Original Research Article

STRATIFICATION FOR RISK FACTORS AND ITS CORRELATION TO OUTCOME IN CHILDREN WITH MALNUTRITION OF AGE 6 MONTHS TO 5 YEARS

ABSTRACT

Background: Wide range of illness is covered under malnutrition including under nutrition, specific nutrient deficiencies and over nutrition. There is heavy cost burden on Pakistani economy due to high prevalent condition. Children are affected in several ways and exposed to infectious diseases, psychosocial mal-development and cognitive deficiencies. **Objectives:** Objectives of this study are to determine the risk factors of malnutrition in children of age 6 months to 5 years and to determine the correlation between risk factors of malnutrition and outcome in children of age 6 months to 5 years. **Methodology:** A prospective observational study was conducted at Paediatric Medicine Department, PUMHS (Nawabshah). 138 patients were recruited using the non-probability consecutive sampling technique. Informed consent was taken from study participants before enrolment into the study. Children admitted to peadiatric medicine ward were explored for malnutrition risk factors. A pre-designed proforma was used for data collection. Data was analyzed using SPSS version 21. **Results:** Out of 138 children, 78 (56.5) were males and 60 (43.5) were females. Average age of patients was 27.49 ± 13.32. Using criteria of MUAC, 97 (70.28%) were severely malnourished and 41 (29.71%) were moderately malnourished. By criteria of weight-to-height z-score, 116 (84.05%) were severe malnourished and 22 (15.94%) were moderately malnourished. Among child factors, the highest prevalent risk factor was bottle and mixed feeding practice (122, 88.40%). Child related factors were significantly associated with patients' outcome. Among parental risk factors, the highest prevalent risk factor was unemployment (96, 69.57%) fathers of patients were unemployed. Among environmental factors, the most prevalent risk factor was use of inappropriate water source (102, 73.91%). 31 (22.46%) children expired at the end of the study. Environmental factors were also found to be associated with patients' outcome. **Conclusion:** Lack of breast feeding, unemployment and inappropriate source of water were most prevalent factors. Furthermore, illiteracy and incomplete vaccination status were also prevalent. Therefore, interventions are needed in order to overcome these problems. Parental education should be done and high authorities should make efforts to provide clean and safe water in rural area as well.

Keywords: Nutrition, Malnutrition, Risk factors, Children, Pakistan.

INTRODUCTION

The term malnutrition covers a wide range of illnesses, including under nutrition, specific nutrient deficiencies and over nutrition (1). It kills, retards, cripples, blinds and impairs human developments on truly massive scale worldwide (2). Severe protein-energy malnutrition (PEM) is a leading cause of death among children younger than five years of age (3). Malnutrition is classified into two classical syndromes, marasmus (wasting syndrome) and kwashiorkor, or a mixture of both (marasmic-kwashiorkor) (4).

Children are the most nutritionally vulnerable group especially in the developing world (5). Annually some 30 million infants around 82,000 every day are born with intrauterine malnutrition growth retardation mainly due to poor maternal nutritional status (6). The prevalence of malnutrition imposes significant costs on the Pakistani economy as well as society and the high mortality due to malnutrition leads to the loss of the economic potential of the children (7, 8). It affects children in many ways, predisposing them to different infectious diseases, psychosocial mal-development and cognitive deficiencies (9). The cost of hospital admission and treatment in addition to parental days off work should not be ignored (10).

The reported proportion for risk factors of malnutrition in children include child characteristics / factors as preterm (10%) and low birth weight (28%), bottle feed (10%) and short time breast feed <4 months (10%), less number for meals per day (38%), incomplete immunization (74%) while the parental characteristics / factors as separation in marriage (14%), illiterate (30%), co-morbid (14%), alcoholism (16%) and smoking (32%), whereas the socio-economic and environmental and household factors as rural population (18%), mud / bush houses (12%), pit toilet (48%) and water supply as no water supply (16%) and well, river and tank (24%), however the outcome reported as improved and discharge (75%), discharged against medical

advice (15%) and died (9%) respectively (11). There is emerge need to know about malnourished children admitted to Pediatric Intensive Care Unit (PICU), have a worse outcome in relation to abnormal nutritional status while previous international study shown that presence of malnourishment increases mortality of children admitted to PICU.

Although malnutrition is acknowledged as one of the major health problems at people's university hospital, there is paucity of data on the prevalence and outcome of this condition in the hospital. Therefore, the study will generate a local data to explore the risk factors and to correlate them in relation to outcomes so that patients can be properly rationalized and managed according to the finding of present study. Moreover appropriate preventive and management strategies can be planned to reduce the burden of risk factors and to improve the outcomes.

Objectives of this study are to determine the risk factors of malnutrition in children of age 6 months to 5 years and to determine the correlation between risk factors of malnutrition and outcome in children of age 6 months to 5 years.

OPERATIONAL DEFINITIONS:

MALNUTRITION: It was defined as a low weight-for-height/length (severe wasting; below −3 SD of the median weight-for-height/length of the WHO growth standards), or the presence of visible severe wasting or nutritional edema, or in children aged 6–59 months, a mid-upper arm circumference (MUAC) of <115 mm.

RISK FACTORS:

(A) CHILD FACTORS:

Preterm: birth of a baby before 37 gestational weeks of gestation by history or ultrasonography.

Low Birth weight: was revealed as < 2.5 kg i.e 2499gm.

Feeding methods: was explored as bottle feed, breast feed or mixed.

Age when breastfeeding ceased: when complementary (weaning) food was started, number of feeds / meals per day.

Immunization: was assessed as complete, incomplete and up to date by expanded program on immunization (EPI) card.

Birth spacing between patient and sibling before: will be evaluated in years as <1, 1-2 and >2 years.

Recurrent Diarrhea; 4 or more episodes of loose motion in last 6 months requiring hospital admission was considered as recurrent diarrhea.

Recurrent Chest Infection; 3 or more episodes of upper respiratory tract infection during last 6 months was considered as chest infection.

Immunization status; Complete, Incomplete, Up to date.

(B) PARENTAL FACTORS

Education level: was categorized as illiterate or literate (primary, secondary, bachelor, masters and higher).

Occupation: was nominated as house wife or employed for any private or government sector, unemployed or has self business.

Health status: was presented as well or ill.

Addiction:

- **Smokers:** It was defined as those who smoking cigarettes, bidis, or hookah daily.
- **Tobacco users:** These were defined as those who using chewable tobacco products, gutka, naswar, khaini, or zarda paan daily.
- **Alcohol drinkers:** These were defined as those who reported to consuming alcohol within the past one year.

(C) SOCIO-ECONOMIC, ENVIRONMENTAL AND HOUSEHOLD FACTORS:

Total number of people in household: was expressed as quantity of peoples living at home.

Total number of income earners in household: was explored as quantity of income earners at home (Rs. 60,000 =poor), (Rs. 60,000 to 120,000= middle) and (Rs. >120,000 =upper).[12]

Residence: was present as urban or rural area.

Type of toilet: was categorized as flush, pit and bush

Water supply: was evaluated as hand pump, motor and others (well, river, tank).

Poor sanitation: the non-hygienic conditions and status inquired by taking history and physical examination.

OUTCOME:

Improved and discharge: was labeled when the child has the weight gain, edema reduced or subsided and discharges from hospital.

Not improved: patient was labeled when child was not recover and have no weight gain, edema not subsided.

Leave against medical advise or discharge on request: parents or attendants not willing to stay in hospital.

Reffered: child sent to any other hospital setup for further management.

Expired: child not improved and died due to illness.

METHODOLOGY

Setting: Paediatric Medicine Department, PUMHS(Nawabshah).

Duration: Duration of study was 6 months after the approval of synopsis from 29/08/2016 to 28/12/2016.

Sample Size: Through Raosoft, by considering the lowest prevalence of risk factors as preterm 10%[11]; with 6% margin of error. Total 96 children with malnutrition were recruited and explored for risk factors and outcome. Through Raosoft, by considering the lowest prevalence i.e. death in malnutrition as 9%[11]; with 5% margin of error. Total 138 children with malnutrition were recruited and explored for risk factors and outcome.

Sample technique: Patients were selected by Non-Probability, purposive Sampling.

Inclusion criteria:

- The children of 6 months to 5 year with malnutrition of either gender.

Exclusion criteria:

- Children with recurrent diarrhea, recurrent chest infection, diabetes mellitus, sickle cell disease, leukemia, lymphoma and the children have tuberculosis and HIV infections were be excluded from the study.
- Congenital malformations (e.g. cleft lip, cleft palate)/ chrosomal syndromes and cardiac problems.
- Parents / guardians not willing to enroll their child in the study.

Study design: Comparative Cross Sectional Study.

Data Collection Procedure:

All children presented in paediatric medicine ward PUMHS hospital, Nawabshah with malnutrition were recruited for the study after acquiring the ethical approval. All the children with malnutrition admitted and explored for risk factors and outcome according to the parameters as child factors (preterm: birth weight: feeding methods: age when breastfeeding ceased, age when complementary feeding introduced, number of meals per day, immunization, birth spacing between patient and sibling before), parental factors (marital status, education

level, occupation, health status, addiction) socio-economic, environmental and household factors (total number of income earners in household, residence, type of housing, type of toilet, water supply, poor sanitation) and outcome (improved and discharge or not improved) mentioned in operational definition. The detail clinical history was taken, relevant physical examination was performed and specific investigations were advised. The written consent was taken from every attendant / guardian of the children for participation in the study while the data was collected on pre-designed proforma and all such maneuvers (relevant history taking, physical examination, evaluation of risk factors and outcome) were explored by principal researcher and were under medical ethics whereas all the expenditures of the study were bored by researcher herself.

Data Analysis Procedure:

The data was saved and analyzed in SPSS version 17.00. The frequency and percentage (%) was calculated for age, gender, duration of malnutrition, risk factors and outcome on children with malnutrition. The mean and standard deviation (SD) were calculated for quantitative variables. The stratification was done for age, gender, risk factors, outcome and duration of malnutrition to see the effect and to control the confounders while the correlation between existence of risk factors for malnutrition and outcome was explored whereas the chi-square test was used at 95% CI (confidence interval) and level of significance was p-value ≤ 0.05.

RESULTS

Table 1. Descriptive Statistics of study parameters

Variables	**frequencies or mean**
age (in months)	27.49 ± 13.32
body temperature	98.49 ± 0.62
Gender	
Male	78 (56.5)
Female	60 (43.5)
Edema	
Negative	54

Positive	84 (60.9)

Total 138 children meeting the inclusion criteria were included in the study. Average age and body temperature was 27.49 ± 13.32 and 98.49 ± 0.62 Fahrenheit. Out of total 138, 78(56.5) children were male and females were 60(43.5%). Finding of edema was positive in 84 (60.9) children and remain were negative for edema presence.

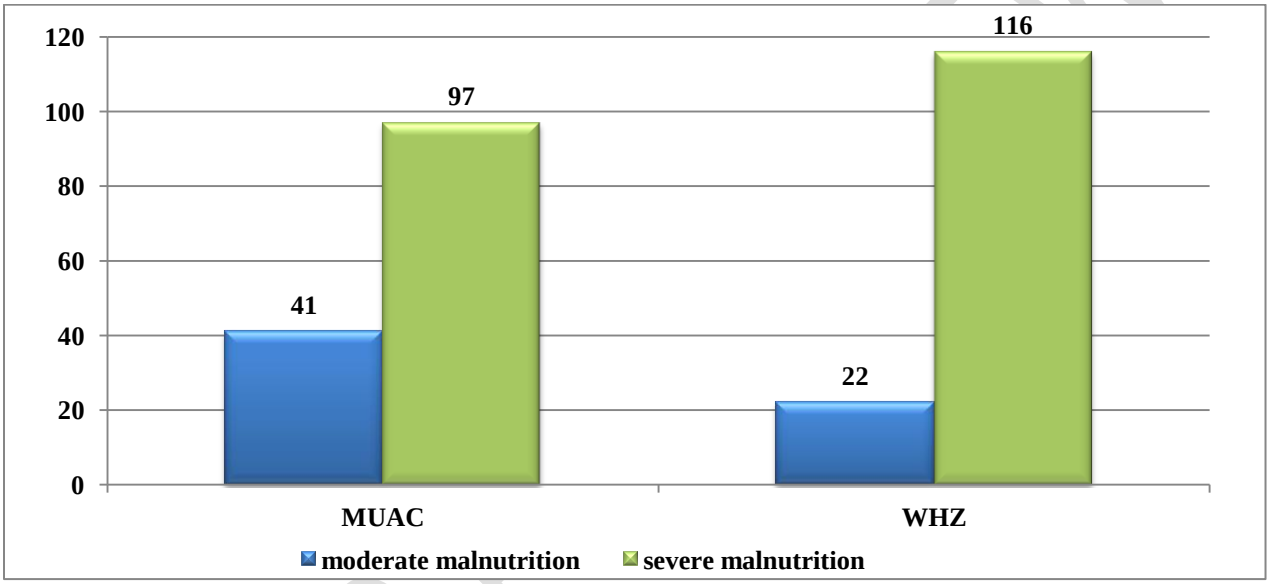

Fig. 1. Prevalence of malnutrition using MUAC and WHZ

Prevalence of moderate malnutrition according to mid upper arm circumference and weight for height z-score was 29.71% (41/138) and 15.94% (22/138) respectively. 70.28% (97/138) and 84.05% (116/138) patients were identified as severe malnourished according to mid upper arm circumference and weight for height z-score respectively.

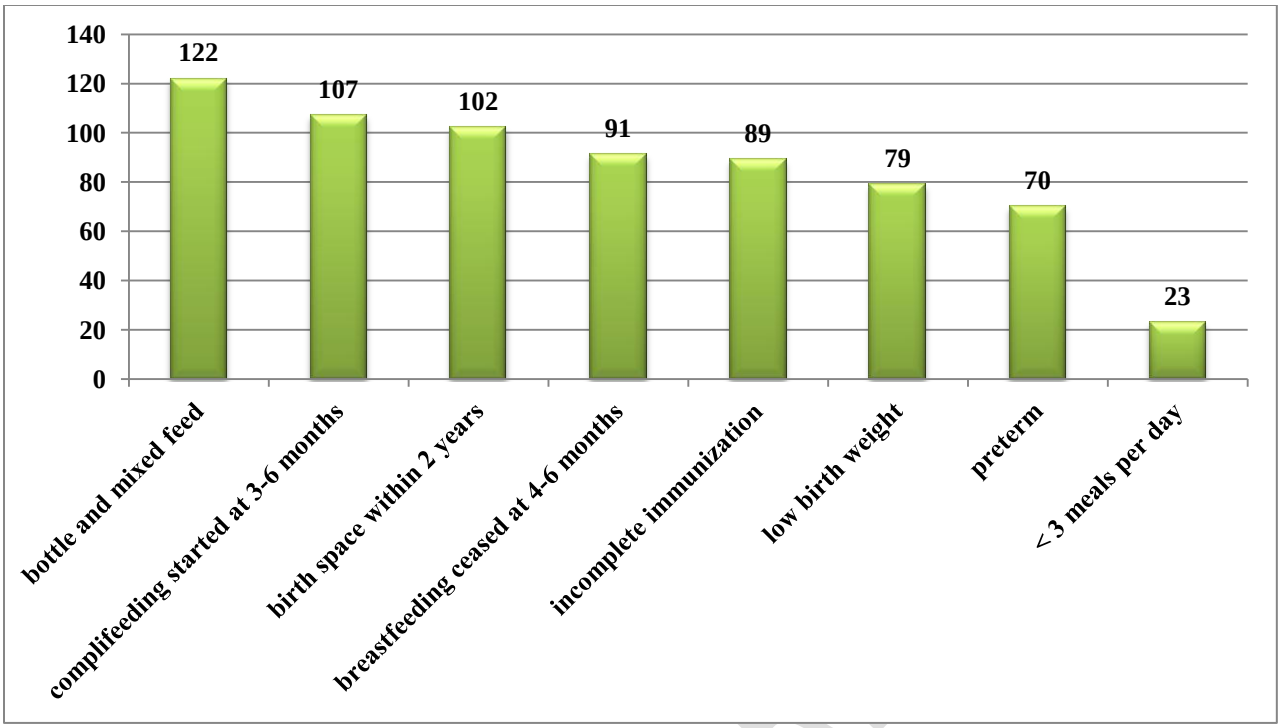

Fig. 2. Prevalence of child related risk factors

The highest child risk factor observed in the study was lack of breastfeeding. 122 (83.3%) children were exposed to lack of breast feeding, out of these 122, 99(81.14) were on mixed feeding and 23 children were on bottle feed. 2nd highest risk factor identified was age at which complimentary feeding was started. It was reported by 107 (77.53%) mothers that they introduced complimentary feeding within 3 to 6 months. Out of 107, 8(7.47%) mothers started complementary feeding before within 3 to 4 months while 98(91.56) mothers introduced complimentary feeding within 5 to 6 months. However, 32 (23.18%) started complimentary feeding after 6 months. 102 (73.91%) children were born with birth interval of within 2 years and 33 (23.9%) were those who had history of birth interval less than a year. 91 (65.94%) admitted that they stopped breast feeding within age of 4 to 6 months. On the other hand, 47 (34.06%) mothers ceased breastfeeding after 6 months. Another risk factor which was present in majority

of the participant was incomplete immunization which was present in 89 (64.45%) children. Only 41 (29.7%) children presented with history of complete immunization while immunization status for 8(5.8%) children was on up to date. History of low birth weight of present in most of the study participants (n=79, 57.24%). More than half of the children (n=70, 50.72%) were born prematurely. 23 (16.67%) mothers responded that they provide < 3 meals to their children in a day.

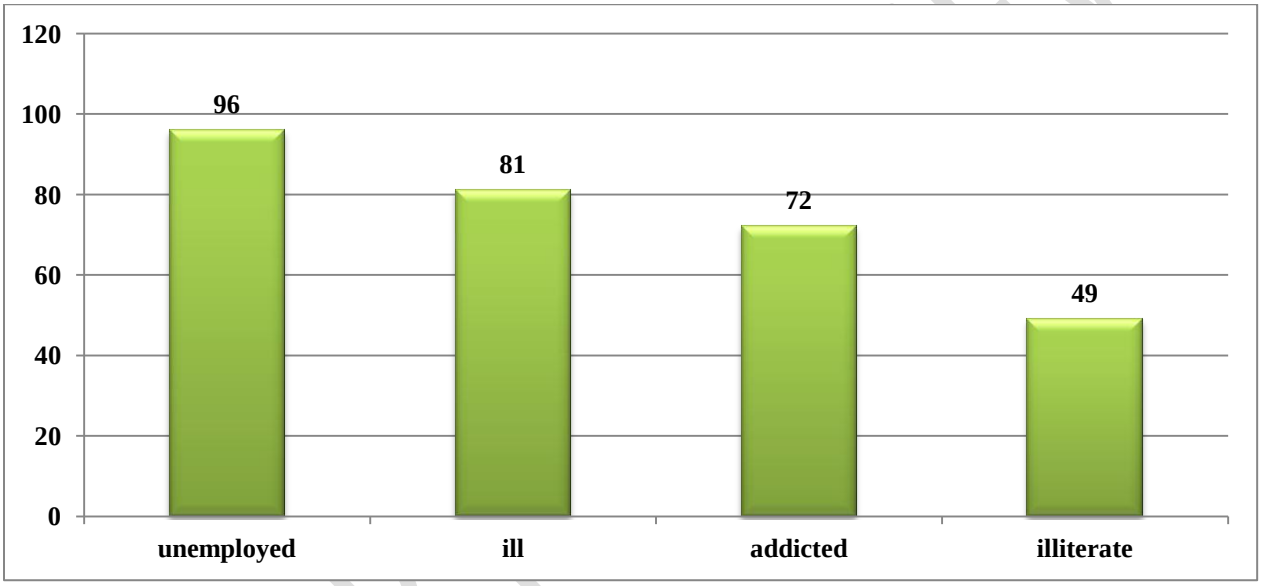

Fig. 3. Prevalence of parental risk factors

The highest parental risk factor was unemployment. 96 (69.57%) fathers of patients were unemployed. 81(58.7%) parents were ill. Majority of the parents (n=72, 52.17%) were addicted. 49(35.50%) parents were completely illiterate. Primary, secondary, higher, bachelor and above were 35(25.36%), 36(26.08%), 12(8.7%), and 4 respectively.

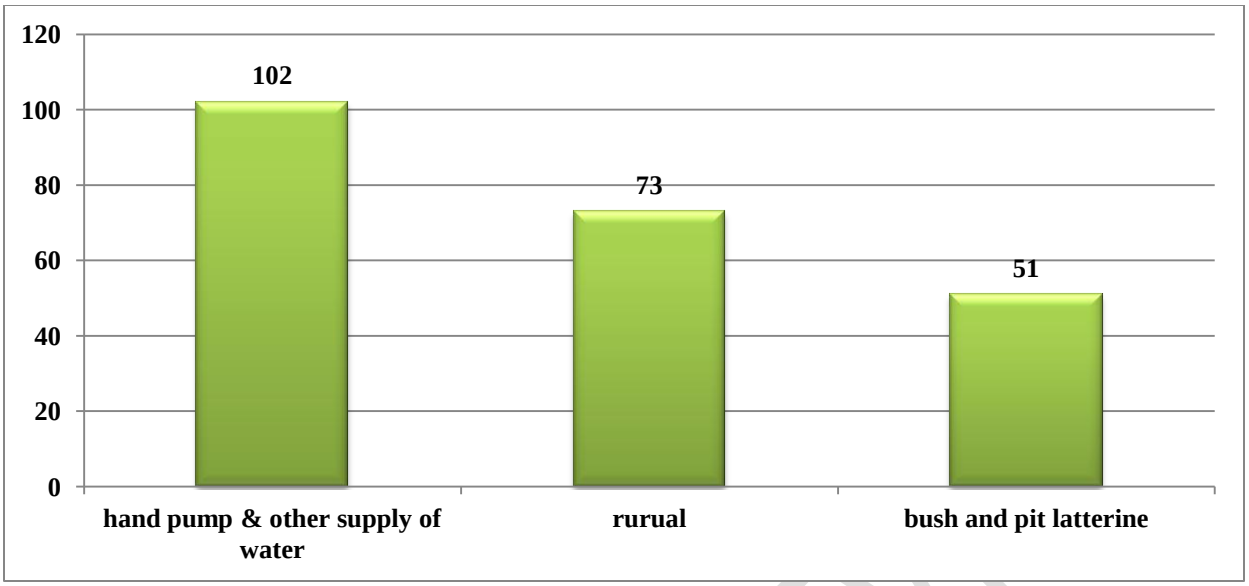

Fig. 4. Prevalence of environmental risk factors

The prevalence for environmental risk factor was highest for inadequate water supply among all risk factors. 102 (73.91%) families had no safe water supply and they were obtaining water either through hand pump or well. 60 (43.5%) were using hand pump water while 42 (30.4%) were getting water from well, tubes or rivers. 36 (26.1%) mothers reported that they had safe source of water and they had motor at their home place to acquire water. Second highest environmental risk factor was belonging from rural area. 73 (52.9%) patients were those who belonged from rural areas. 51 (36.95%) patients had no proper washroom and they were using pit and bush latrines.

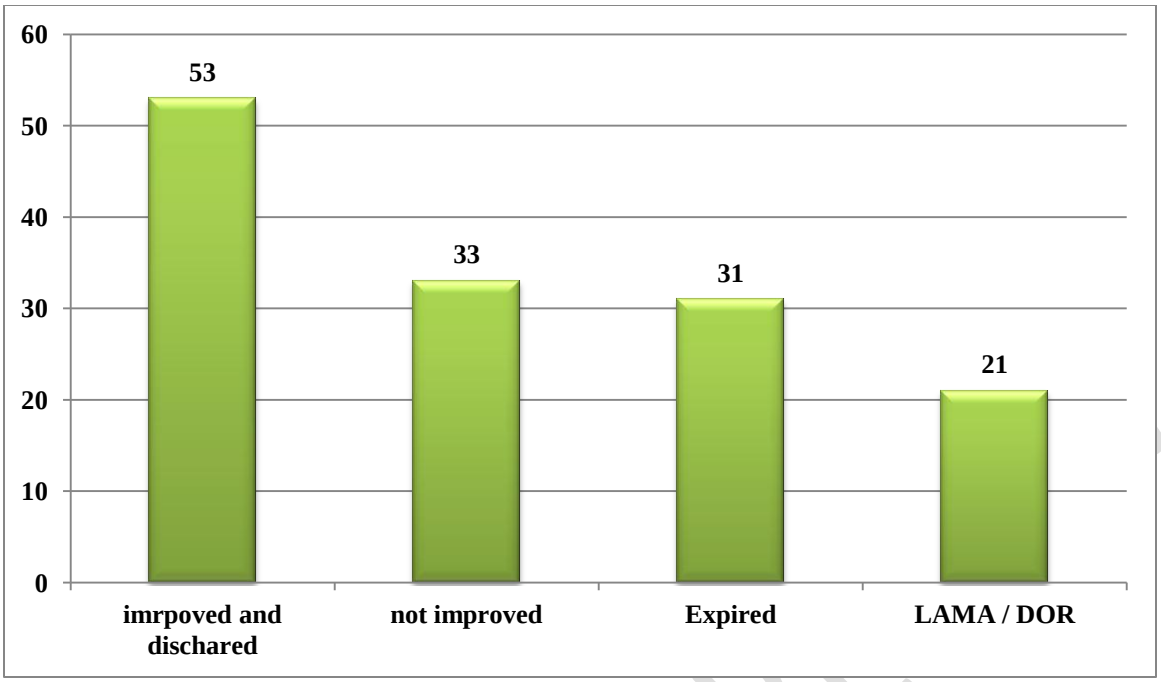

Fig. 5. Frequency of outcome of patients

Most of the patients enrolled into the study were improved and safely discharged (n=53, 38.40%). 33 (23.91%) patients had shown any improvement. 31 (22.46%) patients had expired and 21 (15.21%) were either left against medical advice or discharged on request.

Table 2. Association of outcomes with anthropometric parameters

	Improved	Not improved	Expired	DOR/LAMA	P-value
Gender					
Male	24 (30.8)	24 (30.8)	17 (21.8)	13 (16.7)	0.088
Female	29 (48.3)	9 (15)	14 (23.3)	8 (13.3)	
Presence of edema					
Yes	33 (39.3)	22 (26.2)	18 (21.4)	11(13.1)	0.742
No	20 (37)	11 (20.4)	13 (24.1)	10 (18.5)	
Weight for height					
<-2 SD to >-3 SD	9 (40.9)	7 (31.8)	4 (18.2)	2 (9.1)	ł0.708
<-3SD	44 (37.9)	26 (22.4)	27 (23.3)	19 (16.4)	
Mid-upper arm circumference					
12.5 cm to 11.5 cm	18 (43.9)	13 (31.7)	5 (12.2)	5 (12.2)	0.170
<11.5cm	35 (36.1)	20 (20.6)	26 (26.8)	16 (16.5)	

ł Fisher-Exact test is reported

Ratio of mortality was high among males as compared to females but patients' outcomes were not significantly associated with gender (p=0.088).frequency of improved patients was high among patients presented with edema and expiry was high among those without edema but there was evidence of significant association (p=0.742). Patients' outcomes were also not significantly associated with WHZ and MUAC.

Table 3. Association of outcomes with child related factors

	Improved	Not improved	Expired	DOR/LAMA	P-value
Preterm					
Yes	20 (28.6)	14 (20)	22 (31.4)	14 (20)	*0.008
No	33 (48.5)	19 (27.9)	9 (13.2)	7 (10.3)	
Birth weight					
<2.5	20 (25.3)	13 (16.5)	30 (38)	16 (20.3)	*<0.001
>2.5	33 (55.9)	20 (33.9)	1 (1.7)	5 (8.5)	
Feeding method					
Breast feed	9 (56.2)	6 (37.5)	1 (6.2)	0 (0)	ł*0.007
Bottle feed	4 (17.4)	10 (43.5)	4 (17.4)	5 (21.7)	
Mixed	40 (40.4)	17 (17.2)	26 (26.3)	16 (16.2)	
Age of breastfeeding ceased					
4-6 months	28 (30.8)	24 (26.4)	24 (26.4)	15 (16.5)	0.077
>6 months	25 (53.2)	9 (19.1)	7 (14.9)	6 (12.8)	
Age of complementary feeding					
3-4 months	1 (12.5)	2 (25)	3 (37.5)	2 (25)	ł0.434
5-6 months	36 (36.7)	23 (23.5)	23 (3.5)	16 (16.3)	
>6 months	16 (50)	8 (25)	5 (15.6)	3 (9.4)	
No. of meals per day					
<3	3 (13)	5 (21.7)	11 (47.8)	4 (17.4)	ł*<0.005
3-4	38 (40.4)	23 (24.5)	16 (17)	17 (18.1)	
>4	12 (57.1)	5 (23.8)	4 (19)	0 (0)	
Immunization status					
Complete	26 (63.4)	5 (12.2)	5 (12.2)	5 (12.2)	ł*<0.001
Incomplete	22 (24.7)	28 (31.5)	23 (25.8)	16 (18)	
Up to date	5 (62.5)	0 (0)	3 (37.5)	0 (0)	
Birth spacing					

<1	5 (15.2)	10 (30.3)	14 (42.4)	4 (12.1)	*<0.001
1-2	23 (33.3)	17 (24.6)	16 (23.2)	13 (18.8)	
>2	25 (69.4)	6 (2.8)	1 (2.8)	4 (11.1)	

*P<0.05 was taken as statistically significant
ł Fisher-Exact test is reported

Feeding method was significantly associated with patients' outcome (p=0.007) and it was observed that mortality was high among those who were not mixed feeding method. There was no association of age at which breast feeding was cease and patients' outcome. Starting age of complementary feeding was also not associated with patients' outcome. There was significant association between no. of meals provided per day and patients' outcome. Proportion of expiry was higher among patients who were provided less 3 meals in a day were (p=0.005). Immunization status was also found significantly associated with patients' outcome and mortality was high among those who presented with incomplete immunization status (p<0001). Birth spacing was also found significantly related to patients' outcome and higher proportion of patients expired who had birth space of within a year (p<0.001).

Table 4. Association of Outcomes with parental factors

	Improved	**Not improved**	**Expired**	**DOR/LAMA**	**P-value**
Parental Education					
Illiterate	5 (9.4)	18 (34)	22 (41.5)	8 (15.1)	*<0.001
Primary	13 (41.9)	9 (29)	4 (12.9)	5 (16.1)	
secondary	20 (55.6)	6 (16.7)	3 (8.3)	7 (19.4)	
Higher or above	15 (83.3)	0 (0)	2 (11.1)	1 (5.6)	
Employed					
Yes	34 (81)	1 (2.4)	3 (7.1)	4 (9.5)	*<0.001
No	19 (19.8)	32 (33.3)	28 (29.2)	17 (17.7)	
Health status					
Well	42 (73.7)	6 (10.5)	2 (3.5)	7 (12.3)	*<0.001
ill	11 (13.6)	27 (33.3)	29 (35.8)	14 (17.3)	
Addiction					
Yes	18 (25)	17 (23.6)	23 (31.9)	14 (19.4)	*<0.002
No	35 (53)	16 (24.2)	8 (12.1)	7 (10.6)	

*P<0.05 was taken as statistically significant

All of the parental risk factors were significantly associated with patients' outcome. Proportion of expired children was high among illiterate parents. Similarly expiry of patients was high among unemployed parents, patients who were will and addicted.

Table 5. Association of environmental and socio-economic risk factors with patients' outcome

	Improved	Not improved	Expired	DOR/LAMA	P-value
Residence					
Rural	9 (12.3)	24 (32.9)	28 (38.4)	12 (16.4)	*<0.001
Urban	44 (67.7)	9 (13.8)	3 (4.6)	9 (13.8)	
Type of toilet					
Flush	50 (57.5)	18 (20.7)	6 (6.9)	13 (14.9)	ł*<0.001
Pit	0 (0)	2 (25)	3 (37.5)	3 (37.5)	
Bush	3 (7)	13 (30.2)	22 (51.2)	5 (11.6)	
Water supply					
Hand pump	20 (33.3)	21 (35)	8 (13.3)	11 (18.3)	*<0.001
Motor	30 (83.3)	3 (8.3)	0 (0)	3 (8.3)	
Other	3 (7.1)	9 (21.4)	23 (54.8)	7 (16.7)	
Poor sanitation					
Yes	31 (30.4)	24 (23.5)	28 (27.5)	19 (18.6)	*0.003
No	22 (61.1)	9 (25)	3 (8.3)	2 (5.6)	

*P<0.05 was taken as statistically significant
ł Fisher-Exact test is reported

Patients' residence (p<0.001), type of toilet used (p<0.001), sources for water supply (p<0.001) and poor sanitation (p=0.003) was found to be significantly associated with patients' outcome.

Table 6. Association of demographic factors with malnutrition

Parameter	MUAC			WHZ		
	moderate malnutrition n=41	**Severe malnutrition n =97**	**P-value**	**Moderate malnutrition n=22**	**Severe malnutrition n=116**	**P-value**
Demographic Variables						
age (in months)	26.74 ± 13.82	29.27 ± 12.02	0.310	28.82 ± 14.86	27.24 ± 13.06	0.613
body temperature	98.47 ± 0.57	98.56 ± 0.73	0.474	98.64 ± 0.422	98.46 ± 0.646	0.112
Gender						
male	27 (34.6)	51 (65.4)	0.151	18 (23.1)	60 (76.9)	0.009
female	14 (23.3)	46 (76.7)		4 (6.7)	56 (93.3)	

Average age of patients who diagnosed as moderately malnourished according to MUAC was 26.74 ± 13.82 months whereas mean age of patients who were labeled as severely malnourished was 29.27 ± 12.02 months. The mean of age for severely malnourished patients was greater than those of moderately malnourished patients (as per MUAC) but the difference in mean age of two groups was not statistically significant (p=0.310). Average age of patients for patients who were diagnosed as moderately and severely malnourished as per WHZ was 28.82 ± 14.86 and 27.24 ± 13.06 respectively. But there was no statistically significant difference in mean age between the groups (p=0.613).

The mean temperature for moderately and severely malnourished patients (as per MUAC) was 98.47 ± 0.57 and 98.56 ± 0.73 and no statistically significant difference was observed in mean body temperature (p=0.474). Likewise, no statistically significant difference was observed in mean body temperature for moderately and severely malnourished (as per WHZ) patients (p=0.112).

Among 78 males, 27 (34.6%) were identified as moderately malnourished by MUAC and 51 (65.4%) were severely malnourished. Proportion of males labeled as severely malnourished is greater than those of moderately malnourished. Similarly, out of 60 females, majority females (n=46, 76.7%) were severely malnourished according to MUAC. However, this difference of proportion is significantly different (p=0.151). Among WHZ malnourished patients, 60 (76.9%) males were severely malnourished as compared to 18(23.1%) moderately malnourished patients. 56 (93.3%) females were observed as severely malnourished by WHZ. Therefore, for malnourished patients identified by using WHZ proportion of males and females were significantly higher in severely malnourished group (p=0.009). Therefore, gender was significantly associated with weight-to-height z-score as evident by p-value.

Table 7. Association of child related risk factors with malnutrition

	Mid Upper Arm Circumference			Weigh-for-height Z-score		
	Moderate malnutrition	**Severe malnutrition**	**P-value**	**Moderate malnutrition**	**Severe malnutrition**	**P-value**
Preterm						
Yes	20 (28.6%)	50 (71.4%)	0.766	9 (12.9%)	61 (87.1%)	0.315
No	21 (30.9%)	47 (69.1%)		13 (19.1)	55 (80.9%)	
birth weight (in kg)						
<2.5	15 (19)	64 (81)	*0.001	9 (11.4)	70 (88.6)	0.091
>2.5	26 (44.1)	33 (55.9)		13 (22)	46 (78)	
feeding methods						
bottle feed	8 (34.8)	15 (65.2)	0.308	1 (4.3)	22 (95.7)	ł*0.023
Breastfeed	7 (43.8)	9 (56.2)		6 (37.5)	10 (62.5)	
Mixed	26 (26.3)	73 (73.7)		15 (15.2)	84 (84.8)	
age at breastfed ceased						
4 - 6 months	30 (33)	61 (67)	0.244	16 (17.6)	75 (82.4)	0.464
>6	11 (23.4)	36 (76.6)		6 (12.8)	41 (87.2)	
age at start of complimentary feed						
3 - 4 months	4 (50)	4 (50)	*0.033	1 (12.5)	7 (87.5)	0.574
5 - 6 months	33 (33.7)	65 (66.3)		14 (14.3)	84 (85.7)	
>6	4 (12.5)	28 (87.5)		7 (21.9)	25 (78.1)	
number of meals per day						
<3	5 (21.7)	18 (78.3)	0.128	5 (21.7)	18 (78.3)	ł 0.277
>4	10 (47.6)	11 (52.4)		1 (4.8)	20 (95.2)	
3 to 4	26 (27.7)	68 (72.3)		16 (17)	78 (83)	
immunization status						
Complete	14 (34.1)	27 (65.9)	0.151	6 (14.6)	35 (85.4)	0.915
Incomplete	27 (30.3)	62 (69.7)		15 (16.9)	74 (83.1)	
Up to date	0 (0)	8 (100)		1 (12.5)	7 (87.5)	
birth spacing						
<1 year	10 (30.3)	23 (69.7)	0.82	8 (24.2)	25 (75.8)	0.26

1 - 2 years	12 (33.3)	24 (66.7)	4	8 (11.6)	61 (88.4)	1
> 2 years	19 (27.5)	50 (72.5)		6 (16.7)	30 (83.3)	

*P<0.05 was taken as statistically significant
ł Fisher-Exact test is reported

Total 70 (50.72%) study subjects had history of preterm, out of them 50 (71.4%) and 61 (87.1%) were labeled as severely malnourished by MUAC and WHZ respectively. Proportion of preterm children was higher in severely malnourished group for both MUAC and WHZ. However, this difference of high proportion was not statistically significant for patients identified as malnourished by MUAC (p=0.766) and WHZ (p=0.315).

For MUAC malnourished patients, patients who had low birth weight history were more severely malnourished (n=64, 81%). 15(19) patients were those who had history of low birth weight but they were labeled as moderately malnourished by MUAC. Birth weight was found to be significantly associated with malnutrition (assessed by MUAC). The similar trend observed for patients identified as malnourished by WHZ i.e. prevalence of severe malnutrition was high among patients with history of low birth weight (n = 70, 88.6). However, no statistical association was found between the two factors (p=0.091).

For patients identified as malnourished by MUAC, prevalence of severe malnourishment was high for patients whose feeding method was mixed (n = 73.7%) but there was no evidence of significant association of feeding method with malnutrition (p=0.308). However, feeding method was significantly associated with malnourishment when assessed by WHZ (p= 0.023).

For both MUAC and WHZ groups, frequency of severe malnutrition was high among patients whose breastfeeding was ceased within age of 4-6 months. Total 61 (67%) and 75 (82.4%)

patients were severely malnourished in MUAC and WHZ groups respectively. Nevertheless, the association between ages at which breastfeeding and malnourishment by MUAC (p=0.244) and WHZ (p=0.464) was not statistically significant.

Total 8(5.79%) mothers reported that they started complimentary feeding within 3 to 4 months of their child birth out of them, 4(50) were moderately malnourished and 4(50) were severely malnourished as per criteria of MUAC. Severely malnourishment was higher in prevalence for children who were started with complimentary feeding within 5 to 6 months (n=28, 87.5%) and it was observed that association was significant between the two factors (p=0.033). However, for WHZ group, this association was not significant (p=0.574).

Prevalence of severe malnutrition for MUAC criteria was high for patients who were provided <3 meals in a day (n=18, 78.3%). However, for WHZ malnourished children, the prevalence of severe malnutrition was high for patients who were provided with more than 4 meals in a day. There was no significant association between meals provided in a day malnourishment as determined by MUAC (p=0.128) and WHZ (p=0.277).

Among patients who had complete history of immunization, 14 (34.1) were moderately malnourished and 27 (65.9%) were severely malnourished as per MUAC. Among patients with incomplete immunization history, 62 (69.7%) and 27 (30.3%) were severely and moderately malnourished according to MUAC respectively and all of the patients were severely malnourished whose immunization was up to date. The similar pattern of prevalence was observed WHZ malnourished patients and no statistical significance was observed for MUAC (p=0.151) and WHZ (p=0.915) malnourished patients. No significant association was observed

between birth spacing and malnourished patients as determined by MUAC (p=0.824) and WHZ (p=0.261)

Table 8. Association of parental risk factors with malnutrition

	Mid Upper Arm Circumference			**Weigh-for-height Z-score**		
	Moderate malnutrition	**Severe malnutrition**	**P-value**	**Moderate malnutrition**	**Severe malnutrition**	**P-value**
Marital Status						
married	32 (29.6)	76 (70.4)	0.822	17 (15.7)	91 (84.3)	ł0.583
divorced	1 (16.7)	5 (83.3)		1 (16.7)	5 (83.3)	
separated	3 (42.9)	4 (57.1)		0 (0)	7 (100)	
widow	5 (29.4)	12 (70.6)		4 (23.5)	13 (76.5)	
Parental education						
illiterate	16 (30.2)	37 (69.8)	0.978	10 (18.9)	43 (81.1)	ł0.561
primary	10 (32.3)	21 (67.7)		6 (19.4)	25 (80.6)	
secondary	10 (27.8)	26 (72.2)		5 (13.9)	31 (86.1)	
Higher or above	5 (27.8)	13 (72.2)		1 (5.6)	17 (94.4)	
Occupation						
employed	13 (31)	29 (69)	0.833	4 (9.5)	38 (90.5)	0.173
Unemployed	28 (29.2)	68 (70.8)		18 (18.8)	78 (81.2)	
Health status						
well	18(31.6)	39 (68.4)	0.687	7 (12.3)	50 (87.7)	0.324
Ill	23 (28.4)	58 (71.6)		15 (18.5)	66 (81.5)	
Addiction						
Yes	14 (19.4)	58 (80.6)	*0.006	14 (19.4)	58 (80.6)	0.24
No	27 (40.9)	39 (59.1)		8 (12.1)	58 (87.9)	

*P<0.05 was taken as statistically significant
ł Fisher-Exact test is reported

Proportion of severe malnutrition was higher than moderate malnutrition for all of sub-categories of marital status of parent for both MUAC and WHZ. Thus, no significant association was observed for marital status of parent and occurrence of malnutrition by criteria of MUAC

(p=0.822) and WHZ (p=0.583). Although prevalence of severe malnutrition was high among illiterate but there was no significant association between parent education and malnutrition. Similarly, pattern observed for occupation of parent i.e. prevalence severe of malnutrition by MUAC and WHZ was higher among those parents who were unemployed as compared to moderate malnutrition but there was no statistical significance between the two factors for both the criteria i.e. for MUAC (p=0.833) and WHZ (p=0.173). Health status of parent was also had no impact on prevalence of malnutrition of their children as no statistically significant association was observed between health status malnutrition as determined by using MUAC (p=0.687) and WHZ (p=0.324). Proportion of severe malnutrition was higher for patients whose parents were addicted as compared to non-addicted parents. Among 72 addicted parents, 58 (80.6%) children were severely malnourished as per MUAC criteria. Out of 66 non-addicted parents, 39 (59.1%) children were severely malnourished according to MUAC. Statistical significance was observed between addicted parents and malnourishment for MUAC group (p=0.006). The similar phenomenon was observed for WHZ malnourished patients and addiction however, no significant association was observed (p=0.24).

Table 9. Association of environmental and socio-economic factors with malnutrition

	Mid Upper Arm Circumference			Weigh-for-height Z-score		
	Moderate malnutrition	**Severe malnutrition**	**P-value**	**Moderate malnutrition**	**Severe malnutrition**	**P-value**
Residence						
Rural	18 (24.7)	55 (75.3)	0.169	16 (21.9)	57 (78.1)	*0.042
urban	23 (35.4)	42 (64.6)		6 (9.2)	59 (90.8)	
type of toilet						
Flush	29 (33.3)	58 (66.7)	0.362	13 (14.9)	74 (85.1)	0.227
Pit	1 (12.5)	7 (87.5)		3 (37.5)	5 (62.5)	
Bush	11 (25.6)	32 (74.4)		6 (14)	37 (86)	
water supply						
hand pump	16 (26.7)	44 (73.3)	0.068	11 (18.3)	49 (81.7)	0.348
motor	16 (44.4)	20 (55.6)		3 (8.3)	33 (91.7)	
others	9 (21.4)	33 (78.6)		8 (19)	34 (81)	
Sanitation						
Poor	28 (27.5)	74 (72.5)	0.328	16 (15.7)	86 (84.3)	0.890
Satisfactory	13 (36.1)	23 (63.9)		6 (16.7)	30 (83.3)	

*P<0.05 was taken as statistically significant

Among rural resident, 18 (24.7%) and 55 (75.3%) were labeled as moderately and severely malnourished by MUAC i.e. among rural residents, the prevalence of severe malnutrition was high as compared to moderate malnutrition. There 65() study participants from urban out of which 42 (64.6%) were severely malnourished and remaining were moderately malnourished. But no statistical significance association was observed between area of residence and MUAC malnutrition (p=0.169). Same trend for prevalence of malnutrition was observed for WHZ malnourished patients i.e. frequency of severe malnutrition was high among rural residents as

compared to moderate malnutrition and statistically significant association was observed among WHZ malnutrition and residence (p=0.042). There was no significant association between type of toilet and malnutrition by MUAC (p=0.362) and WHZ (p=0.227). Proportion of severely malnourished identified by using MUAC criteria was highest among those who acquired water from river, lake or tube wells as compared to moderate malnutrition but no significant association was indicated between source and MUAC malnutrition (p=0.068). Significant association of water sources was also not observed for WHZ malnutrition (p=0.348). Prevalence of MUAC malnutrition was higher among those who sanitation status was poor but no evidence was found for significant association (p=0.328). Similarly, for WHZ malnutrition, proportion of severely malnourished was higher than moderate malnourished among poor sanitation patients but there was no significant association (p=0.890).

Table 10. Association of patients' outcome with malnutrition

	Mid Upper Arm Circumference			**Weigh-for-height Z-score**		
	Moderate malnutrition	**Severe malnutrition**	**P-value**	**Moderate malnutrition**	**Severe malnutrition**	**P-value**
improved and discharge	18 (34)	35 (66)	0.170	9 (17)	44 (83)	ł0.708
not improved	13 (39.4)	20 (60.6)		7 (21.2)	26 (78.8)	
DAMA or DOR	5 (23.8)	16 (76.2)		2 (9.5)	19 (90.5)	
expired	5 (16.1)	26 (83.9)		4 (12.9)	27 (87.1)	

ł Fisher-Exact test is reported

High proportion of mortality was observed for MUAC malnourished patients (n = 26, 83.9%) followed by patients who were not improved (n=20, 60.6%) as compared to moderate malnourished patients. However, significant association was not found between MUAC malnutrition and patients' outcome (p=0.170). For WHZ malnutrition, the highest proportion of severe malnourishment was observed for

DISCUSSION

Malnutrition is major public health issue in developing countries. It was stated in a report issued by UNICEF in 2006 that approximately 146 million children in low and middle income countries are underweight that contributes to one out of 4 children and more than half of these children belong India, Bangladesh and Pakistan [12]. The reasons due to which children are at high risk of malnutrition includes poor diet, inadequate care, infectious diseases and unbalanced food distribution within the household in low middle income countries[13] Therefore, the presents study was conducted with aim to assess prevalence and risk factors of malnutrition among infants in district of Sindh. The study enrolled total 138 patients with mean age of 27.49 ± 13.32 months. The mean age of 26.36±13.9 months was also reported in a previously conducted study [14].

Mid upper arm circumference and weight to height ratio was used to assess status of nutrition among study participants. According to MUAC prevalence of moderate and severe malnutrition was 29.71% (41/138) and 70.28% (97/138) respectively. Our finding is consistent with another study conducted in Pakistan that showed prevalence of moderate and severe malnutrition was 26.8% and 73.2% using the same cut-off that we used in our study [14].The prevalence of severe malnutrition by using WHZ was 84.05% (116/138). In our study, the prevalence of severe malnutrition found by using WHZ was similar to the study conducted in South East Asia and reported higher prevalence of severe malnutrition when found alone with WHZ as in our study [15]. However, the result is contradictory to study conducted in Pakistan that found 30% children had WHZ scoring <-2SD and 70% had scoring <-3SD [14]. Another Pakistani study, conducted in Tharparkar-Sindh, showed prevalence of WHZ severe malnutrition using the same cut-off was 48% [16]. The reason of high severe malnutrition in our study was that only malnourished children were included in our study and out of total malnourished, break

up was presented for moderate and severe malnourished study participants. Most of the study participants in our study were males (56.5%) as compared to females (43.5%) which indicated that malnutrition was higher among males as compared to females. The finding is in agreement with study conducted in Tharkparkar that reported high prevalence of severe malnutrition among males (53.44%) as compared to females (40.42%) [16].The study conducted by Azuine et al. [14] also reported the male dominance (52.5%) as compared to females.

In our study, various risk factors that could have association with malnutrition were studied and categorized as child risk factors, parental risk factors and socio-economic and environmental risk factors. The association of these risk factors was also observed with patients' outcome. Among child risk factors, the highest risk factors observed was lack of breastfeeding. In our study, 83.3% children were exposed risk of improper breastfeeding including children who were either on bottle or mixed feeding. It was reported in another study conducted in rural areas of Sindh that 75% mothers continued breastfeeding for at least two years of age [17]. In our study, feeding method also found significantly associated with patients' outcomes. The study conducted in USA also reported that increase in exclusive breastfeeding was associated with decrease in child mortality[14].The single essential factor in reducing child deaths and morbidity is exclusive breastfeeding at least for six months [18]. It is also recommended by World Health Organization (WHO) that breastfeeding should be begun quickly after the birth and must be on-going for six months followed by complementary food till age of 24 months [19].

In the present study, birth interval for 73.91% children was less than 24 months. The finding is agreement with study an Indian study that also reported majority of the malnourished children had birth interval of less than 24 months [20]. The higher proportion of short birth interval could be attributed to the fact that most of families belong to rural area and illiterate who had no

awareness regarding family planning. Many studies have reported birth interval of <24 months as a risk factor of malnutrition [12]. In our study, birth spacing was significantly related to patients' outcome and expiry was significantly higher for children who had history of birth interval < 2 months. Fotso et al [15] also found in his study that preceded birth space of < 18 months was associated with increased mortality risk.

In this study, majority (64.49%) children had history of incomplete immunization who were either MAM or SAM. However, there was no significant difference in prevalence of MAM and SAM. However, there are studies that showed significant association of immunization status with malnutrition [13][21]. In our study, frequency of expired children was high for those who had incomplete immunization status and was significantly associated with patients' outcome. It was also reported in another study conducted in 2016 that relative risk for mortality after vaccination was significantly lower for all-cause mortality [22].

Another risk that was prevalent in our study was low birth weight. In the current study, low birth weight was prevalent among 57.24% children and also significantly associated with malnutrition when diagnosed using MUAC. However, found non-significant association for WHZ malnutrition. The finding of significant association of low birth weight is line with other studies. A Bangladeshi study reported high prevalence of stunting among children who had history of low birth weight as compared to normal birth weights children. The study reported that low birth children had significantly higher risk to develop malnutrition as compared to health children [23]. Another study conducted in Malawi, also reported a significant association of low birth with child nutrition status [24]. In our study, there was significant association with LBW and patients' outcome and frequency of expired patients was high for LBW children. The finding is

in agreement with other study that reported LBW babies had higher risk of mortality during infancy as compared to babies weighing 3500grams or above [16].

The prevalence for risk factor preterm was 50.72% and prevalence of severe malnutrition was high among preterm babies. The study conducted in Ethiopia found that being preterm was associated with high risk of wasting and underweight [25]. In our study, high frequency of expiry was observed for patients who were preterm and there was significant association between patients' outcome and being born as preterm. Another study also showed that high risk of neonatal mortality for preterm and small gestational age babies [17].

Among parental risk factors, the most prevalent was unemployment of parents followed by their unhealthy status, addiction and illiteracy. Being an unemployed is an indicator of low socioeconomic status which could impact child's nutritional status. A study conducted in Pakistan report significant association of socioeconomic status with stunted and underweight malnourished children [26]. Parental education and monthly income was also found significant risk factor for wasting in an Ethiopian study [25]. Other studies conducted in Vietnam and China also found significant association of maternal education and low income with malnutrition indicators [27][28] .

In our study, the highly prevalent environmental risk factor was use of unsafe water. 102(73.91%) people reported that they acquire water either through hand pump or river or lakes. The frequency of moderate and severe malnutrition was not statistically different for people who were using safe and unsafe water. DHS data showed statistical association of water source with height-for-age, weight-for-age and weight-for-height [26]. A study conducted in Iraq found significant association between drinking water source and nutritional status[29]. In our study,

water source was related to child mortality as expiry was high for those who were acquiring water from unsafe water sources (hand pump, river, lakes etc). The finding is consistent with study conducted in Nigeria that observed high mortality risk for children who were using unimproved water[18].

Most of participants were from rural area which was found significant for WHZ malnutrition in our study. The finding is consistent with DHS data that also found that rural residence increases risk of stunting and underweight[26]. In the current study, 51(36.96%) were not using safe toilet facility which indicates poor sanitation practices. There are studies that significantly associated type of toilet used and nutritional status[26],[30].

In our study, poor sanitation, types of toilet and residence area were also significantly associated with patients' outcome. Poor sanitation was also found significant mortality predictor in Nigerian study [18]. In an Indian study, type of toilet facility was also found significantly associated with high death risk among under five years of children [19].

CONCLUSION

Frequency of severe malnutrition was high in our study as determined by MUAC and WHZ. Majority of malnourished children was male as compared to females. All of the child related factors were associated with patients' outcome and expiry was high among child who presented with history of LBW, preterm, incomplete immunization status, mal-practices for breast feeding and inadequate meals per day. Parental factors and environmental factors were also associated with patients' outcome. Educational sessions should be also be conducted through free lectures to create awareness among mother for breastfeeding and child-related nutrients requirements. Campaigns should be started for monitoring of immunization status. Policy makers should

intervene to provide safe drinking water and create employment opportunities to reduce unemployment which was observed associated with patients' outcome in our study.

REFERENCES

1. Tette EM, Sifah EK, Nartey ET. Factors affecting malnutrition in children and the uptake of interventions to prevent the condition. BMC Pediatr. 2015;15:189.
2. Arthur SS, Nyide B, Soura AB, Kahn K, Weston M, Sankoh O. Tackling malnutrition: a systematic review of 15-year research evidence from INDEPTH health and demographic surveillance systems. Glob Health Action. 2015;8:28298.
3. Sahu SK, Kumar SG, Bhat BV, Premarajan KC, Sarkar S, Roy G, et al. Malnutrition among under-five children in India and strategies for control. J Nat Sci Biol Med. 2015;6(1):18-23.
4. Nisar MU, Anwar Ul Haq MM, Tariq S, Anwar M, Khawar A, Waqas A, et al. Feeding Patterns and Predictors of Malnutrition in Infants from Poor Socioeconomic Areas in Pakistan: A Cross-sectional Survey. Cureus. 2016;8(1):e452.
5. Khattak UK, Iqbal SP, Ghazanfar H. The Role of Parents' Literacy in Malnutrition of Children Under the Age of Five Years in a Semi-Urban Community of Pakistan: A Case-Control Study. Cureus. 2017;9(6):e1316.
6. Manjunath R, K JK, Kulkarni P, Begum K, R GM. Malnutrition among under-five children of kadukuruba tribe: need to reach the unreached. J Clin Diag Res. 2014;8(7):Jc01-4.
7. Das JK, Achakzai AB, Bhutta ZA. Stop stunting: Pakistan perspective on how this could be realized. Matern Child Nutr. 2016;12 Suppl 1(Suppl Suppl 1):253-6.
8. Mustufa MA, Jamali AK, Sameen I, Burfat FM, Baloch MY, Baloch AH, et al. Malnutrition and poor oral health status are major risks among primary school children at Lasbela, Balochistan, Pakistan. J Health Pop Nutr. 2017;36(1):17.
9. Asfaw M, Wondaferash M, Taha M, Dube L. Prevalence of undernutrition and associated factors among children aged between six to fifty nine months in Bule Hora district, South Ethiopia. BMC Public Health. 2015;15:41.

10. Bentley A, Das S, Alcock G, Shah More N, Pantvaidya S, Osrin D. Malnutrition and infant and young child feeding in informal settlements in Mumbai, India: findings from a census. Food Sci Nutr. 2015;3(3):257-71.
11. Kanan SO, Swar MO. Prevalence and outcome of severe malnutrition in children less than five-year-old in Omdurman Paediatric Hospital, Sudan. Sudanese journal of paediatrics. 2016;16(1):23-30.
12. Farid-ul-Hasnain S, Sophie R. Prevalence and risk factors for Stunting among children under 5 years: a community based study from Jhangara town, Dadu Sindh. J Pak Med Assoc. 2010;60(1):41.
13. Gebre A, Reddy PS, Mulugeta A, Sedik Y, Kahssay M. Prevalence of Malnutrition and Associated Factors among Under-Five Children in Pastoral Communities of Afar Regional State, Northeast Ethiopia: A Community-Based Cross-Sectional Study. J Nutrition Metab. 2019;2019.
14. Azuine RE, Murray J, Alsafi N, Singh GK. Exclusive Breastfeeding and Under-Five Mortality, 2006-2014: A Cross-National Analysis of 57 Low- and-Middle Income Countries. Int J Mch Aids. 2015;4(1):13-21.
15. Grellety E, Golden MH. Weight-for-height and mid-upper-arm circumference should be used independently to diagnose acute malnutrition: policy implications. BMC Nutrition. 2016;2(1):10.
16. Khan GN, Turab A, Khan MI, Rizvi A, Shaheen F, Ullah A, Hussain A, Hussain I, Ahmed I, Yaqoob M, Ariff S. Prevalence and associated factors of malnutrition among children under-five years in Sindh, Pakistan: a cross-sectional study. BMC Nutrition. 2016;2(1):69.
17. Katz J, Lee AC, Kozuki N, Lawn JE, Cousens S, Blencowe H, et al. Mortality risk in preterm and small-for-gestational-age infants in low-income and middle-income countries: a pooled country analysis. Lancet. 2013;382(9890):417-25.
18. Ezeh OK, Agho KE, Dibley MJ, Hall J, Page AN. The impact of water and sanitation on childhood mortality in Nigeria: evidence from demographic and health surveys, 2003-2013. Int J Environ Res Public Health. 2014;11(9):9256-72.

19. Bora JK, Raushan R, Lutz W. The persistent influence of caste on under-five mortality: Factors that explain the caste-based gap in high focus Indian states. BioRxiv. 2019:516070.
20. Shahjada A, Sharma B, Sharma S, Mahashabde P, Bachhotiya A. Effects of birth interval on nutritional status of under five children in periurban area of Madhya Pradesh, India. International J Med Sci Public Health. 2014;3(6):723-7.
21. Ma'alin A, Birhanu D, Melaku S, Tolossa D, Mohammed Y, Gebremicheal K. Magnitude and factors associated with malnutrition in children 6–59 months of age in Shinille Woreda, Ethiopian Somali regional state: a cross-sectional study. BMC Nutrition. 2016;2(1):44.
22. McCarthy NL, Gee J, Sukumaran L, Weintraub E, Duffy J, Kharbanda EO, et al. Vaccination and 30-day mortality risk in children, adolescents, and young adults. Pediatrics. 2016;137(3):e20152970.
23. Rahman MS, Howlader T, Masud MS, Rahman ML. Association of Low-Birth Weight with Malnutrition in Children under Five Years in Bangladesh: Do Mother's Education, Socio-Economic Status, and Birth Interval Matter? PLoS One. 2016;11(6):e0157814.
24. Ntenda PAM. Association of low birth weight with undernutrition in preschool-aged children in Malawi. Nutr J. 2019;18(1):51.
25. Amare D, Negesse A, Tsegaye B, Assefa B, Ayenie B. Prevalence of undernutrition and its associated factors among children below five years of age in Bure Town, West Gojjam Zone, Amhara National Regional State, Northwest Ethiopia. Adv in Public Health. 2016;2016.
26. Abbasi S, Mahmood H, Zaman A, Farooq B, Malik A. Indicators of Malnutrition in Under 5 Pakistani Children: A DHS Data Secondary Analysis. J Med Res Health Educ. 2018;2(3):12.
27. Zhang J, Shi J, Himes JH, Du Y, Yang S, Shi S, et al. Undernutrition status of children under 5 years in Chinese rural areas-data from the National Rural Children Growth Standard Survey, 2006. Asia Pac J Clin Nutr. 2011;20(4):584.
28. Demissie S, Worku A. Magnitude and factors associated with malnutrition in children 6-59 months of age in pastoral community of Dollo Ado district, Somali region, Ethiopia. Sci J Public Health. 2013;1(4):175-83.

29. Hasanain F, Jamsiah M, Zaleha M, Azmi MTamil MA. Association between drinking water sources and diarrhea with malnutrition among kindergarten's children in Baghdad city, Iraq. Malays J Public Health Med. 2012;12(1):45-8.
30. van Cooten MH, Bilal SM, Gebremedhin S, Spigt M. The association between acute malnutrition and water, sanitation, and hygiene among children aged 6–59 months in rural E thiopia. Matern Child Nutr. 2019;15(1):e12631.