2SD)**
		N(%)	N(%)	N(%)
1-2	451	22(4.9)	68(15.1)	361(80.0)
2-3	349	8(2.3)	15(4.3)	326(93.4)
Boys	428	16(3.7)	46(10.7)	366(85.5)
Girls	372	14(3.8)	37(9.9)	321(86.3)
Stunting (Height-for-Age)				
Age Group (Years)		**Severe (≤3SD)**	**Moderate (-3SD to-2SD)**	**Normal (≥ -2SD)**
		N(%)	N(%)	N(%)
1-2	451	30(6.7)	93(20.6)	328(72.7)
2-3	349	12(3.4)	33(9.5)	304(87.1)
Boys	428	23(5.3)	77(18.0)	328(76.6)
Girls	372	19(5.1)	49(13.2)	304(81.7)
Wasting (Weight-for-Height)				
Age Group (Years)		**Severe (≤3SD)**	**Moderate (-3SD to-2SD)**	**Normal (≥ -2SD)**
		N(%)	N(%)	N(%)
1-2	451	17(3.8)	10(2.2)	424(94.0)
2-3	349	8(2.3)	3(0.9)	338(96.8)

Boys	428	16(3.7)	5(1.2)	407(95.1)
Girls	372	9(2.4)	8(2.2)	355(95.4)

Table 3. Distribution of subjects based on MUAC classification

Underweight (Weight-for-age)			
Particulars	**Severe (≤3SD)**	**Moderate (-3SD to-2SD)**	**Normal (≥ -2SD)**
Normal (≥12.5 cm)	0(0.0)	3(8.8)	31(91.2)
MAM (11.5-12.5 cm)	2(5.4)	0(0.0)	35(94.6)
SAM (≤ 11.5 cm)	28(3.8)	80(11.0)	621(85.0)
Stunting (Height-for-age)			
Particulars	**Severe (≤3SD)**	**Moderate (-3SD to-2SD)**	**Normal (≥ -2SD)**
Normal (≥12.5 cm)	4(11.8)	8(23.5)	22(64.7)
MAM (11.5-12.5 cm)	3(8.1)	2(5.4)	32(86.5)
SAM (≤ 11.5 cm)	35(4.8)	116(15.9)	578(79.3)
Wasting (Weight-for-height)			
Particulars	**Severe (≤3SD)**	**Moderate (-3SD to-2SD)**	**Normal (≥ -2SD)**
Normal (≥12.5 cm)	1(2.9)	1(2.9)	32(94.1)
MAM (11.5-12.5 cm)	1(2.7)	1(2.7)	35(94.6)
SAM (≤ 11.5 cm)	22(3.2)	11(1.5)	295(95.3)

Table 4. Relative risk from multinomial logistic regression for stunting, underweight and wasting by selected background characteristics

Particulars	Weight-for-age (Underweight)		Height-for- age (Stunted		Weight-for-height (Wasted)	
	COR	AOR	COR	AOR	COR	AOR
	(95%CI)		(95%CI)		(95%CI)	
Residence						
Kuchha house	0.83 (0.41-1.66)	0.72 (0.34-1.49)	1.22 (0.64-2.31)	1.15 (0.59-2.22)	0.69 (0.23-2.05)	0.66 (0.22-1.98)
Kuchha/ Pucca house	0.81 (0.46-1.40)	0.68 (0.38-1.22)	1.46 (0.86-2.45)	1.35 (0.79-2.31)	0.45 (0.19-1.06)	0.41 (0.17-1.00)
Pucca	-		-		-	
Education of mothers						
Illiterate	0.76 (0.22-2.57)	1.02 (0.29-3.64)	1.68 (0.47-5.93)	1.34 (0.39-4.63)	0.38 (0.09-1.66)	0.43 (0.10-1.91)
Primary	1.00 (0.30-3.32)	1.25 (0.36-4.40)	2.14 (0.61-7.50)	1.78 (0.52-6.08)	0.48 (0.11-2.04)	0.12 (0.12-2.30)
Intermediate	0.79 (0.11-5.26)	1.00 (0.14-7.14)	3.07 (0.59-15.92)	2.54 (0.50-12.7)	0.96 (0.12-7.45)	1.06 (0.13-8.34)
High School	0.34 (0.05-2.15)	0.60 (0.09-4.01)	3.78 (0.88-16.27)	2.49 (0.60-10.36)	0.00 (0.00-0.00)	0.00 (0.00-0.00)
College	-		-		-	
Socioeconomic status (wealth index)						
Low (2-5)	0.42 (0.16-1.10)	0.39 (0.14-1.09)	0.48 (0.19-1.21)	0.39 (0.14-1.09)	0.62 (0.16-2.31)	0.64 (0.17-2.47)
Middle (6-9)	0.45 (0.16-1.23)	0.49 (0.17-1.42)	0.55 (0.21-1.45)	0.49 (0.17-1.42)	0.47 (0.11-1.95)	0.52 (0.12-2.25)
High (10-14)			-		-	
Place of delivery						
Own house	1.29 (0.73-2.28)	1.05 (0.58-1.90)	1.06 (0.63-1.76)	0.93 (0.55-1.57)	0.38 (0.91-1.64	0.34 (0.80-1.45)
Govt.hospital	-		-		-	-
Birth weight						
Low	1.44 (0.95-2.18)	1.59 (1.03-2.45)	0.98 (0.69-1.39)	1.03 (0.72-1.48)	1.02 (0.52-1.99)	1.09 (0.56-2.15
Normal	-		-		-	-

COR=Crude odds ratio, AOR=Adjusted odds ratio, CI=confidence interval, statistically significant ($p<0.05$)

Figure 1 Socio demographic profile of the studied population

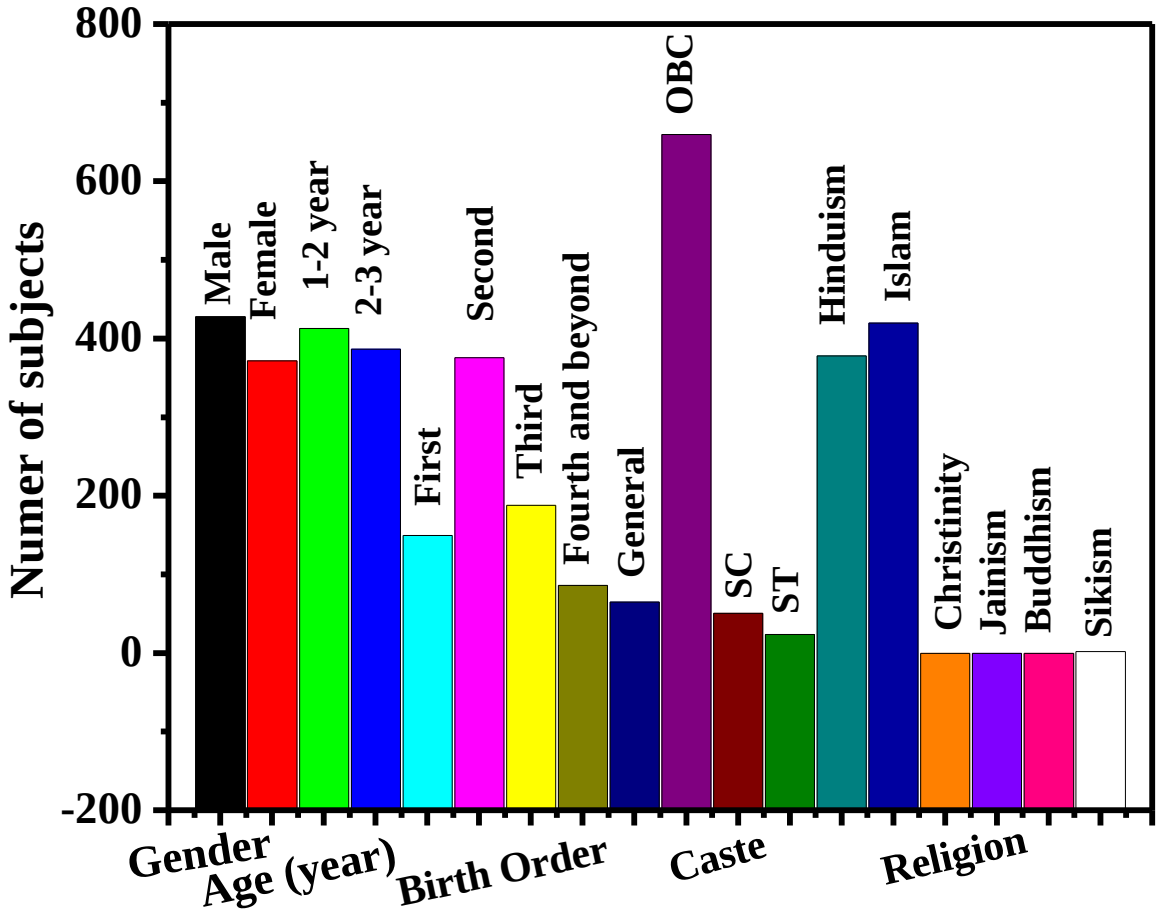

Figure 2 Mean anthropometric measurements of the subjects

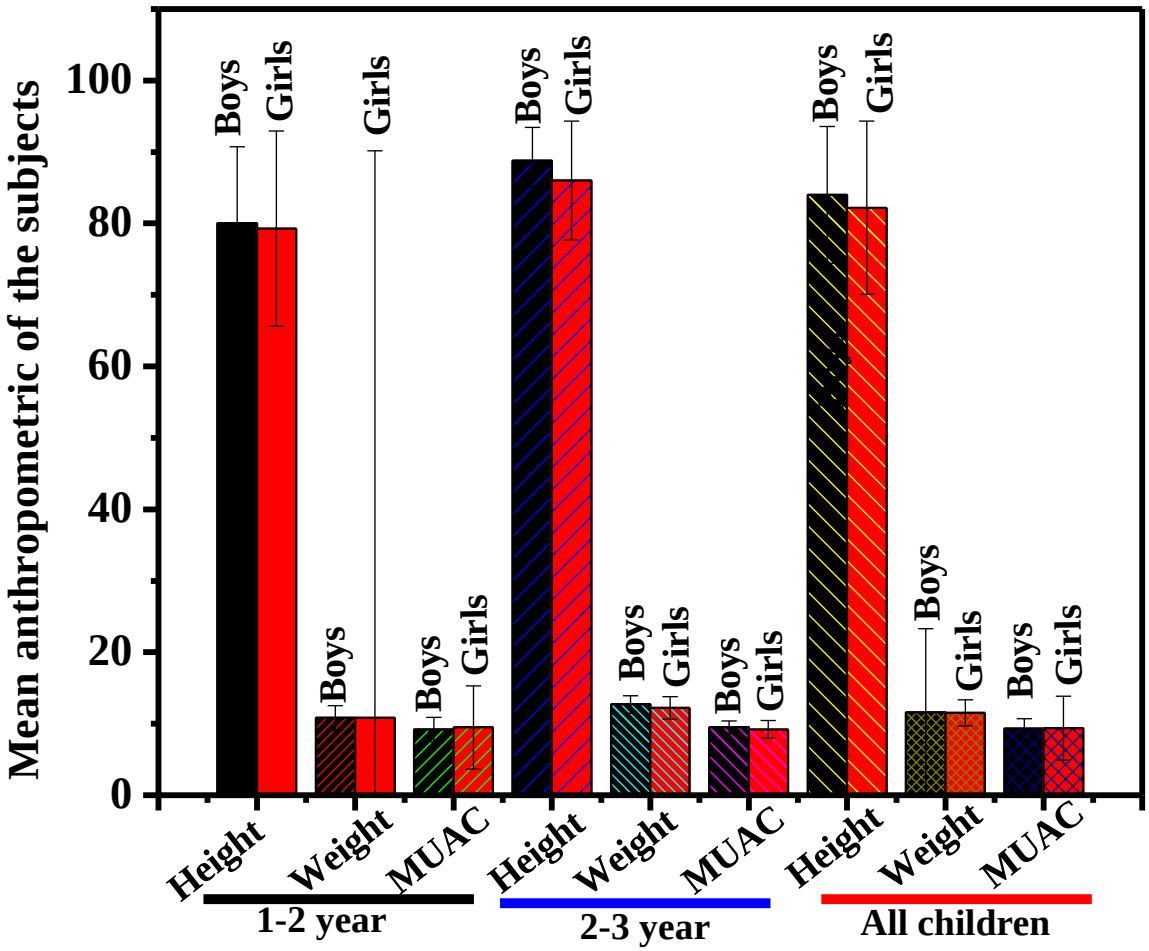

Figure 3 Age-wise distribution of children according to nutritional status

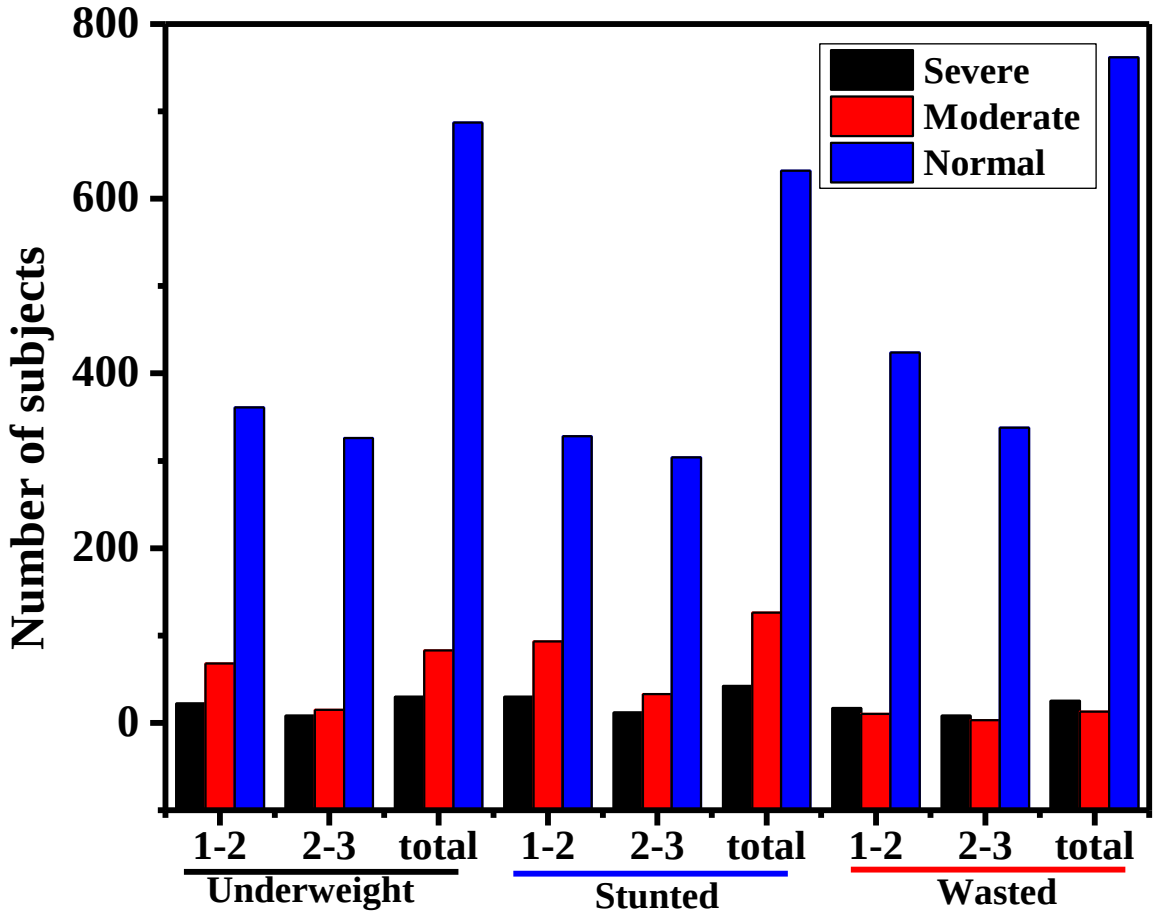

Figure 4 Gender wise distribution of children according to nutritional status