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Red Blood Cell Parameters among Malnourished Children Under-Five Years Attending Al-Sadaqa Teaching Hospital, Aden-Yemen

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ABSTRACT

Malnutrition means deficiencies or inadequate nutrients as well as excesses or imbalances of nutrients intake by the individuals. This study was aimed to determine the abnormal Red blood cell parameters among malnourished children under-five years attending AL-Sadaqa teaching hospital, Aden governorate and to determine the associated factors related to malnutrition as well as abnormal parameters among those children. A hospital based cross-sectional study was conducted on 101 malnourished children under 5years. The blood samples were collected from all studied group and the hematological parameters were measured by using automated hematological analyzer from (Sysmex) Company and the data was analyzed by SPSS. Out of 101 malnourished children, majority were females 55(54.5%).The highest percentage was 51.5% among MAM while the SAM and 48.5%. The means of RBCs, HCT, MCV and MCHC were slightly decreased with increasing of RDW among SAM children than MAM. Significant associations were found between children with age group >20 and their residence and acute malnutrition (p=0.049 and p=0.015). About 81.40% of malnourished children had anemia with only 4% of children had severe anemia. The percentages of low RBCs, HCT, MCV, MCH and MCHC were 48%, 92.2%, 88.2%, 93.1% and 63.7%, respectively, while 77.2% of children had high RDW. Significant associations between residence, illustrate and primary school education of both fathers and Mothers and anemia (p=0.043, 0.005, 0.003, 0.02 and 0.005), respectively. It can be concluded that the prevalence of SAM and anemia among children under-five years in Aden, Yemen were high. The residence increasing the risk of SAM, anemia and decreasing of most RBC parameters among children. The severity of acute malnutrition and RDW are increased by increasing the age of children. The low education levels of both father and mothers may be another factor that contributing in decreasing the levels of most RBC parameters.

Keywords: RBC parameters, Malnutrition, Children, Under Five years, Aden, Yemen.

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INTRODUCTION

The term malnutrition doses not only mean deficiencies or inadequate nutrients but it involved excesses or imbalances of nutrients intake by the individuals (1). Undernutrition' is characterized by abnormal height and weight where some malnourished children show low height for age (stunting), some show low weight for height z-score (WHZ) (wasting) and other show low weight for age (underweight) .(2)

Malnutrition may be acute or chronic. In acute malnutrition, the nutritional status of individual is deteriorated rapidly during short period of time (3,4).There are two forms of acute malnutrition include: moderate acute malnutrition (MAM) and severe acute malnutrition (SAM). The main diagnostic characteristics of SAM are the presence of oedema of feet, severe wasting (WHZ < −3) and mid-upper arm circumference (MUAC) < 115 mm while MAM is defined by moderate (WHZ −2 and −3), MUAC between 115 mm and <125 mm (5). SAM among children is the major health issue in Yemen.(6)

Red blood cell (RBC) parameters (indices) are group of tests that used for diagnosis and differentiate anemias (7). Anemia is one of hematological disorders that characterized by either reduction of RBCs or hemoglobin (HGB) or hematocrit (HCT) (8).The disorder effects individuals in all ages but occur more frequently among pregnant women and malnourished children especially those under-five children (9). The RBC parameters abnormalities may directly be effected by malnutrition especially deficiency of nutrients leading to risk of mortality among malnourished children (10). Other parameters include:, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW) may also effected due to decreasing of nutrients.(11)

Micronutrient is a term is used to describe lacking or insufficient of essential nutrients such as vitamins and minerals. Excessive uptake of nutrients leads to overweight and obesity which increase the risk of heart diseases (12). Malnutrition results from deficiency of iron, protein-energy, vitamin A, iodine and other essential nutrients .(13)

The risk of malnutrition is threaten millions of people globally where the worst hit being among children (14).World Health Organization (WHO) estimated that prevalence of stunted, wasted and overweighed children under 5years globally were 149 million, 45 million and 37 million, respectively (12) and it estimated about 40% of children between aged 6 to 59 months had anemia (15). In Yemen, there no any published data about the association between malnutrition and RBC parameters among under-five children. Therefore this study were aimed to determine the abnormal red blood cell parameters among malnourished children under-five years Aden and to determine the associated factors related to malnutrition as well as abnormal parameters among those children.

Therefore this study was aimed to determine the abnormal Red blood cell parameters among malnourished children under-five years attending AL-Sadaqa teaching hospital, Aden governorate and to determine the associated factors related to malnutrition as well as abnormal parameters among those children.

SUBJECTS AND METHODS

This hospital based cross-sectional study was conducted on 101 malnourished children under 5years during period from January to June 2024 who were admitted at the nutrition clinic of the Al-Sadaqa Teaching Hospital, Aden. The questionnaire was previously designed to collect data from all children and their parents but with some modifications. It included: age, sex, residence, measurement to diagnosis the type of acute malnutrition as (height, weight, MUAC, Z score) and the presence of microbial infections for children and education level, occupation and size of family for their parents and breast feeding of mother (10,16). Malnourished children with age below 5 years were enrolled in the our study while those non-malnourished children

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and those above years of age and chilfren who had been received a blood transfusion in the last three months, children who had been confirmed chronic diseases like renal failure, cancer and liver diseases, and children with tuberculosis (TB) and Acquired immunodeficiency syndrome (AIDS) were excluding from the study. Five ml of venous blood was collected into tubes containing ethylene diamine tetra acetic acid (EDTA), and then hematological parameters were measured by using automated hematological analyzer from (Sysmex) Company.

STATISTICAL ANALYSIS

A statistical package for social sciences (SPSS) software (version 22) was uses to analyses the data. The normal distributed quantitative data was expressed as mean value, and standard deviation (SD) and the qualitative data was expressed as percentages and chi -square (x2) test was used for the estimation of probability between of two variables where the significant P-value was (≤ 0.05).

RESULTS

A Total 101 of malnourished children under 5 years were enrolled in our study, majority were females 55(54.5%) (table1).The highest percentage was 51.5% among MAM than 48.5% among SAM and (figure1). The means of RBCs, HCT and MCHC were slightly decreased with increasing of RDW among SAM children than MAM (table2). Significant associations were found among children with age group >20 and their residence and acute malnutrition (p=0.049 and p=0.015), respectively, but there was no any significant association between RBC parameters and malnutrition (table 3). About 81.40% of malnourished children had anemia and the percentages of low RBCs, HCT, MCV, MCH and MCHC were 48%, 92.2%, 88.2%,93.1% and 63.7%, respectively, while 77.2% of children had high RDW (figure 2). Only 4% of children had severe anemia while the mild and moderate anemia were 31.7% and 45.5%, respectively (figure 3). Significant associations between residence, illustrate and primary school education of both fathers and Mothers and anemia (p=0.043, 0.005, 0.003, 0.022, and 0.005), respectively. Low RBCs was associated with males, age groups <10 and >20 months, rural residence, illiterate education and private work of fathers and illiterate and secondary education of mothers, breast feeding and parasitic infection (p=0.0001, 0.005, 0.015, 0.019, 0.005, 0.051, 0.003, 0.038, 0.057 and 0.010), respectively (table 4).

The age groups <10 months of children, daily laborer and government employee as occupations of father and university education of mother were significantly associated with low MCV (p=0.058, 0.026 and 0.037 and 0.037), respectively. The primary education of father had a significant association with low HCT (p=0.014). The age group <10 months was associated with low MCH (p=0.041). The age group <10 and 10-20 months and residence had significantly associations with low MCHC (p=0.014, 0.040 and 0.024), respectively. The associations were also statistical significant between high RDW and age group 10-20 months and >20 months (p=.006 and 0.005), respectively (table 4).

Table (1): Distribution of malnourished children under 5 years according to their age and sex, Aden-Yemen

Age/months	Male		Female		Total	
	No.	%	No.	%	No.	%
<10 Months	19	44.1	15	55.9	34	33.7
10-20 Months	16	51.6	15	48.4	31	30.7
>20Months	11	30.6	25	69.4	36	35.6
Total	46	45.5	55	54.5	101	100.0

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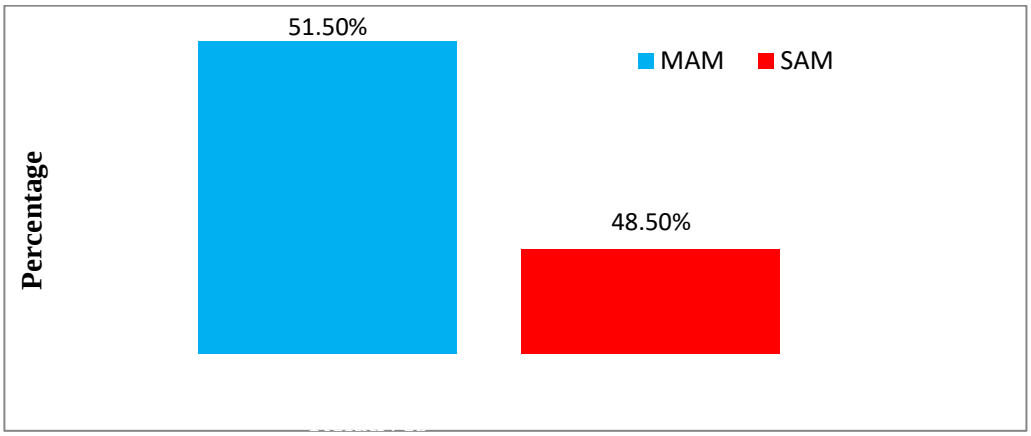

Fig. 1. The prevalence of MAM and SAM among children under 5 years, Aden-Yemen

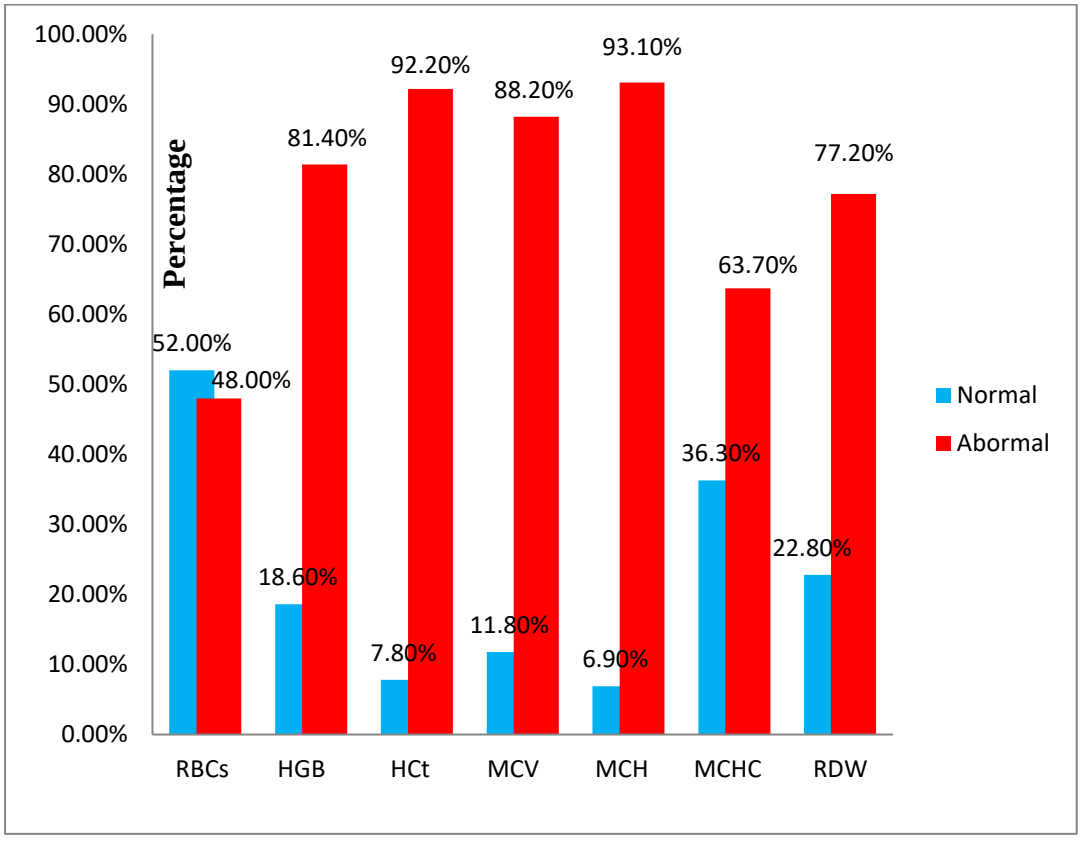

Fig. 2. The prevalence of abnormal red blood cell parameters among malnourished children under-five years, Aden-Yemen

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RBCs: red blood cells; HGB, hemoglobin; MCV: mean corpuscular volume; HCT: hematocrit; MCH: mean corpuscular hemoglobin; MCHC: mean corpuscular hemoglobin concentration; RDW: red cell distribution width.

Table (2): Association of mean, min-max values and percentages of abnormal RBC parameters with acute malnutrition among children under 5 years, Aden- Yemen

RBCs parameters		MAM (n=52)		SAM (n=49)		*P*
		No.	%	No.	%	
HGB (g/dL)	Decreased	44	84.6	38	77.6	0.257
	Min. – Max.	5.8-13.0		4.6-14.8		
	Mean ± SD.	9.79 ± 1.35		9.84 ± 1.64		
RBCs (×10¹²/L)	Decreased	29	55.8	29	59.2	0.442
	Min. – Max.	2.40-5.61		2.63-6.35		
	Mean ± SD.	4.45 ±0.581		4.39 ±0.748		
MCV (fL)	Decreased	47	90.4	42	85.7	0.338
	Min. – Max.	14.0-89.8		49.2-84.7		
	Mean ± SD	70.42±7.11		70.42±11.51		
HCT (%)	Decreased	49	94.2	44	89.8	0.325
	Min. – Max.	16.7-38.5		15.9-45.8		
	Mean ± SD	31.129±4.06		31.022±523		
MCH (pg)	Decreased	50	96.2	44	89.8	0.194
	Min. – Max.	13.7-40.1		16.9-31.2		
	Mean ± SD	22.52± 3.74		22.91± 3.25		
MCHC (g/dL)	Decreased	33	63.5	31	63.3	0.574
	Min. – Max.	23.4-34.7		3.4-36.6		
	Mean ± SD	31.20±192		30.96±3.88		
RDW(%)	Elevated	42	80.8	36	73.5	0.262
	Min. – Max.	11.6-32.0		11.9-37.8		
	Mean ± SD	15.78±3.33		16.66±4.52		

- P: Probability value ≤ 0.05 (significant)
- MAM: moderate acute malnutrition; SAM: Severe Acute malnutrition; RBCs, red blood cells; HGB: hemoglobin; MCV: mean corpuscular volume; HCT: hematocrit; MCH: mean corpuscular hemoglobin; MCHC: mean corpuscular hemoglobin concentration; RDW: red cell distribution width; SD: standard deviation; Min-max: minimum-maximum.

DISCUSSION

Acute malnutrition is one of leading causes of mortality and mortality that characterized by long-term abnormalities effecting the health and growth of youngest children (17). The prevalence of acute malnutrition among children in this study was 51.5% for MAM and 48.5% for SAM. A study conducted in Nigeria revealed slightly similar finding where the SAM among children was 50% (18).

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Table (3): The association of acute malnutrition with socio-demographic characteristics and other risk factors among malnourished children under 5 years, Aden- Yemen

Variable	MAM		SAM		*p*
	No	%	No	%	
Sex					
Male (n=46)	21	45.7	25	54.3	0.191
Female (n=55)	24	43.6	31	56.4	
Age groups/months					
<10(n=34)	14	41.2	20	58.8	0.103
10-20 (n=31)	15	48.4	16	51.6	0.421
>20(n=36)	23	63.9	13	36.1	0.049
Residence					
Urban (n=87)	49	56.3	38	43.7	0.015
Rural (n=14)	3	21.4	11	78.6	
Education of Father					
Illiterate (n=34)	16	47.1	18	52.9	0.336
Primary (n=33)	17	51.5	16	48.5	0.583
Secondary (n=29)	15	51.7	14	48.3	0.575
University (n=5)	4	80.0	1	20.0	0.200
Education of Mother					
Illiterate (n.=50)	24	48.0	26	52.0	0.310
Primary (n=35)	19	54.3	16	45.7	0.421
Secondary n=13)	6	46.2	7	53.8	0.454
University (n=3)	3	100.0	0	0.0	0.133
Occupation of Father					
Daily Laborer (n=47)	25	53.2	22	46.8	0.452
Private (n=30)	17	56.7	13	43.3	0.323
Government Employee (n=18)	7	38.9	11	61.1	0.176
Without work (n=6)	3	50.0	3	50.0	0.632
Occupation of Mother					
House Wife (n=97)	50	51.5	47	48.5	0.668
Daily Laborer (n=2)	1	50.0	1	50.0	0.737
Private (n.=2)	1	50.0	1	50.0	0.737

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Family Size					
≤ 4 (n.=45)	23	51.1	22	48.9	0.553
>4 (n.=56)	29	51.8	27	48.2	
Breast – feeding (0-23 Month)					
Yes (n=55)	30	54.5	25	45.5	0.318
No (n=46)	22	47.8	24	52.2	
Infection					
Bacterial infection (n=15)	6	40.0	9	60.0	0.247
Parasitic infection (n=8)	6	75.0	2	25.0	0.155

- ***P*:** Probability value ≤ 0.05 (**significant**)

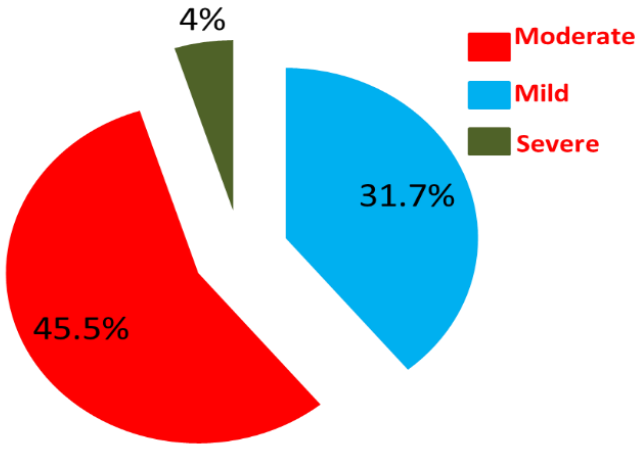

Fig. 3. The severity of anemia among malnourished children under-five years, Aden- Yemen

Other studies conducted globally reported different SAM results such as 27.0% in Zambia (19), 21.2% in Ethiopia (20), 8.7% in Sri Lanka (21), 8% in Ethiopia (22), 6.5% in Sudan (23), 5.8% and 4.1% in Nepal (24,25) and 4.4% Mali (26). The differences in sample sizes and methods of sampling and types of studied population as well as the socioeconomic status and seasons may be the main reasons for the variations in the prevalence of malnutrition among children under five years old (27).

The SAM is higher 56.4% among females than males. Our finding is similar to that conducted in Yemen, North-Western Nigeria and Nepal (6,18,25,28). Different results were reported in Ethiopia, Bangladesh, India and Nigeria (29,30,31,32). It is suggested that differences in socioeconomic factors and care practices might be sources of difference in malnutrition between males and females (33).

In the present data, an age group >20 children had a significant association with acute malnutrition (p=0.049). Research from India and Sudan showed that SAM was more frequent among children in the age group 6 to 12 months and less than 24months (32,34).

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Table 4: Association of Abnormal RBC parameters with socio-demographic characteristics and other risk factors among malnourished children under 5 years, Aden- Yemen

Variable	HGB			RBCs			MCV			HCT			MCH			MCHC			RDW		
	No	%	*P*	No	%	*P*	No	%	*P*	No	%	*P*	No	%	*P*	No	%	*P*	No	%	*P*
Sex																					
Male (n=46)	37	80.4	0.529	38	82.6	0.0001	42	91.3	0.278	43	93.5	0.462	44	95.7	0.299	29	60.0	0.557	39	84.8	0.077
Female (n=55)	45	81.8		20	36.4		47	85.5		50	90.9		50	90.9		35	63.6		39	70.9	
Age groups/ months																					
<10(n=34)	28	82.4	0.530	26	76.5	0.005	27	79.4	0.058	33	97.1	0.179	29	85.3	0.041	16	47.1	0.014	27	79.4	0.458
10-20 (n=31)	26	83.9	0.436	17	54.8	0.446	29	93.5	0.220	29	93.5	0.532	31	100.0	0.070	24	77.4	0.040	29	93.5	0.006
>20(n=36)	28	77.8	0.345	15	41.7	0.015	33	91.7	0.316	31	86.1	0.104	34	94.4	0.516	24	66.7	0.385	22	61.1	0.005
Residence																					
Urban (n=87)	68	78.2	0.043	46	52.9	0.019	77	88.5	0.522	79	90.8	0.289	82	94.3	0.249	59	67.8	0.024	65	74.7	0.119
Rural (n=14)	14	100.0		12	85.7		12	85.7		14	100.0		12	85.7		5	35.7		13	92.9	
Education of Father																					
Illiterate (n=34)	31	91.2	0.055	26	76.5	0.005	31	91.2	0.373	33	97.1	0.179	31	91.2	0.437	20	58.8	0.322	29	85.3	0.129
Primary (n=33)	21	63.6	0.003	16	48.5	0.147	29	87.9	0.597	27	81.8	0.014	32	97.0	0.266	22	66.7	0.400	22	66.7	0.067
Secondary (n=29)	25	86.2	0.302	14	48.3	0.169	25	86.2	0.470	28	96.6	0.271	26	89.7	0.321	19	65.5	0.481	23	79.3	0.487
University (n=5)	5	100.0	0.344	2	40.0	0.360	4	80.0	0.476	5	100.0	0.656	5	100.0	0.693	3	60.0	0.607	4	80.0	0.681
Education of Mother																					
Illiterate (n.=50)	45	90.0	0.022	36	72.0	0.003	47	94.0	0.065	47	94.0	0.396	48	96.0	0.226	30	60.0	0.313	42	84.0	0.085
Primary (n=35)	23	65.7	0.005	16	45.7	0.064	28	80.0	0.068	30	85.7	0.093	32	94.3	0.539	22	62.9	0.553	25	71.4	0.221
Secondary (n=13)	12	92.3	0.248	4	30.8	0.038	13	100.0	0.172	13	100.0	0.318	11	84.6	0.221	11	84.6	0.077	10	76.9	0.609

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University (n=3)	2	66.7	0.469	2	66.7	0.612	1	33.3	0.037	3	100.0	0.779	2	66.7	0.196	1	33.3	0.302	1	33.3	0.129
Occupation of Father																					
Daily Laborer (n=47)	38	80.9	0.568	30	63.8	0.156	45	95.7	0.026	42	89.4	0.283	46	97.9	0.81	30	63.8	0.547	37	78.7	0.463
Private (n=30)	24	80.0	0.522	13	43.3	0.051	26	86.7	0.503	30	100.0	0.053	27	90.0	0.344	16	53.3	0.129	21	70.0	0.192
Government Employee (n=18)	15	83.3	0.548	10	56.6	0.531	13	72.2	0.037	16	88.9	0.435	16	88.9	0.364	13	72.2	0.282	15	83.3	0.368
Without work (n=6)	5	83.3	0.685	5	83.3	0.187	5	83.3	0.541	5	83.3	0.399	5	83.3	0.358	5	83.3	0.282	5	83.3	0.586
Occupation of Mother																					
House Wife (n=97)	78	80.4	0.428	54	55.7	0.104	85	87.6	0.598	89	91.8	0.715	91	93.8	0.253	63	64.9	0.138	74	76.3	0.349
Daily Laborer (n=2)	2	100.0	0.658	2	100.0	0.327	2	100.0	0.775	2	100.0	0.847	2	100.0	0.866	1	50.0	0.601	2	100.0	0.595
Private (n.=2)	2	100.0	0.658	2	100.0	0.327	2	100.0	0.775	2	100.0	0.847	1	50.0	0.134	0	0.0	0.132	2	100.0	0.595
Family Size																					
≤ 4 (n.=45)	35	77.8	0.297	29	64.4	0.141	38	84.4	0.237	41	91.1	0.514	40	88.9	0.139	29	64.4	0.503	34	75.6	0.450
>4 (n.=56)	47	83.9		29	51.8		51	91.1		52	92.9		54	96.4		35	62.5		44	78.6	
Breast – Feeding (0-23 Month)																					
Yes (n=55)	44	80.0	0.471	36	65.5	0.057	49	89.1	0.489	50	90.9	0.462	52	94.5	0.400	37	67.3	0.247	45	81.8	0.167
No (n=46)	38	82.6		22	47.8		40	87.0		43	93.5		42	91.3		27	58.7		33	71.7	
Infection																					
Bacterial infection (n=15)	12	80.0	0.570	8	53.3	0. 470	11	73.3	0.076	14	93.3	0.661	14	93.3	0.722	12	80.0	0.122	12	80.0	0.540
Parasitic infection (n=8)	7	87.5	0.534	1	12.5	0.010	7	87.5	0.651	7	87.5	0.496	8	100.0	0.551	4	50.0	0.324	6	75.0	0.583

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Two studies from Bangladesh and Nepal demonstrated that children from 6 –24 months and 13 to 24 months had highest rates of SAM (28,31). Increasing the age of children increases their requirements for essential nutrients which is lacking among those who live in developing and poorest countries.

In the current study, a residence of children also had a significant association with acute malnutrition (p=0.015). Similar finding was noticed in Bangladesh (31). Residence effects on the nutritional status of children due to behavioral of mothers in rural area and lacking of education, medical and health care services that introducing to the pregnant women, mothers and children (31).

In the present results, there was no any significant association was observed between red blood cell parameters and acute malnutrition. Similar result was revealed in Congo (35). Khan et al. revealed significant associations between most means of RBC parameters and SAM children (16). Factors associated with acute malnutrition are complex and wide-ranging particularly in developing countries (36). Dwivedi et al. revealed significant association between high RDW and SAM which is indicator for anisocytosis that occurs due to deficiency of essential nutrients (37).

There were slightly decreasing in the means of RBCs, HCT and MCHC and increasing of RDW among SAM children than MAM in our research. Khan and colleagues showed decreasing in the means of RBCs, HGB, HCT, MCV, MCH and MCHC among SAM children (16). SAM is occurred due to highly decreasing of nutrients thereby effecting the production of RBC parameters (37).

The prevalence of anemia in our study was 81.40%. Similar finding 81.46% was reported in India (38).Two Indian studies were also slightly consistent to ours which were 84% and 85% (37, 39). Several studies recorded higher than our finding such as in 95%, 91% and 90% in India (40,41,42) and 88% in Brazil (43). One of the highest rate was 95% among SAM children in India (16).On other hand, lower than our result were conducted in Uganda 71.9% (44), Cameroon 70.5% (45), Senegal 69.3% (46), Rwanda 69% (47), Bangladesh 56.5% (9), Sri Lanka 55.5% (21), Ethiopia 53.4% and 44.7% (10,48), Nigeria 50.49% (49), Ethiopia 39.78% (50), Nigeria 9.7% (51) and Congo 9.3% (35). Several factors may contribute in variations of anemia in different studies globally such as; socio-demographic status, feeding practice of mothers, distribution of microbial infections, sample size of studied groups and availability of vitamins and minerals rich fruits and vegetables (10). Malnutrition and anemia are considered major public health problem among children under-five years that effect growth, development and general health of children leading to potential consequences last for long time of their life (52)

According to sex in this research, the females had highest rate 81.8% than males, but this association was not statistically significant (p=0.529). Our result contrary to those revealed in Ethiopia and Cameroon (10,45, 53,54). The differences in designing of study, sample size, socio-demographic characteristics and residence areas of studied population may contribute in variation of results (55).

As regard to the age group of children, this data detected highest rate of anemia among children aged 10-20month (83.9%), followed by aged <10 (82.4%), but these results were without significant differences. Different studies reported different results such as; in Cameroon in age group 49 to 60 months (45), Ethiopia in age group 6-23months and 12–23months (10,55).

This result demonstrated significant association between residence and anemia (p=0.043). Takele et al., recorded similar association (56). The anemia was increased among children who live in rural regions may be attributed to history of anemia

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among mothers and their education levels and lacking of medical services (57).

The associations were also significant between illustrate and primary school education of both fathers and mothers and low HGB (p=0.055, 0.003, 0.022 and 0.005), respectively. Getawa et al. found similar results (10). High level of education of both mothers and fathers may protect their children from the risk of anemia (58).

Regarding to the severity of anemia among our studied group, the majority 45.5% had moderate anemia, followed by mild 31.7% and 4% with severe anemia. High rates of severe anemia than ours were reported globally as 15% in Pakistan (16), in Ethiopia 17.2% (10) and 19% in India (37).

This study revealed that the RBCs count was low in 48% of children. Khan et al. found 56% of SAM children had decreased RBCs (16). Panezai et al. found significant association between reducing RBCs and malnourished children (59). The synthesis and production of red blood cells in the one marrow is effected by the deficiency of iron and some essential vitamins among malnourished children (60). The decrease of RBCs count among children may also be occurred due to chronic diseases, genetic diseases and environmental factors (61).

Current data showed significant associations between low RBCs and males, age groups <10 and >20 months, rural residence, illiterate education and private work of fathers and illiterate and secondary education of mothers, breast feeding and parasitic infection (p=0.0001, 0.005, 0.015, 0.019, 0.005, 0.051, 0.003, 0.038, 0.057 and 0.010), respectively. A study from Haiti recorded significant differences between decreasing RBC parameters and males and age group <24months (57). Gebreweld et al. revealed that residence and low maternal education may be risk factors for decreasing of the RBCs due to poor knowledge among women about importance of breastfeeding and good nutrients for them and their children (55).

Regarding MCV indices in this work, 88.2% of children had low MCV. There was no any study that either agreed or disagreed with our finding. The MCV measures the size of red blood cells. It is used detection type anemia based on the RBCs size, either microcytic (low MCV) or macrocytic (high MCV) anemia (62).

As regard to MCV in our report, the age groups <10 months of children, daily laborer and government employee as occupations of father and university education of mother were significantly associated with low MCV (p= 0.058, 0.026 and 0.037 and 0.037), respectively. Getawa et al. found significant association between daily laborer and decreasing RBC parameters among children under-five years old (10).

According to the current data, the low HCT was in 92.2% of children. HCT is another indicator for the percentage of circulating RBCs in the whole blood stream (63).It is automated procedure which calculated based on the multiplication of RBCs count by MCV value, thereby decrease of theses indices lead to decreasing of MCV (64). In this study, primary education of father was significantly associated with low HCT (p=0.014). The result about HCT was recorded as the first finding among malnourished children.

In this result, the low MCH was in 93.1% of children. No any previous study among malnourished children that either similar or different from ours. The MCH is a measure of the average content (mass, weight) of HGB per single RBC. It can be calculated by dividing concentration of HGB by RBCs count (65). A statistically significant association was found between age group <10 months and low MCH (p=0.041).

As stated by our research, the MCHC was low in 63.17% of children. In contrast to MCH, the MCHC can measure of the average concentration of HGB in volume of RBC. It can be calculated by dividing the

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concentration of total HGB concentration by HCT (65). The associations were statistical significant between low MCHC and age group <10 and 10-20 months (p=0.014 and 0.040), respectively. The residence also had significant association (p=0.024). These reported data about MCHC among malnourished children in the current study were no showed in any previous study.

Regarding to RDW in the present data, 77.2% of children had high RDW. The RDW is indicator for the average of variation in the size and the shape of RBCs. It is calculated with a machine by using the MCV and RBCs (65). The associations were statistical significant between high RDW and age group 10-20 months and >20 months (p=.006 and 0.005), respectively. Increasing of RDW among malnourished children under 5years.is also detected as first report.

The main limitations of this study were related to small sample size, study period and type of study. This study was insufficient to detected the real causes of abnormal RBC parameters among malnourished. In addition, all children who enrolled in this study were malnourished, so the overall prevalence of acute malnutrition was not estimated.

CONCLUSIONS

It can be concluded that the prevalence of SAM and anemia among children under-five years in Aden, Yemen were high. The residence increasing the risk of SAM, anemia and decreasing of most RBC parameters among children. The severity of acute malnutrition and RDW are increased by increasing the age of children. The low education levels of both father and mothers may be another factor that contributing in decreasing the levels of most RBC parameters.

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Ethical Clearance & Informed Consent

The ethical approval of this study was obtained from the Ethics Committee of College of Medicine and Health Sciences at University of Science and Technology, Aden; MEC No. (MEC/AD051).

Conflict of Interest

The author declares that no conflict of interest.

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