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Original Research Article

A Study of Nutritional Status of Children Aged 1 to 5 Years in Urban Field Practice Area of Darbhanga Medical College, Laheriasarai

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Abstract:

Background: Children's nutritional status assessment is an important tool for understanding the causes and consequences of malnutrition. The current study was carried out to examine the nutritional condition of children aged 1 to 5 years in the urban field practise area of Darbhanga Medical College, Bihar, India and to analyze the risk-factors associated with malnutrition.

Methods: From January 2021 to December 2022, a community based cross sectional research was done at the Urban Health Training Centre (UHTC) Bahadurpur, which is affiliated with Darbhanga Medical College and Hospital (DMCH) in Bihar, India. Total 224 children aged 1-5 years were randomly chosen, and study was initiated after taking a written consent from their parents. The anthropometric measurements were taken as per WHO standard. Children were examined for any dietary deficits and morbidities. The data was analyzed by the Chi square test using MS-Excel and SPSS version 20.0.

Results: The extent of malnutrition among children in terms of underweight, stunting, wasting and overweight was found to be 24.10%, 16.07%, 3.57% and 5.35% respectively. The study showed that underweight boys were higher than girls while stunting and wasting was maximum in girls as compared to boys.

Conclusions: Although malnutrition has reduced over time, it still horrifies the state and significantly depends on the socio-economic and behavioural state of the community.

Keywords: Malnutrition, Stunting, Underweight, Wasting, Overweight.

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Introduction

Children have the biggest risk of delayed physical growth, mental illness, and social developmental problem among people of all ages in any community. Appropriate psychomotor and behavioural development is the cornerstone of their healthy lifestyles, which eventually contributes to any nation's socioeconomic success [1]. A balanced food intake is an important predictor of a child's overall growth and development [2]. A child's growth and nutritional development are influenced by a country's economic, cultural, demographic, and climatic circumstances [3].

Malnutrition is one of the global health concerns and is detrimental to children's natural growth, lowering an individual's quality of life. It includes both under- as well as over- nutritional disorder[4]. Undernutrition is caused by a nutrient deficient diet and causes wasting (low weight-for-height), underweight (low weight-for-age), vitamin and mineral deficiencies, and stunted development (low height-for-age), whereas overnutrition is caused by a nutrient rich diet and causes obesity, over-weight, diet-related noncommunicable diseases (NCDs) such as diabetes mellitus, and heart disease. Anthropometry makes use of bodily measures such as weight, height, arm circumference, and waist circumference [5, 6].

The study on nutritional status in Indian children found 46.5% undernourished kids lived in Meghalaya, followed by 42.9% in Bihar and 20% in Puducherry [7]. According to the 2019-21 National Family Health Survey (NFHS-5) 36% of children were stunted, 19% had wasted growth, 32% were underweight, and 3% were overweight.

The majority of the youngsters from low-income illiterate families were malnourished [8, 9].

According to the Bihar Economic Survey 2019-20, 11% of the overall kid population lives in Bihar, with the majority of them living in rural regions. The overall number of stunted, wasting, and underweight children in Darbhanga district was 49%, 16.6%, and 41.1%, respectively [10, 11]. According to UNICEF, the main causes of the predominance of impoverished children in Bihar include poverty, a lack of essential services, a lack of sufficient infrastructure, and demographic inequities [12].

Children's nutritional status surveys are important for understanding the causes and consequences of malnutrition[13, 14]. The current study was carried out to examine the nutritional condition of children aged 1 to 5 years in the urban field practise area of Darbhanga Medical College's Department of Preventive and Social Medicine in Bihar, India. In addition, the study also focussed on the risk-factors associated and morbidities prevalent in children due to malnutrition.

Materials and Methods

Study Setting

A community-based cross-sectional study was conducted in urban area under Urban Health Training Centre (UHTC) Bahadurpur attached with Darbhanga Medical College and Hospital (DMCH), Bihar, India during January 2021 to December 2022.

Ethical permission was obtained from the ethical committee, DMCH. Children aged from 1 to 5years residing in the study area for >1 year were included in the study. An informed written consent was also received from the participants before initiating the study. Parents unwilling to participate or give consent for the present investigation and severely ill children were excluded.

Sample Size

Sample size (n) was determined by using the formula, n = (zα)2pq/d2; with39.2% under-nutrition, precision of 6.5%, error 5% and non-response rate of 4%, an optimum sample size for the proposed study was estimated to be224.

Total 224 kids aged 1 to 5 years were selected through systematic random sampling.

Data Collection

The data was collected using a semi-structured pre-tested questionnaire regarding socio-demographic and epidemiological parameters such as family size, immunisation history, birth history, birth weight, birth spacing, and feeding practises, among other things. Questions about the patient's medical history were asked, followed by a general, systemic. Anthropometric measurements and clinical examinations were also performed. Nutritional status and anthropometric indices were assessed using WHO and MUAC guidelines.

Data Analysis

MS-Excel and SPSS version 20.0 were used data analysis. Chi square test was employed to determine the statistical significance and p-value ≤0.05 was considered significant. The data is also presented as mean with standard deviation (SD) and percentage wherever required.

Results

Demographic and Socio-economic characteristics of the studied population

Characteristic of study population as per age and gender

Total 224 children of 1-5 years ages were selected to assess the nutritional state and estimate the prevalence of malnutrition in the studied area. Of these, 110 (49.11%) were male child and 114 (50.89%) were girl child. The mean±SDage of children was 34.48±13.87 months. Table 1 shows the distribution of children on the basis of age and sex. The data revealed female child were more than male. The distribution was however non-significant among studied population (p-value 0.8).

Table 1: Distribution of studied population as per their age and gender

Age-groups (months)	Male		Female		Total		p-value
	Frequency	%	Frequency	%	Frequency	%	
12-23	22	20	36	31.58	58	25.89	0.8
24-35	35	31.82	37	32.46	72	32.15	
36-47	30	27.27	17	14.91	47	20.98	
48-59	23	20.91	24	21.05	47	20.98	
Total	110	100	114	100	224	100	

p-value ≤ 0.05 was considered significant

Educational qualification of parents

The present data suggested that most of the parents (45% mother and 38% father) were high school passed. Almost 26% (58) each of mother and father had completed middle school. Total 8 mother (3.6%) mother and 16 father (7.14%) had qualified their intermediate exams. Only 1 mother and 6

father had completed graduate and above qualifications. Almost 25% mother (56) and 26.4% father (59) were illiterate (Figure 1).

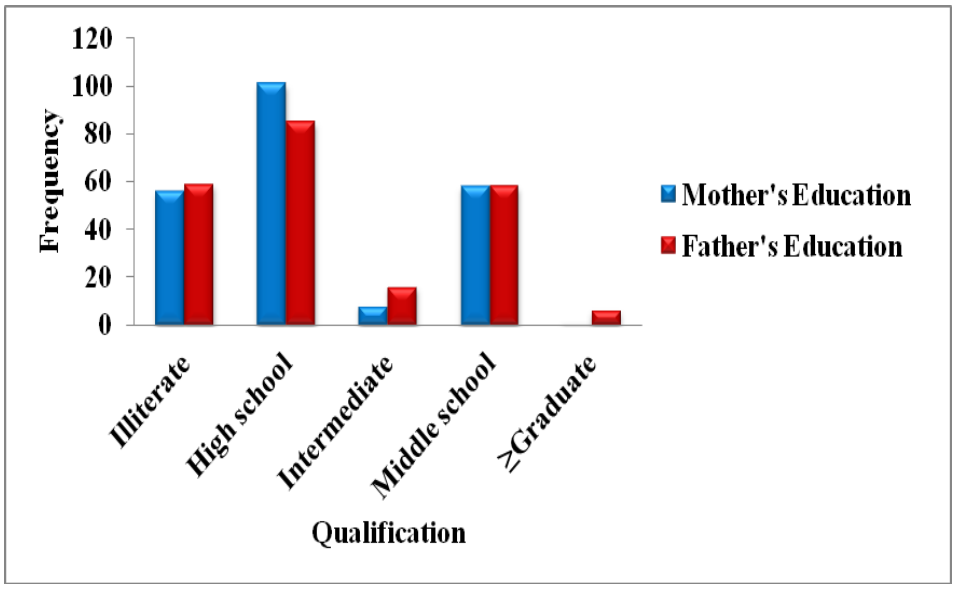

Figure 1: Educational status of mother and father

Occupational status of parents

The present findings revealed that almost 67% mothers (150) were unemployed, whereas only 2.7% fathers (6) were unemployed. 128 fathers (57.14%) were semi-skilled, 6 (2.7%) were clerk, 2.23% (5) were professionals and 5.35% (12) had shops; however none of the mothers were found in these groups (Figure 3). On the other hand, 26 (11.16%) and 21 (9.38%) fathers were skilled worker and unskilled worker respectively while 25 mothers (10.27%) were skilled worker and 35 (15.62%) mothers were unskilled worker (Figure 2)

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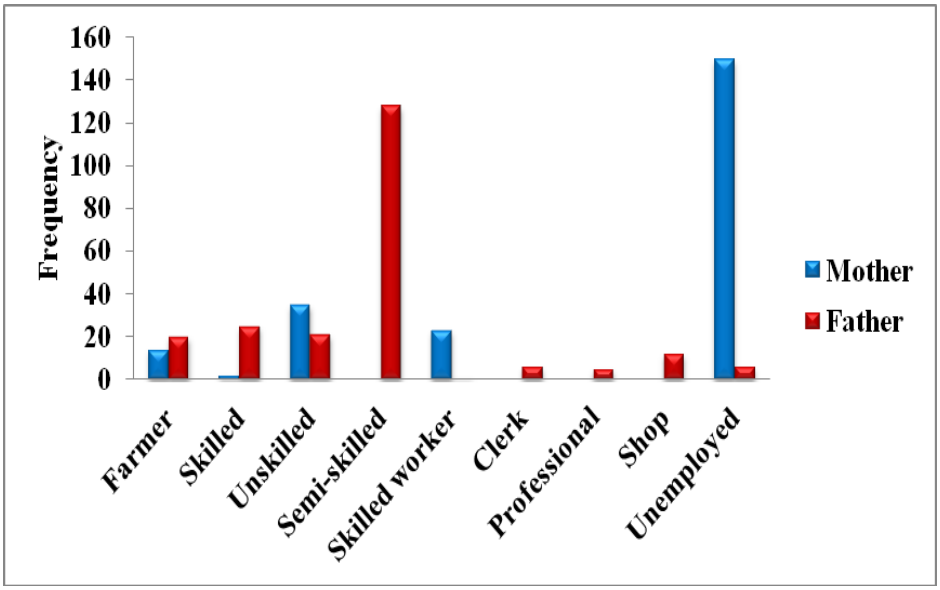

Figure 2: Occupation of children's mother and father

Socio-economic status and type of family in which children reside

The socio-economic status of the family was investigated and it was found that almost 150 families (67%) belonged to class IV, 51 (23%) to class III and only 23 (10%) were in class II group socio-economic group (Figure 3 a). Figure 3 b shows that most of families were of joint type (126, 56%) followed by nuclear family (80, 36%). Only 18 families (8%) were residing with 3-generations together.

Place of birth and birth-order of children

The data revealed that only 42 (18.75%) children were born at home and majority of children 182 (81.25%) were delivered in hospital (Figure 3 c).

The order of birth was investigated among studied population. It was found that 75 (33.48%) and 88 (39.28%) children were first and second child respectively. 46 (20.53%) of them were 3rd child and 14 (6.25%) were fifth. Only 1 (0.44%) was 4th child (Figure 3 d).

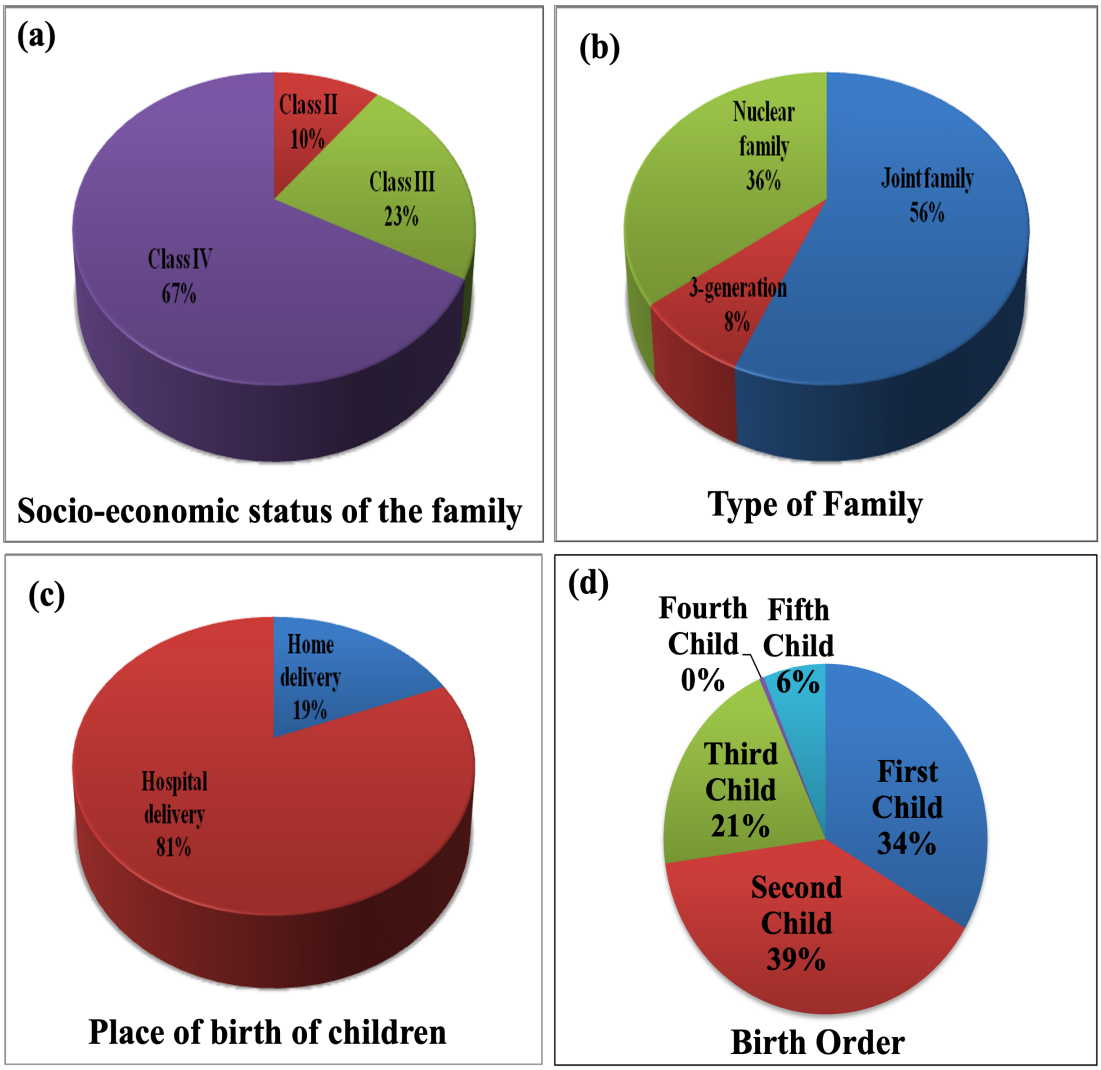

Figure 3: Illustration of (a) Socio-economic status of the family, (b) Type of family, (c) Birth place, and (d) Birth-order of children

Birth weight and immunization status

Majority of children (72.76%) had >2.5 Kg weight at the time of birth and only 27% were week, had <2.5 Kg weight (Table 2).

Most of the children (93%) were fully immunized as per their age and 6.7% were partially immunized (Table 2).

Table 2: Birth weight and immunization

Birth weight (Kg)	**Frequency**	**Percentage**
2-2.4	61	27.23
2.5-2.9	139	62.05
3-3.4	24	10.71
Immunization of children		
Fully immunized for age	209	93.30
Partial immunization	15	6.70

Interval between children

About 86 (38.39%) children were born after 2 years gap. Of 224 children, 75 (33.5%) of them were first child. 29 (12.95%) were born after a year gap, 24 (10.71%) after 3years gap and 10 (4.46%) were after 4 years gap (Figure 4).

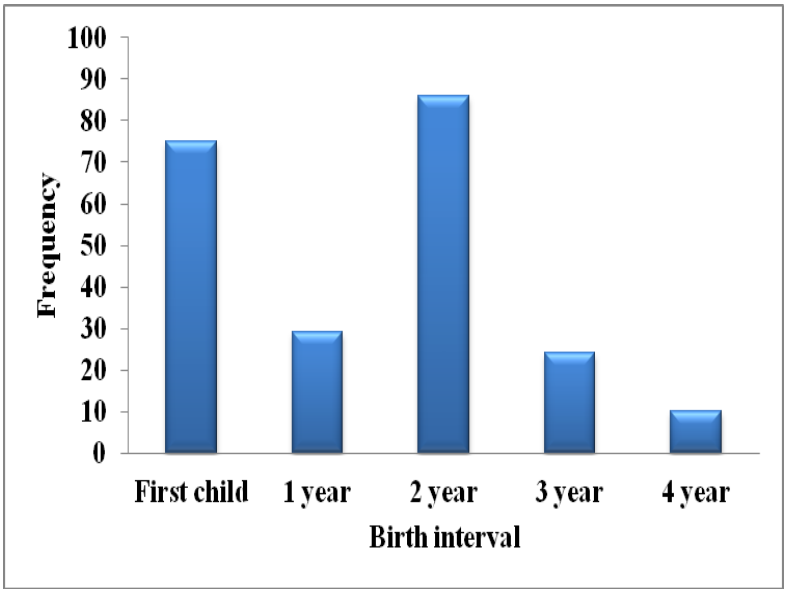

Figure 4: Birth spacing between child

Method of cooking and complementary feeding after 6 months

It was estimated that majority of households (140) used traditional chulha producing smoke whereas only 84 households used smokeless chulha for cooking (Figure 5 a).

The study found that most of the children (183) were given complementary food in te form of semi-solids or solids after 6 months; however, 41 (18%) children were not complementary feeded (Figure 5 b).

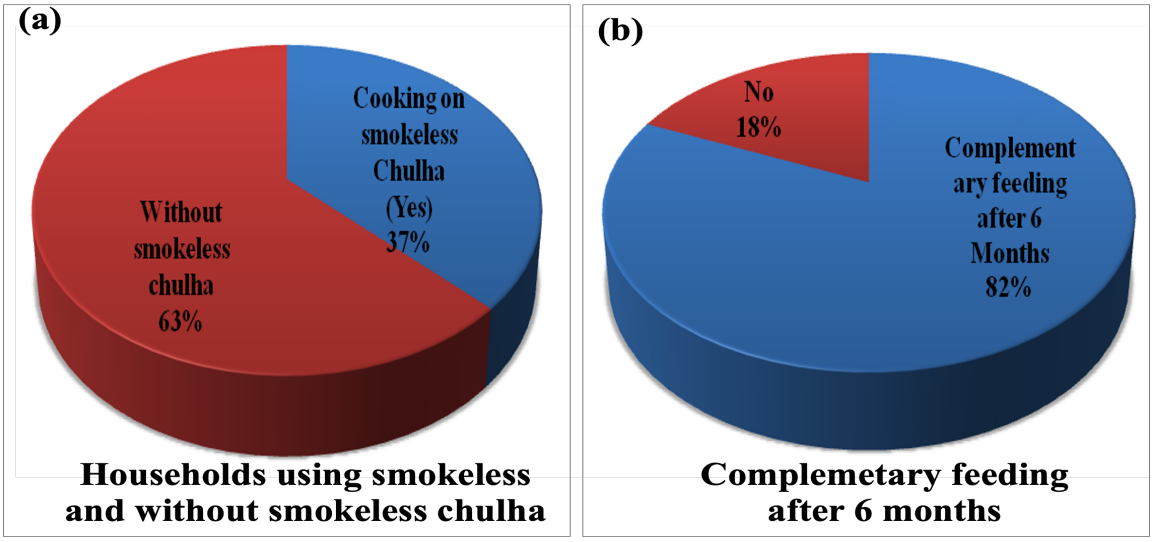

Figure 5: (a) Cooking method, and (b) Complemetary feeding after 6 months

Morbidity and pallor in children

All the studied population stated that they have access o their Aganwadi centers. No morbidity was found in 22% cases (50 children). It was observed that almost 78% (174) children had morbidity in earlier 6 months (Figure 6 a). It was found that pallor was present in 101 (45%) children. Pallor was absent in 55% (123) children (Figure 6 b).

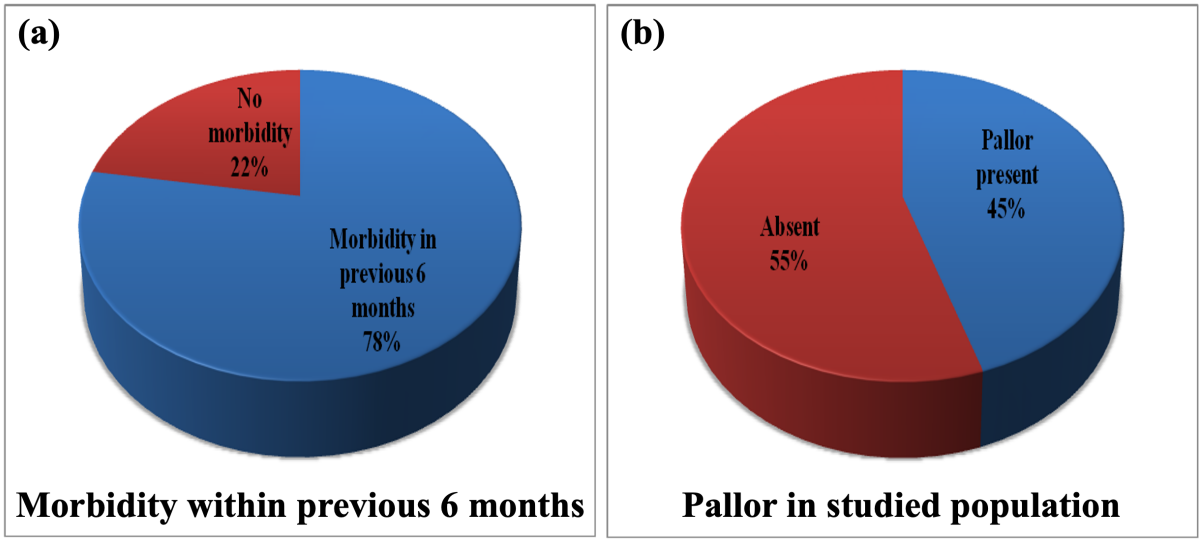

Figure 6: (a) Morbidity, and (b) Pallor in children

Determination of nutritional status in children as per mid upper arm circumference (MUAC) measurement

In the present investigation, mean±SD MUAC among children was 13.6±1.07 cm. The minimum circumference measured was 9.8 cm and maximum was 15.2 cm.

As per WHO, children with less than 11.5 cm, mid upper arm circumference are severely malnourished, above 12.5 cm at at risk of developing mal-nutrition and above 13.5 cm are well nourished [15].

Table 3 shows the nutritional status of children asccording to MUAC measured.

Table 3: Measurement of MUAC (cm)

MUAC (cm)	Frequency	Percentage	Remarks
<11.5	8	3.57	Severe malnutrition
11.5-12.5	28	12.5	Moderate
12.6-13.5	68	30.36	At risk, borderline
>13.5	120	53.57	Well nourished

The realtion between MUAC and socio-demographic parameters was studied.

Table 4 represents the relationship of MUAC with socio-demographic varaiables. It was obseved that most of the children in the present study were optimally nourished with more than 13.5 cm MUAC, however this relation was not found to be statistically signifucant (p-value 0.71). Maximum cases of malnutrition were found in 24-35 months children. MUAC based malnutrition was observed to be decreased with growing age but was not found to be significantly related (p-value 0.71). Girl children were severely malnourished and more boys were either moderately malnourished or were at risk of nutrition (p-value 0.20).

On the contrary, MUAC was estimated to be statistically related to birth order, birth interval between children, complementary feeding at 6 months, their immunization status and presence of pallor in children (p-value<0.05).

Table 4: Relationship of MUAC and socio-demographic parameters

Variables	MUAC				
	<11.5 (cm)	11.5-12.5 (cm)	12.6-13.5 (cm)	>13.5 (cm)	p-value
Age-group (months)					
12-23	3	7	18	30	0.71
24-35	4	12	20	36	
36-47	1	5	13	28	
48-59	0	4	17	26	
Gender					
Male	3	18	36	53	0.20
Female	5	10	32	67	
Socio-economic status					
Class II	1	2	6	14	0.05

Class III	2	10	15	24	
Class IV	5	16	47	82	
Birth order					
First child	2	10	22	41	0.03
Second	3	13	28	44	
Third	3	4	14	25	
Fourth	0	0	1	0	
Fifth	0	1	3	10	
Birth interval					
First child	2	10	22	41	0.02
1 yr gap	2	2	10	15	
2 yr gap	2	10	26	48	
3yr gap	0	3	7	14	
4 yr gap	2	3	3	2	
Complementary feeding at 6 months					
Yes	3	22	56	102	0.009
No	5	6	12	18	
Immunization					
Fully immunized	5	27	63	114	0.004
Partially immunized	3	1	5	6	
Pallor					
Present	7	16	28	54	0.05

p-value≤0.05 was considered significant.

Prevalence of underweight, stunting, wasting and overweight in studied population

The prevalence of nutritional status was estimated on the basis of underweight, stunted, wasted and overweight condition of children in the studied population.

It was estimated that among 224 children, 114 (50.89%) had normal growth, 54 (24.10%) were underweight, 36 (16.07%) were stunted, 8 (3.57%) were wasted and 12 (5.35%) were overweight; however, these values were not statistically significant with p-value 0.95 (Table 5).

Table 5: Table showing prevalence of Malnourished children

Criteria	Category	Number	Percentage
Weight for Age	Under weight	54	24.1
	Normal	158	70.54
	Obese	12	5.36
Height	No stunting	188	84
	Stunted	36	16
Weight For Height	No wasting	216	96..43
	Wasting	8	3.57

In normal cases, out of 114 children, 56 (49.12%) were male and 58 (50.88%) were female. The distribution of patients in this group was found to be statistically significant (p-value 0.01).

Majority of male children were of 36-47 months, however maximum female child belonged to 24-35 months (Table 6). These children were well nourished and did not have any type of mal-nutrition.

Total 54 children were underweight in the present study. Out of 54, 28 (51.85%) were male and 26 (48.14%) were female children. Among male, 9 (16.66%) belonged to 48-59 months age, followed by 24-35 months age consisted of 8 (14.81%) underweight children. Where as 8 (14.81%) female children of 24-35 months age followed by 7 (12.96%) underweight children belonged to 48-59 months. Minimal underweight children belonged to 36-47 months age-group in both male and female cases (5, 9.25%); however there was insignificant effect (p-value 0.98) of age on abundance of underweight children (Table 6). Among 36 stunted children, 17 (47.2%) were male and 19 (52.7%) were female; however, the distribution was non-signifficant with p-value 0.64. Maximum children belonged to 12-23 (30.55%) and 24-35 months age-group (27.7%).

Of 8 wasted children, 3 (37.5%) were male and 5 (62.5%) were female children. Almost 4 (50%) children were of 24-35 months and 3 (37.5%) were 12-24 months (p-value 0.37).

Total 12 children were overweight equally distributed in both genders (50%). Of them, 33.33% were of 12-23 months (p-value 0.06).

Table 6: Distrbution of studied population on the basis of normal, underweight, stunted, wasted and overweight children

	Age (months)	Male	Female	Total	p-value*	p-value**
Normal	12-23	9	19	28	0.01	0.95
	24-35	17	22	39		
	36-47	19	6	25		
	48-59	11	11	22		
	Total	56	58	114		
Underweight	12-23	6	6	12	0.98	
	24-35	8	8	16		
	36-47	5	5	10		
	48-59	9	7	16		
	Total	28	26	54		
Stunted	12-23	5	6	11	0.64	
	24-35	6	4	10		
	36-47	4	4	8		
	48-59	2	5	7		
	Total	17	19	36		
Wasted	12-23	2	1	3	0.37	
	24-35	1	3	4		
	36-47	0	1	1		
	48-59	0	0	0		
	Total	3	5	8		
Overweight	12-23	0	4	4	0.06	
	24-35	3	0	3		
	36-47	2	1	3		
	48-59	1	1	2		
	Total	6	6	12		

*p-value of separate groups as per chi-square analysis, **p-value of overall population as per chi square. p-value≤0.05 was considered significant.

Factors related to underweight in chidren in studied groups

The statistical analysis revealed that, the prevalence of underweight children was independent of age and gender, however it significantly depended on socio-economic status, introduction of food after 6 months, parents' occupation, use of smokeless chulha, pallor in children and morbidity in previous 6 months.

Children may be underweight irrespective of their birth order, interval, birth weight, place of birth (Table 7).

Table 7: Relationship of underweight and socio-demographic factors

Factors	Underweight	Normal	p-value
Age-group (months)			
12-23	12	46	0.35
24-35	16	56	
36-47	10	37	
48-59	16	31	
Gender			
Male	28	82	0.64
Female	26	88	
Socio-economic status			
Class II	10	13	0.04

Class III	14	47	
Class IV	30	120	
Birth order			
First child	21	54	0.72
Second	19	69	
Third	12	34	
Fourth	0	1	
Fifth	2	12	
Birth interval			
First child	21	54	0.50
1 yr gap	4	25	
2 yr gap	22	64	
3yr gap	4	20	
4 yr gap	3	7	
Birth weight (Kg)			
2-2.4	10	51	0.10
2.5-2.9	35	104	
3-3.4	9	15	
Complementary feeding at 6 months			
Yes	39	144	0.03
No	15	26	
Immunization			
Fully immunized	52	157	0.31
Partially immunized	2	13	
Pallor			
Present	41	60	0.000
Absent	13	110	
Mother's education			
Illiterate	14	42	0.32
high school	21	80	
Intermediate	3	5	
Middle school	15	43	
≥Graduate	1	0	
Father's education			
Illiterate	17	42	0.70
high school	21	64	
Intermediate	2	14	
Middle school	13	45	
≥Graduate	1	5	
Mother's occupation			
Farmer	0	14	0.03
Skilled	0	2	
Unskilled	10	25	
Skilled worker	10	13	
Unemployed	34	116	
Father's occupation			
Farmer	0	20	0.002
Skilled	5	20	
Unskilled	1	20	
Skilled worker	1	0	
Unemployed	3	3	
Clerk	2	4	
Professional	0	5	
Semi-skilled	36	92	
Shop	6	6	
Place of delivery			
Home delivery	9	33	0.65
Hospital	45	137	

Type of family			
Joint	28	98	0.30
3-gen	7	11	
Nuclear	19	61	
Use of smokeless chulha			
Yes	29	55	0.004
No	25	115	
Morbidity in previous 6 months			
Yes	54	120	0.000
No	0	50	

Chi-square test was performed to analyze the factors associated with underweight and p-value<0.05 was considered significant.

Factors related to stunting in chidren in studied groups

The present findings envisaged that, factors such as birth order, birth interval among children, their weight at the time of birth, introduction of food at 6 months, use of smokeless chulha, pallor in children and morbidity in previous 6 months affected childrens' growth as stunted children. Children may be stunted irrespective of age, gender, immunization status, place of birth, type of family, parents' occupation (Table 8).

Table 8: Relationship of stunting and socio-demographic factors

Factors	Stunting	Normal	p-value
Age-group (months)			
12-23	11	47	0.87
24-35	10	62	
36-47	8	39	
48-59	7	40	
Gender			
Male	17	93	0.80
Female	19	95	
Socio-economic status			
Class II	6	17	0.29
Class III	6	45	
Class IV	24	126	
Birth order			
First child	6	69	0.02
Second	16	72	
Third	8	38	
Fourth	0	1	
Fifth	6	8	
Birth interval			
First child	6	69	0.01
1 yr gap	9	20	
2 yr gap	18	68	
3yr gap	3	21	
4 yr gap	0	10	
Birth weight (Kg)			
2-2.4	21	40	0.000
2.5-2.9	15	124	
3-3.4	0	24	
Complementary feeding at 6 months			
Yes	22	161	0.0004
No	14	27	
Immunization			
Fully immunized	34	175	0.76
Partially immunized	2	13	
Pallor			
Present	22	79	0.03

Absent	14	109	
Mother's education			
Illiterate	10	46	0.48
high school	12	89	
intermediate	1	7	
Middle school	13	45	
≥Graduate	0	1	
Father's education			
Illiterate	10	49	0.02
high school	10	75	
intermediate	7	9	
Middle school	9	49	
≥Graduate	0	6	
Mother's occupation			
Farmer	0	14	0.08
Skilled	0	2	
Unskilled	2	33	
Skilled worker	6	17	
Unemployed	28	122	
Father's occupation			
Farmer	5	15	0.22
Skilled	6	19	
Unskilled	5	16	
Skilled worker	0	1	
Unemployed	0	6	
Clerk	0	6	
Professional	0	5	
Semi-skilled	16	112	
Shop	4	8	
Place of delivery			
Home delivery	9	33	0.29
Hospital	27	155	
Type of family			
Joint	23	103	0.36
3-gen	1	17	
Nuclear	12	68	
Use of smokeless chulha			
Yes	22	62	0.001
No	14	126	
Morbidity in previous 6 months			
Yes	36	138	0.0004
No	0	50	

Chi-square test was performed to analyze the factors associated with stunting and p-value<0.05 was considered significant.

Factors related to wasting in chidren in studied groups

The present data revealed that, the prevalence of wasted children significantly depended on introduction of food at 6 months, pallor in children, immunization status, and mother's education. Children may be stunted irrespective of other factors mentioned in Table 9.

Table 9: Relationship of wasting and socio-demographic factors

Factors	Wasting	Normal	p-value
Age-group (months)			
12-23	3	55	0.35
24-35	4	68	
36-47	1	46	
48-59	0	47	
Gender			

Male	3	107	0.50
Female	5	109	
Socio-economic status			
Class II	1	22	0.9
Class III	2	49	
Class IV	5	145	
Birth order			
First child	2	73	0.75
Second	3	85	
Third	3	43	
Fourth	0	1	
Fifth	0	14	
Birth interval			
First child	2	73	0.48
1 yr gap	2	27	
2 yr gap	2	84	
3yr gap	2	22	
4 yr gap	0	10	
Birth weight (Kg)			
2-2.4	3	58	0.54
2.5-2.9	5	134	
3-3.4	0	24	
Complementary feeding at 6 months			
Yes	3	180	**0.0009**
No	5	36	
Immunization			
Fully immunized	5	204	**0.0003**
Partially immunized	3	12	
Pallor			
Present	7	94	**0.01**
Absent	1	122	
Mother's education			
Illiterate	2	54	**0.01**
high school	4	97	
Intermediate	2	6	
Middle school	0	58	
≥Graduate	0	1	
Father's education			
Illiterate	0	59	0.31
high school	5	80	
Intermediate	0	16	
Middle school	3	55	
≥Graduate	0	6	
Mother's occupation			
Farmer	0	14	0.47
Skilled	0	2	
Unskilled	3	32	
Skilled worker	1	22	
Unemployed	4	146	
Father's occupation			
Farmer	0	20	0.34
Skilled	2	23	
Unskilled	2	19	
Skilled worker	0	1	
Unemployed	1	5	
Clerk	0	6	
Professional	0	5	
Semi-skilled	2	126	

Shop	1	11	
Place of delivery			
Home delivery	1	41	0.64
Hospital	7	175	
Type of family			
Joint	4	122	0.54
3-gen	0	18	
Nuclear	4	76	
Use of smokeless chulha			
Yes	3	81	1
No	5	135	
Morbidity in previous 6 months			
Yes	8	166	0.12
No	0	50	

Chi-square test was performed to analyze the factors associated with wasting and p-value<0.05 was considered significant.

Factors related to overweight in chidren in studied groups

It was interpreted from the current data that, the prevalence of overweight children was independent of age and gender, however it significantly dependent on socio-economic status, parents' occupation, and morbidity in previous 6 months (Table 10).

Table 10: Relationship of overweight and socio-demographic factors

Factors	Overweight	Normal	p-value
Age-group (months)			
12-23	4	54	0.87
24-35	3	69	
36-47	3	44	
48-59	2	45	
Gender			
Male	6	104	0.94
Female	6	108	
Socio-economic status			
Class II	6	17	0.000
Class III	1	50	
Class IV	5	145	
Birth order			
First child	7	68	0.21
Second	5	83	
Third	0	46	
Fourth	0	1	
Fifth	0	14	
Birth interval			
First child	7	68	0.16
1 yr gap	2	27	
2 yr gap	1	85	
3yr gap	2	22	
4 yr gap	0	10	
Birth weight (Kg)			
2-2.4	4	57	0.000
2.5-2.9	7	132	
3-3.4	1	23	
Complementary feeding at 6 months			
Yes	9	174	0.53
No	3	38	
Immunization			
Fully immunized	11	198	0.81
Partially immunized	1	14	

Pallor			
Present	3	98	0.15
Absent	9	114	
Mother's education			
Illiterate	2	54	0.62
high school	8	93	
intermediate	0	8	
Middle school	2	56	
≥Graduate	0	1	
Father's education			
Illiterate	0	59	0.0000
high school	5	80	
intermediate	0	16	
Middle school	2	56	
≥Graduate	5	1	
Mother's occupation			
Farmer	0	14	0.0001
Skilled	0	2	
Unskilled	2	33	
Skilled worker	6	17	
Unemployed	4	146	
Father's occupation			
Farmer	0	20	0.0000
Skilled	0	25	
Unskilled	2	19	
Skilled worker	0	1	
Unemployed	0	6	
Clerk	0	6	
Professionsl	5	0	
Semi-skilled	4	124	
Shop	1	11	
Place of delivery			
Home delivery	1	41	0.34
Hospital	11	171	
Type of family			
Joint	5	121	0.19
3-gen	0	18	
Nuclear	7	73	
Use of smokeless chulha			
Yes	3	81	0.35
No	9	131	
Morbidity in previous 6 months			
Yes	12	162	0.05
No	0	50	

Chi-square test was performed to analyze the factors associated with overweight and p-value<0.05 was considered significant.

Discussion

The malnourished state in children under 5 years of age leads to development of underweight, wasted, stunted and overweight children. It affects the morbidity and mortality condition of children [16]. In India, almost 3/10 children are stunted, >1/3rd are wasted among total world's mal-nourished children [17]. Periodic surveys of nutritional state of children assists in analyzing the prevalence of the malnutrition in children and also understand the socio-demographic factors associated with it. The paucity of data on the incidence of malnutrition in children under 5 years of age in Bihar urged to assess the nutritional status among children of 1-5 years.

Mid upper arm circumference (MUAC) based nutritional status

Malnutrition has been considered as a prominent reason for morbidity and mortality especially in children below 5 years [18, 19]. Measurement of MUAC is a simple, acceptable and better predicting

index of early childhood nutritional status than other anthropometric measurements, but with a fixed value irrespective of age related change in less than 5 years children [20].

MUAC <11.5 cm, 11.5-12.5 cm, 12.6-13.5 cm, >13.5 cm predicts severe malnutrition, moderate, at risk and well nourished state of children respectively [15]. As per MUAC index, it was found that almost 53% children were optimally nourished, 4% were severly mal-nourished, 12.5% were moderately nourished and 30% wee at risk of developing malnutrition.

Maqbool and Manzoor also studied MUAC based nutritional status in less than 5 years children and reported maximum children to be optimally nourished (31%), 26% to be severe malnutrion folowed by moderate (28%) and at risk (14%) condition [15]. Biswas et al. also reported 5.1% of severe mlnutrition and 19.1% moderate malnutrition in children under 5 years [21]. The differences in nutritional status of children could be attributed to geographical variance [15].

Accordng to WHO, MUAC screening at community level ia a rapid and inexpensive tool to measure nutritional status of chidren [22]. Severe malnutrition as per MUAC is more related to wasting than other malnutrition condition and is related with high morbidity as well as mortality. Several researches have convinced that MUAC is a reliable parameter to identify severe malnutrition among young children below 5 years [22, 23].

On the contrary, Tripathy et al. suggested that there are enough evidences to proof MUAC cut-offs is linked with severe malnutrition in African coutries but there's shortage of evidences for Indian scenario. In Indian setting. It can accurately used for weight for height cut-offs [24]. John et al. also favoured that MUAC identifies subsets of malnutrition [25]. More investigations are required to support these cut-off measurements.

The influence of socio-demographic parameters on MUAC was assesed and it was envisaged via chi-square test that MUAC was independent of age and gender differences (p-value >0.05); where as it is significantly related to economical state of a household, birth interval and bith order of a child, introduction of food at 6 months, their immunization status and presence of pallor in children <5 years age (p-value <0.05).

Maqbool and Manzoor reported that MUAC based malnutrition, depended significantly on family income, immunization and frequent episodes of illness and similar to present study was found independent of age variation among children below 5 years [15]. Similar to present study, Maqbool and Manzoor reported female children to be more affected from severe malnutrition as compared to boys [15].

Mathew et al. corroborated that severe malnutrition is related to low birth weight, poor family economic status, incomplete immunization and inadequate weaning practices [26]. On the contrary, Tigga et al. reported MUAC based malnutrition to be associated with age, gender, mother's education, maternal occupation, birth order and household income [27]. The difference in family system and geographical variation may be the reason fof the diffeence in results.

Prevalence of malnutrition in studied population and factors associated with it in terms of underweight, stunting, wasting and overweight

In the present study, 51% had normal growth, 44% were under-nourished (24% underweight, 16% stunting, 4% wasting) and 5% were over-weight. Severly malnutrition in children as per MUAC measurement was similar to number of wasted children (p-value<0.05) which was inline with previously suggested findings by Tripathy et al. and John et al. [24,25]. Goyal et al., envisaged almost 45% of studied population to be undernourished and 55% were normal well nourished [28].

According to National Family Health Survey (NFHS-5) 2019-21, 36% of children ≤5 had stunted, 19% had wasted growth, 32% were underweight and 3% were overweight [8]. As per Bihar economic survey, it was estimated that total stunted, wasted and underweight children in Darbhanga district was 49%, 16.6% and 41.1% respectively [10]. The present data was less than NFHS-5 estimation which may be due to variation in economic status, government schemes and provisions as well as changes in other important parameters with time. Apart from this, Global Hunger Index has also confirmed that rate of malnutrition is reducing as compared to previous survey data [9].Farooq et al., also stated maxium under nourished children (64%) and suggested to monitor dietary intake of children as this is crucial and vulnerable age to malnutrition and risk factors associated with it [29].

It was observed that among subsets of undernutrition underweight children were highly present in the studied group as compared to stunting and wasting. The order of prevalence of malnutrition among children less than 5 years was underweight followed by stunting, overweight and wasting in total studied population. Galgamuwa et al. also revealed highest prevalence of underweight children (36%) followed by wasting (33%), stunting (27%) and few cases of overweight (3%) children [30].

The present study observed that more male children (13%, n=224) were underweight as compared to female children (12%, n=224). More females were stunted (8.4%, n=224) and wasted (1%, n=224) as compared to male (7.5%, n=224) and (2%, n=224) respectively. Prevalence of overweight children was equal in both sexes (2.6%); however, the nutritional status was not statistically significant to age and sex among studied population (p-value >0.05). Another study have also found female children to be more suffering from mal-nutrition as compared to boys which may be due to gender bias prevalent among society and biological factors. However, the exact reason of gender differential in case on malnutrition is still poorly understood [31].

Similar to present study, Singh et al. also studied nutritional status in children under 5 years in Rajasthan, India and reported highest prevalence of underweight (60%) followed by stunting (53%) and wasting (28%) among children. The study also reported female child to be more malnourished than male child [32].

Sapkota and Gurung reported 27% underweight, 37% stunting and 11% wasting prevalent in children in Nepal [33]. This was much higher than the present findings. Another study by Siddiqi et al. on assessment of malnutrition among <5 years aged children in Bangladesh found maximum children to be stunted (42%) followed by underweight (40%). This was opposite to present finding. In present finding underweight was highly prevalent followed by stunting [34]. A study by Otgonjargal et al. also stated high prevalence of stunting (15.6%) followed by underweight (4.7%) and wasting (1.7%) [35]. The variation from present findings may be due to the difference in socio-economic status, healthcare facility, government provisions and geographical characteristics of the area under investigation [36].

Galgamuwa et al. reported more female children were underweight and stunted and was statistically significant whereas wasting was more present in male children but was not significantly related[30]. In all cases, age was negatively correlated with the malnutrition. This was in line with the observations made by researchers across the world [37-41].

In the present study, most of the malnutrition children belonged to joint family followed by nuclear family. Very few families were living in 3-generation family system. However, type of family system is not positively associated with malnutrition. All the under-nourished children among studied population belonged to class IV socio-economic status with low income and overweight children belonged to class II sector with high income family. Socio-economic status was observed to have positive association with underweight (p-value 0.04) and overweight (p-value 0.00); on the contrary, it did not showed relation with stunting (p-value 0.29) and wasting (p-value 0.9). The poor economic sector may create difficulty in accessing balanced nutritious diet leading to malnutrition among children. In contrast overweight children were having malnutrition due to high intake of snacks and fast foods as well as less physical activity [42].

Vasudevan and Udayashankar studied nutritional status among under 5 children in Pondicherry and reported dominance of malnutrition in children belonging to Class IV SES group. Most of them resided in a joint family system. The study reported 18.3% underweight, 31.6% stunting and 20.1% wasting [42]. In the present study high incidence of stunting over stunting indicated chronic malnutrition among children [42].

Underweight was significantly found to be related with socio-economic status (p-value 0.04), complementary feeding at 6 months (p-value 0.03), presence of pallor (p-value 0.00), mother's occupation (p-value 0.03), father's occupation (p-value 0.002), type of chulha used for cooking (p-value 0.004) and morbidity status of children (p-value 0.00). Most of the children with working parents were underweight. This may be due to lack of time to provide proper balanced diet to children.

Stunting was found to be significantly associated with birth order (p-value 0.02), interval between children (p-value 0.01), birth weight (p-value 0.00), complementary feeding at 6 months (p-value 0.0004), presence of pallor (p-value 0.03), father's education (p-value 0.02), type of chulha used for cooking (p-value 0.001) and morbidity status of children (p-value 0.0004). Mother's education was not found to be significantly contributing to the stunting among children in the present investigation (p-value 0.48).

Educated father support their family in much strong way.

They are exposed to media and other modes that make them aware about child's health and nutrition, modern health facilities, various benefits provided by government. Educated parents are more aware against traditional old beliefs and advantages of birth spacing [43]. More children (11%) with low economic sections were stunted, although no significant association was found using statistical analysis (p-value 0.29).

Stunting is related to morbidity of children which indicates it influences the cognitive development of children and makes them vulnerable towards diseases [44]. The prevalence of stunting was found highest among the age group of 12-23 months in female and 24-35 months in male. And gradually decreases with growing age. Stunting during first 2 years of birth may be due to late introduction of weaning and complementary feeding practices.

Stunting mainly occurs due to improper feeding habits and/or frequent illness especially during growth of skeleton system slows down reducing the child's length [45, 46]. Therefore, the data indicates that proper child care, weaning practices and timely vaccination may help in preventing risk of stunting.

Soliman et al. also suggested that late and inadequate complementary food introduction as well as frequent infections lead to nutritional stunting which has long-term adverse effect on poor performances and chronic diseases [47]. Initial 2 years post birth demands high nutrition to support proper over-all growth, hence, adverse effect on growth of children retards their further development [48].

Alderman et al., studied the impact of stunting during childhood in their adolescent life. The study stated that impaired behavioural development of stunted children has been observed to have more depression, low self-esteem and anxiety in their later life. It creates future risk of obesity, hormonal imbalance, growth failure and hypertension [49].

Various other surveys have also proved that stunting is due to undernourished state of children that is related with poor physical and mental growth. It is common cause of short stature, functionally developed brain resulting in delayed cognitive development and may cause permanent impairments among children [50, 51].

On the other hand, wasting was calculated to be significantly related to complementary feeding at 6 months (p-value 0.009), child's immunization status (p-value 0.003), presence of pallor (p-value 0.01), and mother's education (p-value 0.01).

Immunization also plays significant role in preventing malnutrition among children. Indian government has launched multiple schemes and ensures that the children should be vaccinated as per their age. This may be one of the reasons of low prevalence of wasting in studied area.

In all the under-nourished cases, pallor was significantly associated. Incidence of pallor was present in 18% underweight children (p-value 0.00), 10% stunted children (p-value 0.03) and 3% wasted children (p-value 0.01). Shivprakash and Joseph also reported 25.4% pallor in under-nutrition children [52]. Yankanchi et al., also reported pallor in 9% under-nourished children. However, the association was not significantly related to under nutrition [1]. The reason for this may be attributed to the fact that malnutrition is dependent on the living standard and environmental changes [36].

Although, age was not found be significantly associated with wasting among children (p-value 0.35), it was more prevalent in children above 35 months and was reduced with increasing age. This may due to increased physical activities with age. Children after 3 years mostly go to school and play outside which channelizes their energy and improves their growth and development [53]. Increased wasting in early months may also be attributed to feeding practices. Mostly child as complementary food are feed with starchy food such as mashed potatoes and bananas which increases their fat deposits [54].

In case of overweight, statistical analysis revealed that it is significantly related with socio-economic condition of a family (p-value 0.00), birth weight (p-value 0.00), father's education (p-value 0.00), mother's occupation (p-value 0.0001), father's occupation (p-value 0.00) and morbidity of children (p-value 0.05). Most of the overweight children belonged to high income group and their father had higher education as compared to under-nourished children. The plausible explanation to overweight may be their high intake and low expenditure of calories leading to fat accumulation in their body. Another reason may be low activity and involvement in idle leisure like watching TV [42].

Singh et al. also reported that malnutrition is more prevalent in families with lower or middle income, poor education [32]. Alom et al., Ahsan et al., and Mahmood et al. also showed that malnutrition was positively linked with the complementary feeding practices and exposure to infection [55-57].

Bhusal and Sapkota reported that parent's education plays important role towards awareness for childcare, child feeding habits, family planning and health care practices. Hence, education of both father and mother is linked to presence of malnutrition in children [58].Karkuki and Mascie confirmed that maternal education, geographical variation and living standards are major indexes of nutritional status among children under 5 years [36].Another study by Mohammed and Asfaw demonstrated that the prevalence of malnutrition among children below 5 years is associated with birth interval, household conditions, economic status, birth order, child's birth weight, father's education level [43].

Conclusion

Although malnutrition has reduced over the period, it still horrifies the state and significantly depends on the socio-economic and behavioural state of the community. Thus, more efforts should be incorporated as awareness programmes, in order to improve further nutritional status of the region. Government schemes like mid-day meals and other benefits at Anganwadi centres should be monitored. Malnutrition among children should be recognized and parents of such children should be counselled to overcome their deficit condition. The current findings can assist government and voluntary organizations to strategize against issue of

malnutrition and counsel people to overcome poor nutritional status.

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Conflict Of Interest

The authors declare that there is no conflict of interest.

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References

1. Yankanchi SG, Ganganahalli P, Udgiri R, Patil SS. Assessment of nutritional status of primary school children in urban field practice area, Vijayapura. International Journal of Community Medicine and Public Health. 2018;5:779-83.
2. Khan QH, Arora G, Nalli SK. Nutritional status of 1-5 years children in the urban slum area of Jagdalpur city, Bastar region, Chhattisgarh. International Journal of Community Medicine and Public Health. 2018;5:1172-6.
3. Striessnig E, Bora JK. Under-Five Child Growth and Nutrition Status: Spatial Clustering of Indian Districts. Spatial Demography. 2020;8(1):63-84.
4. Saunders J, Smith T. Malnutrition: causes and consequences. Clinical medicine (London, England). 2010;10(6):624-7.
5. Natisha D. Global Prevalence of Malnutrition: Evidence from Literature. In: Muhammad I, Ali I, editors. Malnutrition. Rijeka: IntechOpen; 2020. p. Ch. 6.
6. Kumar A, Gopal KV, Prince K, Srilakshmi P, Prathana S, Manita G. A Study on the Assessment of Nutritional Status among Children Using Anthropometric Measurements. Journal of Clinical and Pharmaceutical Research. 2022;2(1):11-3.
7. Roy E. Over 35.5% kids stunted, govt releases target to curb malnutrition. The Indian Express. 2022. [Cited February 4, 2023]. Available from https://indianexpress.com/article/india/over-35-5-kids-stunted-govt-releases-target-to-curb-malnutrition-8055777/.
8. International Institute for Population Sciences (IIPS) and ICF. National Family Health Survey (NFHS-5), 2019-21: India: Volume 1. Mumbai. IIPS. 2021. [Cited February 4, 2023]. Available from https://dhsprogram.com/pubs/pdf/FR375/FR375.pdf.
9. Global Hunger Index (GHI). Global Hunger Index 2022: India. 2022. [Cited February 4, 2023]. Available from https://www.globalhungerindex.org/pdf/en/2022/India.pdf.
10. Bihar economic survey. 2019-20. Finance Department, Government of Bihar. 2020. [Cited February 4, 2023]. Available from https://state.bihar.gov.in/finance/cache/12/Reports/Economic-Survey-2020-EN.pdf.
11. Pant, A., S. Scott, S.K. Singh, R. Sarwal, N. Bhatia, R. Johnston, W. Joe, E. Sarswat, P. Menon, and P.H. Nguyen. State Nutrition Profile: Bihar. POSHAN Data Note 41. New Delhi, India: International Food Policy Research Institute. 2021. [Cited February 4, 2023]. Available from https://www.niti.gov.in/sites/default/files/2021-10/SNP_Bihar_draft_ap_20210823_v2_JAG_41_ES.pdf.
12. United Nations International Children's Emergency Fund (UNICEF). Children in Bihar. 2019. [Cited February 4, 2023]. Available from https://www.unicef.org/india/where-we-work/bihar.
13. Patel Rashmi, Singh P. Anthropometric Assessment of Nutritional Status among Scheduled Caste Children (6-12 years) in Lucknow. Human Biology Review, 2019;8(3):197-204.
14. Frison S, Kerac M, Checchi F et al. Anthropometric indices and measures to assess change in the nutritional status of a population: a systematic literature review. BMC Nutrition. 2016;2:76.
15. Maqbool S, Mazoor I. Acute malnutrition and its determinants among children below 5 years of age using mid upper arm circumference (MUAC) in Lahore: a cross-sectional study. MedERA - Journal of CMH LMC and IOD. 2023;4(1):11-8.
16. Tebeje NB, Biks GA, Abebe SM, Yesuf ME. Prevalence and major contributors of child malnutrition in developing countries: Systematic review and meta-analysis. J Child Obes. 2017;02(04):16.
17. Purohit L, Sahu P, Godale LB. Nutritional status of under- five children in a city of Maharashtra: a community based study. Int J Community Med Public Health. 2017;4(4): 1171-8.
18. Haq IU, Mehmood Z, Khan N, Khan MN, Israr M, Ali Khan E, et al. Risk Factors of Mid-upper Arm Circumference (MUAC) Based Child Malnutrition in the Flood-affected Areas of Pakistan: A Cross-sectional Study. Ecology of food and nutrition. 2021;60(4):491-507.
19. Saleem J, Zakar R, Mushtaq F, Bukhari GMJ, Fischer F. Comparative analysis of

developmental profile between normal and severe acute malnourished under-five children in Pakistan: a multicentre cross-sectional study. BMJ Open. 2021;11(8):e048644.
20. Sarpong SA, Sarpong AK, Lee Y. A Model for Determining Predictors of the MUAC in Acute Malnutrition in Ghana. International journal of environmental research and public health. 2021;18(7):3792.
21. Biswas S, Bose K, Mukhopadhyay A, Bhadra M. Mid-upper Arm Circumference Based Undernutrition among Bengalee Children of Chapra, West Bengal, India. Iranian journal of pediatrics. 2010;20(1):63-8.
22. Sabud P, Ghosh T, Dhar A, Dutta S, Bisai S, Choudhury S. Malnutrition based on mid upper arm circumference and dietary consumption pattern of Lodha tribal children of West Bengal, India. International Journal of Research in Medical Sciences. 2020;8(12):4329-35.
23. Bliss J, Lelijveld N, Briend A. Use of mid-upper arm circumference by novel community platforms to detect, diagnose, and treat severe acute malnutrition in children: a systematic review. Glob Health Sci Pract. 2018;6(3):552-64.
24. Tripathy J, Sharma A, Prinja S. Is Mid-upper Arm Circumference Alone Sufficient to Identify Severe Acute Malnutrition Correctly? Indian Pediatrics. 2016;53:166-7.
25. John C, Ocheke IE, Diala U, Adah RO, Envuladu EA. Does mid upper arm circumference identify all acute malnourished 6–59 month old children, in field and clinical settings in Nigeria? South African Journal of Clinical Nutrition. 2017;30(3):55-9.
26. Mathew SM, Kumar R, Mohanty N. Clinical Profile And Socio-Demographic Characteristics Of Children With Severe Acute Malnutrition (SAM) In Southern Odisha. J Nepal Paediatr Soc. 2021;41(3):374-79.
27. Tigga PL, Sen J, Mondal N. Association of some socio-economic and socio-demographic variables with wasting among pre-school children of North Bengal, India. Ethiopian journal of health sciences. 2015;25(1):63-72.
28. Goyal M, Singh N, Kapoor R, Verma A, Gedam P. Assessment of Nutritional Status of Under-Five Children in an Urban Area of South Delhi, India. Cureus. 2023;15(2):e34924.
29. Farooq U, Sharma SJ, Raghav S. Prevalence of under nutrition among under-5 children in the urban field practice area of a medical college in Muzaffarnagar, Uttar Pradesh. International Journal Of Community Medicine And Public Health. 2023;10(2):644-7.
30. Galgamuwa LS, Iddawela D, Dharmaratne SD, Galgamuwa GLS. Nutritional status and correlated socio-economic factors among preschool and school children in plantation communities, Sri Lanka. BMC Public Health. 2017;17(1):377.
31. Green MS. The male predominance in the incidence of infectious diseases in children: A postulated explanation for disparities in the literature. Int J Epidemiol. 1992;21(2):381–6.
32. Singh MB, Fotedar R, Lakshminarayana J, Anand PK. Studies on the nutritional status of children aged 0-5 years in a drought-affected desert area of western Rajasthan, India. Public health nutrition. 2006;9(8):961-7.
33. Sapkota, V. P. and Gurung, C. K. (2012). Prevalence and Predictor of underweight, Stunting and Wasting in Under- Five Children . Nepal Health Research Council. 120-140.
34. Siddiqi MNA, Haque MN, Goni MA. Malnutrition of Under-Five Children: Evidence from Bangladesh. Asian Journal of Medical Sciences. 2011;2(2):113-9.
35. Otgonjargal, D., Bradley, A., Woodruff, F., Batjarga, l. and Davaalkham, D. (2012). Nutritional status of under- five children in Mongolia. Journal of Medicine and Medical Sciences. 3, 341-349.
36. Karkuki ON, Mascie TCN. Association of nutritional status with socio-economic and demographic variables of under five year old Nepalese children. Medical journal of the Islamic Republic of Iran. 2019;33:28.
37. Fenske N, Burns J, Hothorn T, Rehfuess EA. Understanding child stunting in India: A comprehensive analysis of socio-economic, nutritional and environmental determinants using additive quantile regression. PLoS One. 2013;8(11):e78692.
38. Sharaf MF, Mansour EI, Rashad AS. Child nutritional status in Egypt: a comprehensive analysis of socioeconomic determinants using a quantile regression approach. J Biosoc Sci. 2019;51(1):1–17.
39. Khan JR, Gulshan J. Heterogeneous effects of factors on child nutritional status in Bangladesh using linear quantile mixed model. 2020;4(1):265–81.
40. Simelane MS, Chemhaka GB, Zwane E. A multilevel analysis of individual, household and community level factors on stunting among children aged 6–59 months in Eswatini: A secondary analysis of the Eswatini 2010 and 2014 Multiple Indicator Cluster Surveys. PLoS One. 2020;15:e0241548.
41. Aheto JMK. Simultaneous quantile regression and determinants of under-five severe chronic malnutrition in Ghana. BMC Public Health. 2020;20(1):1–12.
42. Vasudevan K, Udayashankar C. Nutritional status of children under five years of age in a rural area of Pondicherry. International Journal

of Contemporary Medical Research 2019; 6(4):D1-D3.
43. Mohammed S, Asfaw ZG. Bayesian Gaussian regression analysis of malnutrition for children under five years of age in Ethiopia, EMDHS 2014. Archives of public health. 2018;76:21.
44. Cousens, S., Black, R. E., Johnson, H. L., Lawn, J. E., Rudan, I., Bassani, D. G. and Cibulskis, R. Global, regional, and national causes of child mortality in 2008: a systematic analysis. The Lancet. 2010; 375(9730): 1969–1987.
45. World Health Organization (WHO) Working Group. Use and interpretation of anthropometric indicators of nutritional status. Bulletin of the World Health Organization 1986; 64:929–41.
46. Johns, T. and Eyzaguirre, P. Nutrition for sustainable environments. SCN News. 2000; 21:25−29.
47. Soliman A, De Sanctis V, Alaaraj N, Ahmed S, Alyafei F, Hamed N, et al. Early and Long-term Consequences of Nutritional Stunting: From Childhood to Adulthood. Acta bio-medica: Atenei Parmensis. 2021; 92(1): e2021168.
48. Roth DE, Krishna A, Leung M, Shi J, Bassani DG, Barros AJD. Early childhood linear growth faltering in low-income and middle-income countries as a whole-population condition: analysis of 179 Demographic and Health Surveys from 64 countries (1993–2015) Lancet Glob Health. 2017;5:1249–1257.
49. Alderman H, Behrman JR, Glewwe P, Fernald L, Walker S. Bundy DAP, Silva Nd, Horton S, Jamison DT, Patton GC, editors. Evidence of Impact of Interventions on Growth and Development during Early and Middle Childhood. Child and Adolescent Health and Development. 3rd edition. Washington (DC): The International Bank for Reconstruction and Development / The World Bank; 2017, Chapter 7.
50. Kar, B., Rao, S. and Chandramouli, B. Cognitive development in Children with chronic protein energy malnutrition. Behavioral and Brain Function. 2008; 4:31.
51. Kathryn, G. and Khadija B. Long-term consequences of stunting in early life. Maternal and Child Nutrition, 2011; 7: 5–18.
52. Shivprakash NC, Joseph RB. Nutritional Status of Rural School-Going Children (6-12 Years) of Mandya District, Karnataka. Int J Scientific Study. 2014;2(2):39–43.
53. Macharia, C., Kogi-Makau, W. and Muroki, N. A Comparative study on the nutritional status of children (6-59 months) in a World Vision Project area and a Non-Project area in Kathonzweni Division, Makueni District, Kenya. African Journal of Food Agriculture and Nutritional Development (AJFAND): 2005; 5:122.
54. Gina, L., Maria, R. and Chiara, S. Dietary diversity score is a useful indicator of micronutrient intake in non-breast-feeding Filipino children. The Journal of Nutrition 2007;137:472-477.
55. Alom J, Quddus MA, Islam MA. Nutritional status of under-five children in Bangladesh: a multilevel analysis. J Biosoc Sci. 2012; 44(5):525–35.
56. Ahsan KZ, El Arifeen S, Al-Mamun MA, Khan SH, Chakraborty N. Effects of individual, household and community characteristics on child nutritional status in the slums of urban Bangladesh. Arch Public Heal. 2017;75(1):1–13.
57. Mahmood T, Abbas F, Kumar R, Somrongthong R. Why under five children are stunted in Pakistan? A multilevel analysis of Punjab Multiple indicator Cluster Survey (MICS-2014) BMC Public Health. 2020; 20(1):1–15.
58. Bhusal UP, Sapkota VP. Socioeconomic and demographic correlates of child nutritional status in Nepal: an investigation of heterogeneous effects using quantile regression. Globalization and health. 2022;18(1):42.