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ASSESSMENT OF NUTRITIONAL STATUS OF CHILDREN UNDER FIVE YEARS OF AGE, IN SHENDI LOCALITY, RIVER NILE STATE, SUDAN, 2017

Omran M. Ahmed*[1,2], Abd Elbasit E. Mohammed[3,4] and Haghamad Allzain[2,5]

[1]Faculty of Public Health.
[2]Shendi University.
[3]Faculty of Public and Environmental Health.
[4]University of Khartoum.
[5]Faculty of Medicine.

***Corresponding Author: Omran M. Ahmed**
Faculty of Public Health.

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ABSTRACT

Background: Children who aren't optimally breastfed, undernourished, or suffering from micronutrient deficiencies have substantially lower chances of survival than children who are well nourished. They are much more likely to suffer from serious infections and to die from common childhood illnesses such as diarrhea and measles. **Objectives:** This study intended to examine the nutritional status of children under-five (5) years of age in Shendi locality. **Materials and methods:** This was descriptive cross-sectional community-based study, carried out in Shendi Locality in 2017. Three hundred and eighty-four (384) children were selected randomly. A questionnaire and anthropometric measurements were used for data collection. **Results:** The study revealed that the prevalence of PEM was (10.2%). The moderate form was (7.6%) and severe form was (2.6%). The highest percentage of PEM (53.8%) among females. All mothers were breastfeeding. (21.6%) were uneducated and (83.9%) were not working (housewives). Households with a monthly income of about 500 Sudanese pounds were (7%). Families with a size of (6) people were (43%). PEM prevalence had a significant association with father's occupation as well as parent's knowledge about PEM with *P*. value = (0.05) (0.04) respectively. **Conclusion:** The prevalence of PEM was high among children under-five (5) years, especially among females, and was associated with a number of factors such as: monthly income, parents' level of educational, follow-up of children growth and provision of additional meals.

KEYWORDS: Protein Energy Malnutrition, Anthropometric, under 5 years.

Problem statement

Children with severe acute malnutrition (SAM) are nine times more likely to die than well- nourished children. Governments face great challenges in building capacity and providing sufficient resources to prevent and treat acute malnutrition. The challenge is significant barriers to sustainable development in these nations. Climate change and increasing numbers of natural disasters are expected to further challenge the efforts to protect the nutritional status of children and women, in recent years, approximately (2.9 million) children accessed nutritional therapy in (65) countries in 2013. About (17%) of the children needed nutritional therapy (UNICEF, 2013).

INTRODUCTION

Children's growth and development do not occur in a linear fashion, but are influenced by each child's environment, nutrition and parental care. These factors play a critical role in a child reaching her/his full potential. Recent evidence indicates that good nutrition, particularly in early childhood, is critical to the positive health outcomes of children. Sufficient nutrition in early childhood is critical in maintaining healthy growth, proper organ formation and functioning, a strong immune system, and neurological and cognitive development in children (Ismail *et al.*, 2013).

In fact, children's nutritional status can be viewed as a good proxy indicator of a community's state of health. The nutritional status of a child is usually described in terms of anthropometry, i.e. body measurement, such as weight, in relation to age or height, which is reflective of the degree of underweight or wasting of that child (Ismail *et al.*, 2013).

Breast feeding should be initiated immediately after birth, and infants should be exclusive breast-feeding during the first six months of age. This means that a healthy baby is the one who received only breast milk and other fluids such as water, juice and any other liquids

(Horta *et al.*, 2013).

Breastfeeding has well established short-term benefits, particularly the reduction of morbidity and mortality due to infectious diseases in childhood. A pooled analysis of studies carried out in middle/low income countries showed that breastfeeding substantially lowers the risk of death from infectious diseases in the first two years of life (WHO, 2016).

Malnutrition may be due to: inadequate dietary intake, infectious diseases, insufficient household food security, inadequate maternal and child health, insufficient health services and unhealthy environment, inadequate education (Park, 2015). Stunting refers to a child who is too short for his or her age. It's the failure to grow both physically and cognitively and is the result of chronic or recurrent malnutrition. The devastating effects of stunting can last a lifetime (WHO, 2016). Overweight refers to a child who is too heavy for his or her height. This form of malnutrition results from expending too few calories for the amount of food consumed and increases the risk of non- communicable diseases later in life (WHO, 2008). Wasting refers to a child who is too thin for his or her height. Wasting, or acute malnutrition, is the result of recent rapid weight loss or the failure to gain weight. A child who is moderately or severely wasted has an increased risk of death, but recovery is possible (WHO, 2016).

The spectrum of malnutrition for energy balance ranges from severe under nutrition to severe over nutrition leading to morbid obesity. Simultaneously, an individual can show signs of chronic under nutrition with a short height but also be overweight suggesting varying nutritional status during the life span. In middle and high-income countries, overweight/obesity is more prevalent among food insecure households, because processed calories dense foods with high fat and sugar tend to be cheaper than fresh nutrition dense foods (Taren *et.al*, 2017).

Low height for age is considered an indicator of chronic malnutrition (shortness or stunting), which is frequently associated with poor overall economic conditions. Children with height-for- age below (-1) SD from the median of the reference population are considered to have chronic malnutrition (UNICEF, 2015).

Acute malnutrition generally associated with failure to gain weight (thinness or wasting). Two indicators adopted to measure this issue, low weight for height or weight for age. Children whose WFH or WFA below (-3) SD from the median of the reference population are considered to have acute malnutrition (Park, 2015). Severe acute malnutrition (SAM)defined by (WHO) as: a weight for height below (-3SD) based on NCHS reference and/or the presence of oedema. Experts recommended to add MUAC less than 110 mm (6 to 60-month-old children) as an independent diagnostic criterion (Park, 2015).

Nutritional assessment can be done using the Anthropometry, Biochemical /Biophysical methods, Clinical methods, Dietary methods (**ABCD)**, (UNICEF, 2015). Anthropometric measurements use to assess either growth or change in the body composition, also describes the proportion of children in a population considered being malnourished (WHO, 2016). Length and height: The length of children under two years old was measuring used wooden measuring board (also called sliding board) (WHO, 2016). Height: is measured with the child or adult in a standing position (UNICEF, 2015). Weight: The Salter Scale is used for measuring the weight of children under two years old (UNICEF, 2015). Anthropometric Indexes is a combination of two measurements or one measurement plus the person's age (UNICEF, 2015). Height-for age is an index used for assessing stunting, stunting of children indicates that the children have suffered from chronic malnutrition (UNICEF, 2015). Weight-for-height is an index used for assessing wasting, wasted children are vulnerable to infection and stand a greater chance of dying (WHO, 2016). Weight-for-age used in growth monitoring for assessing children who may be underweight (UNICEF, 2015). A baby should gain at least 500g/month in the first 3 months of his life, children who gain less weight become malnourished, it's necessary for babies to gain about 1kg a month, especially in the first 3 months (Park, 2015). Mid upper arm circumference (MUAC) is a good screening tool in determining the risk of mortality among children. When MUAC over 13.5cm means adequately nourished, 12 to 13.5cm moderately malnourished and below 12cm severely malnourished (Park, 2016).

Prevention of Protein Energy Malnutrition: Promoting optimal nutrition practices, meeting micronutrient requirements, breastfeeding and preventing and treating severe acute malnutrition are key goals for nutrition programming (UNICEF, 2015).

Nutritional education: People can be educated on the nutritional value of common foods, importance of exclusive breastfeeding for six months and continuing up to two years or beyond, damage caused by irrational beliefs and cultural practices of feeding, gradual weaning, importance of some foods (milk, eggs …etc.). Also, insufficient quantities, importance of feeding children and adults during illness, and importance of immunizing their children and proper sanitation (UNICEF, 2015).

Treatment of Protein Energy Malnutrition: Severely malnourished children with appetite and no complications should be enrolled in an outpatient therapeutic care program (WHO, 2016). Severely malnourished children with complications should be admitted to an inpatient facility for close monitoring until stabilized. Inpatient care should follow standard WHO protocols for the treatment of severe malnutrition

(Semba, 2016).

Justification of the study

The prevalence of global acute malnutrition among under-five children is 16% and severe acute malnutrition is 5%. The rate of stunting among the under-fives is high (35%), as are rates of severe anemia (38%), Children in the poorest quintiles are the most affected (UNCIEF, 2015).

In Sudan, the under-five mortality rate that estimated in 2009 was 108/1000 live birth, 16% and 40% of Sudanese children suffer from wasting and stunting respectively. The crude death rate in Sudan was 10 children per 1000 population, and crude birth rate in 2009 was 31 children per 1000 population (UNCIEF, 2015).

According to the Sudan Household Health Surveys (SHHS) of 2006 and 2010: the prevalence of children malnutrition among under five is 48.6% in Sudan, the under-five mortality rate declined from 102 to 78 per 1,000 live births; 42% of the deaths were due to neonatal causes according to the statistics center in Federal Ministry of Health (FMOH, 2016). Therefore, the current study would add Knowledge and raised the awareness about this important issue in the local community.

General objective

To examine the nutritional status of children under-five (5) years of age in Shendi locality.

Specific objectives

- To calculate the prevalence of malnutrition among children under–five.
- To classify the grade of malnutrition among children under–five.
- To identify the potential risk factors of malnutrition among children under5.

MATERIALS AND METHODS

This was descriptive cross-sectional community-based study, conducted in Shendi locality, River Nile State-Northern Sudan. Three hundred and eighty-four (n=384) children under (5) years of age was selected to participate in the study.

Shendi locality, River Nile State; lies in the Northern part of the Sudan, between the latitudes (16°– 22°) North, and longitudes (30° – 32°) East, the total area estimated to be 124.000 km2, it shares boarders with number of states: in the East Red Sea State and Gadarif State, Khartoum State from the South, and Northern State from the North (Shendi Locality Records, 2017).

Total number of populations in Shendi Locality are 269,446 persons, where the number of children under five is about 51,408 childrendistributed in five Administrative Units (Shendi Locality Records, 2017).

The sample size was determined using the following statistical formula:

$n = (1.96)^2 \times 0.5\ (1\text{-}0.5) / (0.05)^2 = 384.16 \approx 384$

A stratified random sample was used to collect data, where a Locality was divided to 5 stratums.

Data were collected using the following tools: Questionnaire: A pre-prepared and pre-tested questionnaire was directed to households to obtain data regarding the socio-demographics and potential risk factors. Review of Card: Age of children under-fives was determined by reviewing of vaccination cards. Anthropometric measurements: Data about nutritional status of children were determined by the following anthropometrics measurements: Weight of every child was measured by using properly calibrated equipment (ZT 100) digital weighing scale (5 – 150 Kg) for children above than two years, and German Seca scale 364 (5 – 15 Kg) for infant weighing scale. Each child had the least clothes and no shoes on, the weight of over two-year-old was measured in standing position. MUAC was measured at the mid-point of the left upper arm between the elbow and the shoulder and taken to the closest millimeter using a standard tape. Oedema was identified by applying normal thumb pressure on both legs or foot for three seconds, if a shallow print is left when thumb is lifted child was considered has oedema. The height was measured by wooden measuring board also called Sliding Board for children under 2 years in supine position, the accuracy of which near to 0.5 centimeter in standard situation while each child had the least clothes and no shoes on, and ZT 100 (1–200 Cm) was used to measure the height for children over 2 years old in standing position(WHO, 2006).

Data was analyzed using (SPSS) Statistical Package for Social Science version 20th. The association between different variables was checked using chi-square test at a significant level = 0.05, also ENA (Emergency Nutritional Assessment) software was used to analyze the anthropometric data, and to determine the prevalence of PEM among study population.

Ethical considerations

The research was approved by the faculty committee. Oral consent from head of households was taken before starting the filling of questionnaires and taken anthropometrics measurements from their child's. The researcher created awareness to the respondents, ensuring them that no information generated from them was going to be used against them, but treated with all confidentiality to help them prevent PEM at their communities.

RESULTS

Table (1): The socio-demographic characteristics of children and households.

Variable		No.	%
Gender of children	Male	152	39.6
	Female	232	60.4
	Total	384	100
Age /month	0 – 17	221	57.6
	18 – 29	105	27.3
	30 – 41	39	10.2
	42 – 53	15	3.9
	54 – 59	4	1.0
	Total	384	100
Educational level of mothers	Illiterate	83	21.6
	Basic	88	22.9
	Secondary	121	31.5
	University	90	23.4
	Post graduate	2	0.5
	Total	384	100
Educational level of fathers	Illiterate	69	18
	Basic	126	32.8
	Secondary	121	31.5
	University	62	16.1
	Post graduate	6	1.6
	Total	384	100
Mother's occupation	Employee	33	8.6
	House wives	322	83.9
	Others	29	7.6
	Total	384	100
Monthly income (SDG)	500	27	7
	501 – 1000	256	66.7
	>1000	101	26.3
	Total	384	100
Family size (individual)	< 6	159	41.4
	6	165	43
	> 6	60	15.6
	Total	384	100
Number of under-five per house	1 – 3	323	84.1
	4 – 6	43	11.2
	>6	18	4.7
	Total	384	100

Table (2): The grade of PEM based on (W.F.H) z-scores (and/or oedema).

Grades	Gender				Total	
	Male		Female			
	N.	%	N.	%	N.	%
Moderate PEM	9	50	20	95.2	29	74.4
Severe PEM	9	50	1	4.8	10	25.6
Total	**18**	**100**	**21**	**100**	**39**	**100**

Table (3): Wasting among children under–five according to age based on (W.F.H) z-scores.

Age (month)	Normal > = -2 z score		Moderate wasting >= -3 and <-2 z-score		Severe wasting <-3 z-score		Total
	No.	%	No.	%	No.	%	
6 –17	206	59.7	7	24.1	8	80	221
18–29	81	23.5	22	75.9	2	20	105
30–41	39	11.3	0	0	0	0	39
42–53	15	4.3	0	0	0	0	15
54-59	4	1.2	0	0	0	0	4
Total	345	100	29	100	10	100	384

Table (4): Stunting among children under five according to age and based on (H.F.A) z- scores.

Age (month)	Normal > = -2 z score		Moderate stunting >= -3 and <-2 z-score		Severe stunting <-3 z-score		Total
	No.	%	No.	%	No.	%	
6 –17	128	60.6	14	24.6	55	59.8	197
18 – 29	61	28.9	21	36.8	23	25	105
30 – 41	9	4.3	17	29.8	13	14.1	39
42 – 53	9	4.3	5	8.8	1	1.1	15
54-59	4	1.9	0	0	0	0	**4**
Total	**211**	**100**	**57**	**100**	**92**	**100**	**360**

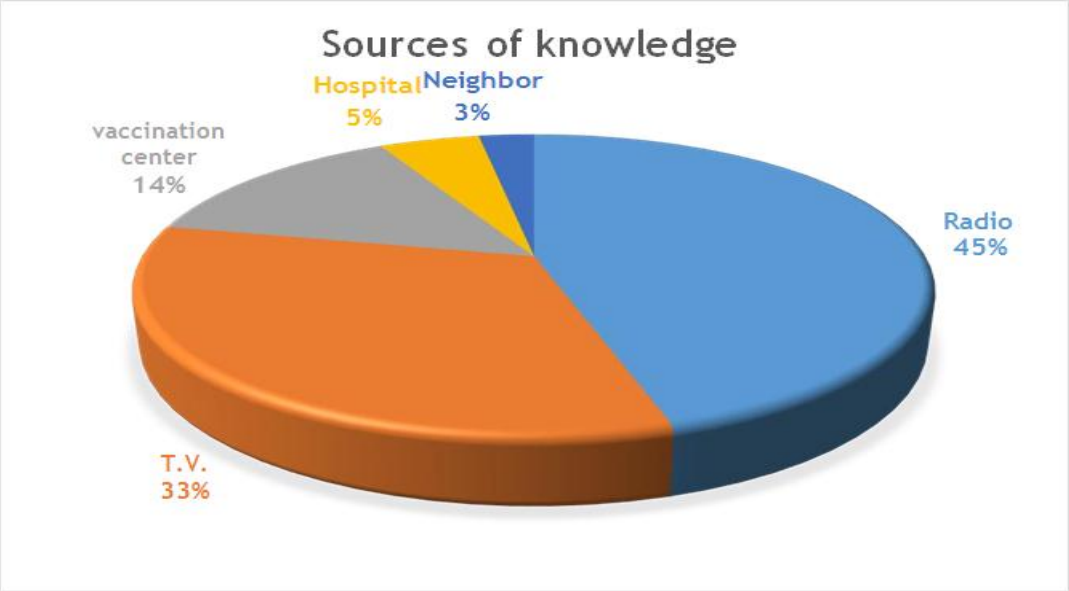

Figure (I): Source of knowledge about malnutrition among study population, Shendi locality 2017 (n =329).

Table (5): Causes of protein energy malnutrition, Shendi locality 2017 (n =329).

Causes	No.	%
Improper nutrition	248	75.4
Infection	23	7
Little or big amount of food	42	12.8
All of the above	16	4.9
Total	**329**	**100**

Table (6): Sign and symptoms of protein energy malnutrition, Shendi locality 2017 (n =329).

Sign and symptoms	No.	%
Diarrhea	141	42.9
Weakness	101	30.7
Crying	6	1.8
all above	81	24.6
Total	**329**	**100**

Table (7): Duration breast-feeding among children under five, Shendi Locality 2017 (n= 384).

Duration / year	No.	%
<1	26	6.8
1	54	14.1
< 2	111	28.9
2	193	50.3
Total	**384**	**100**

Table (8): Immunization coverage to the children under-five, Shendi locality 2017 (n =384).

Immunization	No.	%
Yes	384	100
No	0	0
Total	**384**	**100.0**

Table (9): Types of foods that provided to children by their households, Shendi locality 2017 (n =384).

Types	No.	%
Carbohydrate	114	29.7
Fat	4	1
Protein	66	17.2
All	200	52.1
Total	**384**	**100.0**

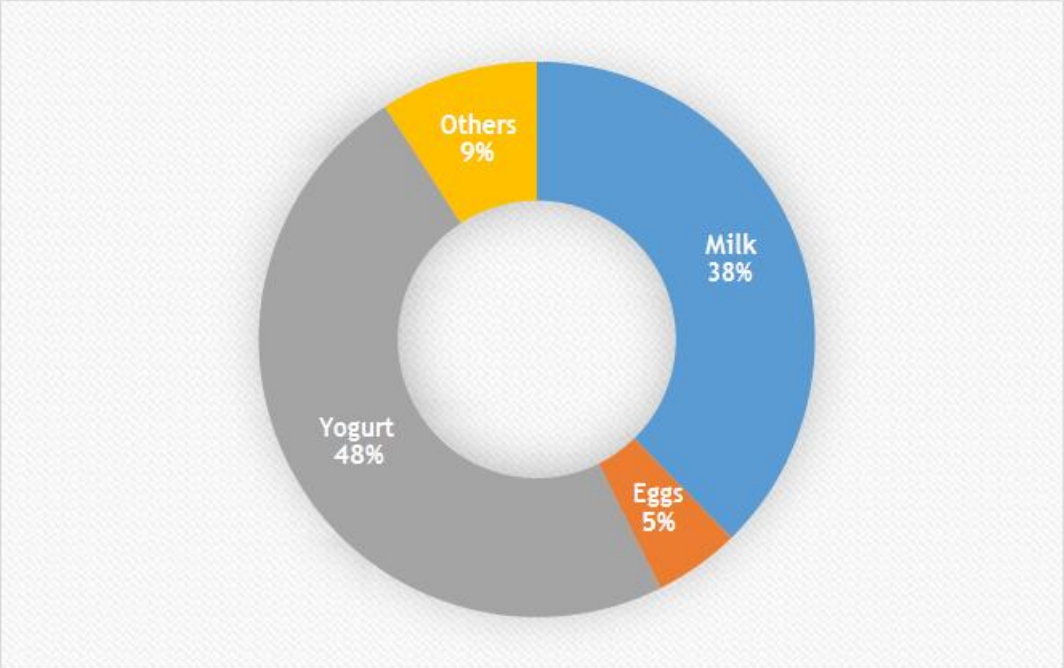

Figure (II): Type of additional meals among study population at Shendi locality, 2017 (n =382).

Table (10): The children nutritional status in the relation to their father's occupation, Shendi Locality 2017(n = 384).

Father's occupation	Nutritional status		Total
	Normal	Malnourished	
Employee	(54) 14.2%	(7) 1.8%	**(61) 16%**
Worker	(88) 22.9%	(13) 3.4%	**(101) 26.3%**
Farmers	(71) 18.6%	(6) 1.6%	**(77) 20.2%**
Others	(131) 34.1%	(14) 3.6%	**(145) 37.7%**
Total	**(345) 89.8%**	**(39) 10.2%**	**(384) 100%**

X^2 = (0.70) *P*. value = (0.05)

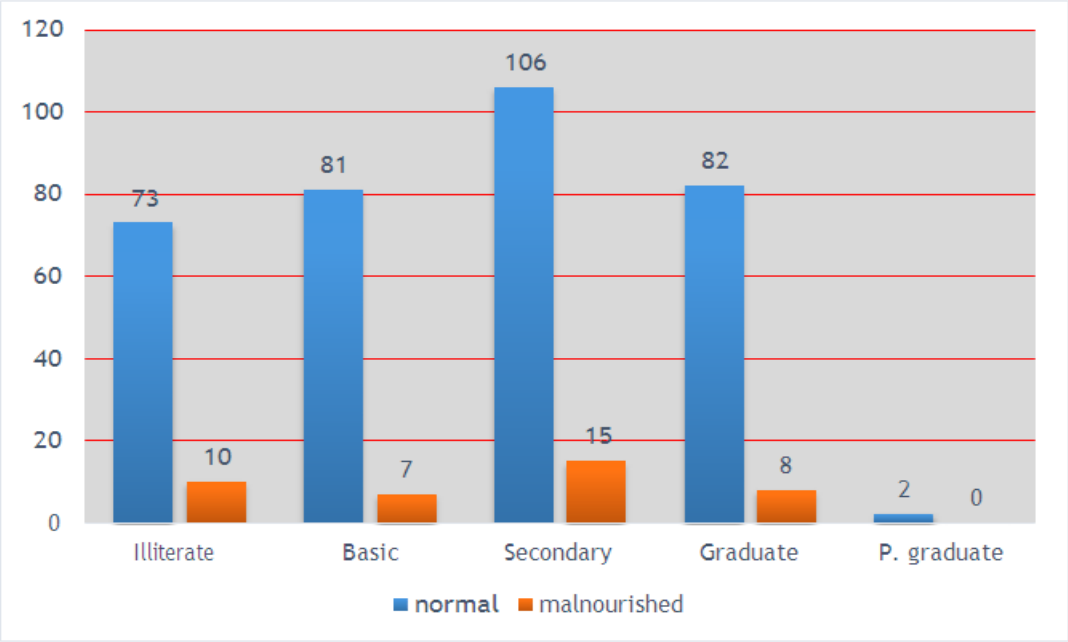

Figure (III): The relationship between educational level of mothers and children nutritional status and, Shendi Locality 2017 (n = 384).

Table (11): The children nutritional status in the relation to monthly income of households, Shendi Locality 2017 (n = 384).

Monthly income	Nutritional status		Total
	Normal	Malnourished	
500 SDG	24 6.3%	3 0.7%	27 7%
501 – 1000 SDG	234 60.9%	22 5.8%	256 66.7%
Above 1000 SDG	86 22.4%	15 3.9%	101 26.3%
Total	**345** **89.8%**	**39** **10.2%**	**384** **100%**

chi-squire (0.217) p. value (0.05)

DISCUSSION

The study showed that a large group (10.2%) of the children under five (5) years of age with PEM. This result complied with a hospital based cross-sectional study in India, carried by (Shyamet al, 2015) who stated that (76.4%) was the prevalence of malnutrition. Also, this result was similar to that obtained by (ELhassain and Gabbad, 2012) who stated that (37.4%) the prevalence of malnutrition in Mygoma Orphanage Centre, Khartoum, Sudan.

The study showed that (10.2%) of under-5 years' children were suffered from PEM, (74.4%) from them had moderate PEM higher among female and 25.6% had severe form of PEM. Results were more similar to the study was conducted at Al-Amir Unit, Umbadda Locality, Khartoum State – Sudan, and carried by (Mohammed, 2003) to study the nutritional education and nutritional status of children under five (5) years, who stated that (88.6%) of children were normal and (11.4%) were malnourished, (4.7%) of them were moderately and (2%) were severely malnourished.

The currrent study demonstrated that malnutrition was higher in females than males. Those findings revealed a strong relation existed between gender and malnutrition. This finding disagreed with the study findings, conducted among children under two (2) years of age residing in a Rural Area of Western Ethiopia, carried by (Hailemariam, 2014), who revealed that (9.7%) of male were malnourished more than (8.2%) of females.

The study showed that (2.6%) of children under (5) years of age with severe wasting while (25.6%) had severe stunting. This finding was similar with the study conducted in Akure South Local Government of Ondo State–Nigeria, to assess foodconsumption and nutritional status of under five children, by (Akorede and Abiola 2015) who stated that the prevalence of stunted, wasted and underweight children was (12.5), (14.8), and (8.5%) respectively.

The study showed that (85.7%) of households aware of PEM, because the educational level of mothers and father was high, just (18%) of fathers were illiterate. Similarly (21.6%) of mothers were illiterate. These finding was similar to those figured out in study conducted in Urban Field Practice Area, Kalalgalli – India, and carried out by (Veena et al, 2013), who stated that a high proportion of higher education status among fathers of children (60%), whereas significant number of mothers (34%) were illiterates.

All mothers (100%) were practicing or practiced exclusive breast feeding. This result was different from study conducted in Akure South Local Government of Ondo State–Nigeria, by (Akorede and Abiola, 2015) who stated that (16.7%) of the mothers practiced exclusively breastfed and majority (60.0%) of them did not practiced exclusively breastfeeding. Also, the result was similar to the stated in community based cross sectional study from March to April 2014, among children under two years of age residing in a rural area of Western Ethiopia, conducted by (Hailemariam, 2014), who stated that the majority of the mothers enrolled in the study (96%) practiced breast feeding.

The household's knowledge about PEM through educational messages via radio or TV from health authority; contribute on immunization of children, the study revealed that (100%) of children under (5) years of age were immunized. These finding was similar to those of the cross- sectional study, conducted in Urban Field Practice Area, Kalalgalli – India, and carried out by (Veena et al, 2013) who stated that (85%) of children were fully immunized, (11%) were partially immunized and (4%) were not immunized at all.

The study showed that (75.8%) of households used nutrition, vaccination follow up cards to monitor growth of children. This result disagreed with those of the study carried out by (Mohammed, 2003) in Al-Amir Unit, Umbadda Locality, who stated all mothers agreed that they did not go to the health unit for growth monitoring after their children completes nine months, because at this time the child completes basic immunization doses.

CONCLUSION

The prevalence of protein energy malnutrition among under five children was (**10.2**%). (74.4%) of child had moderate PEM and 25.6% had severe PEM that occurred highly among male. PEM among female (53.8%) higher

than male (46.2%). The majority of households (85.6%) were knew protein energy malnutrition, (45%) were knew from radio. All mothers (100%) were practiced exclusive breast feeding, (50.3%) practiced breast feeding a long two years, also (100%) of the children were immunized. A majority (93%) of mothers had pregnancy spacing and aware of family planning, whereas (7%) of mothers had not family planning.

Recommendation

Based on the findings, the present study recommended the followings:

Increase the awareness of mother about the importance of child growth monitoring until child reach five years of age.

Improving the environmental conditions, supply of safe water, proper sanitation and good vector control.

Promoting knowledge, counseling, skills and practices of mothers by conduction educational session for them on benefits of exclusive breast–feeding, gradual weaning and all nutritional practices which affect the growth.

Activate the surveillance system that specially focus on children malnutrition, with concentration of early diagnosis and treatment of malnutrition and diarrheal diseases.

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REFERENCES

1. Akorede, Q.J., Abiola, O.M., (2013). Assessment of nutritional status of under five children in akure south local government, Ondo state, Nigeria.
2. Alvarez, D.D., Sanchez. A.J., Gomez, G.G., Tarqui, M.C., (2012), prevalence and determining social factors of overweight in the Peruvian population, 3ed Edition, Med Exp Salud Publicans, Peru, vol. (no 303 – 313).
3. Alvi, Mohsen. Hassan., (2016), A Manual for selecting sampling techniques in research, MPRA publisher, Munich, Germany.
4. CDC (Centre of diseases prevention and control) (2013), Guidelines for evaluation of the nutritional status and growth in refugee children, United State, CDC.
5. Cochran, William.G., (1977), Sampling techniques, 3rd Edition, John Wiley & Sons Publisher, Canada, P. 18, 86.
6. FMOH (Federal Ministry of Health) (2016).
7. Gupta, S.S., Deshmukh, P.R., Dongre, A.R., Garg, B.S., (2007), development of WHO growth standards, India J Pediatric, vol. (no 987–90).
8. Dinsa, G.D., Goryakin, Y.A., Fumagalli, E.A., Suhrcke, M.E., (2012), Obesity and socioeconomic status in developing countries: 3rd Edition: Afghanistan.
9. ELhassain, Neimat.A., Gabbad, Abd-el Safi.A., (2012), malnutrition among Infant Children in Mygoma Orphanage Centre, Khartoum, Sudan, International Journal of Science and Research. ISSN.
10. Gupta, Shyam. Bihari., Singh, Jai. Prakash., Singh, Prabhu. Nath., (2013), Study of Nutritional Status Among Under Five Children Attending Out Patient Department at A Primary Care Rural Hospital, India.
11. Hailemariam, Tsedeke. Wolde., (2014), the prevalence of underweight, Department of Public Health, College of Medical and Health Sciences, Wollega University, Nekemte, Ethiopia.
12. IFPRI (International Food Policy Research Institute) (2016), Global Nutrition Report 2016: Ending Malnutrition by 2030, Washington DC, USA, IFPRI
13. Mahan, L.K., Escott, Stumps., (2004), Food Nutrition and Diet Therapy, 11th edition, Medical nutrition therapy Publisher, Saunders: Philadelphia.
14. Mohammed, Amel. ElSammani., (2003), Nutritional status ofchildren less than five years of age in Al-Amir Unit – Umbadda Locality, Omdurman, Sudan.
15. Park, John. Everett., (2015), Text book of prevention andsocial medicine, 23th Edition, Brij Mohan Bhanot Publisher, India.
16. Pereira, IF. da Silva., Andrade, LM. Barbosa., Constatino, M. H., Lyra, C.O., Evaluate the nutritional status of children under 5years of age in Brazil, (2016), Brazil.
17. Semba, Richard. D., (2016), the rise and fall of protein malnutrition in global health, journal of nutrition and metabolism publisher, Baltimore, USA.
18. Shendi Locality, River Nile State, Sudan, (2017), Shendi Locality Records, Health information department, Shendi Locality.
19. Taren, Douglas. Pee., Saskia, de., (2017), The Spectrum of Malnutrition, Springer Science & Business Media, New York, USA.
20. UNICEF, (United Nations Children's Emergency Fund) (2013), Sudan Country program document 2013-2016, P34, United Nation plaza New York, UNICEF.
21. UNICEF, (United Nations Children's Emergency Fund) (2015), global statistical databases, last update 2015, United Nation plaza New York, UNICEF.
22. UNICEF, (United Nations Children's Emergency Fund) (2015), Management of Severe Acute Malnutrition in children, United Nation plaza, New York, UNICEF.
23. Veena, A.Yadavannavar, MC. Patil, SS., (2012), Assessment of nutritional status of under five children in urban field practice area, IJCRR, Vol 04 issue 22, Bijapur, India.
24. WHO, (World Health Organization) (2006), WHO childgrowth standards, 4th edition, Geneva, WHO.
25. WHO, (World Health Organization) (2008),

Training course on child growth assessment, Geneva, WHO press, WHO.
26. WB, (World Bank) (United Nations Children's Emergency Fund) (World Health Organization) (2016), Level & Trends in Child Malnutrition, New York UNICEF; Geneva WHO; Washington, USA WB.