

Malnutrition among hospitalized children (1-4 years of age) years of age in Abyan and Lahj Governorates / Yemen

Ali Ahmed Al-Waleedi

University of Aden

Abdullah Bin-Ghouth (✉ abinghouth2007@yahoo.com)

Hadhramout University

Research Article

Keywords: Malnutrition, Sick children, Stunting, Wasting

Posted Date: April 21st, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1565128/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Abstract

Background

The analysis of acute malnutrition in 2018 for the Integrated Phase Classification of Food Security in Yemen shows that high malnutrition rates are present in Abyan governorate (23%) and Lahj governorate (21%). This analysis was community based addressed all children and mostly due to problems related to food intake. The role of diseases was not yet addressed in Yemen. The aim of this study is to assess acute and chronic malnutrition among hospitalized children at 12–59 months of age in Lahj and Abyan governorates in Yemen.

Methodology:

A cross-sectional, multi-center study is designed. The assessment of the nutritional status was measured by standardized anthropometry of 951 sick children at age 1–4 years.

Results

The prevalence of Global acute malnutrition (GAM) among the sick children seeking care in health facilities in Lahj and Abyan is 21%. More specifically; the prevalence of moderate acute malnutrition (MAM) is 15.1% while the prevalence of severe acute malnutrition (SAM) is 6.2%. The prevalence of acute malnutrition (wasting) among the studied sick children in lahj is 23.4% while in Abyan is 19.3%. The prevalence of MAM in Lahj is 17.7% and the prevalence of SAM is 5.7%. The prevalence of acute malnutrition (wasting) in Abyan is 12.6% while the prevalence of SAM in Abyan is 6.7%. The prevalence of acute malnutrition among male children (25.2%) is significantly higher than among female children (17.5%). The prevalence of the chronic malnutrition (Stunting) in the studied sick children is 41.3%; the prevalence of stunting in Lahj is 41% while in Abyan is 41.7%.

Conclusions

High acute and chronic malnutrition rates were identified among sick children seeking care in health facilities in lahj and Abyan, and higher than the SPHERE indicators of malnutrition. Boys are more exposed than girls to acute and chronic malnutrition.

Introduction

Malnutrition in children is of high concern in developing countries like Yemen. However, malnutrition is multifactorial. Malnutrition in low-income countries is often, but not solely, be attributable to limited access to food and/or medical care, it is often triggered by disease.¹

Yemen people facing dramatic situation due to war and multi-epidemics and poverty.²

Most of the local and international reports described the situation in Yemen is the worst humanitarian crises in the world. Malnutrition among Yemeni children is one of the painful crises. In 2015, UNICEF's report concludes that a striking ten of Yemen's 22 governorates are on the edge of famine, as defined by the five-point Integrated Food Security Phase Classification (IPC) scale.³ In 2017; a study published in the lancet indicated that according to organizations working to end hunger, about 370 000 of Yemen's children are suffering from severe malnutrition. Additionally, one million children younger than five years old are at risk of acute malnutrition.⁴

The rate of child malnutrition in Yemen is one of the highest in the world and the nutrition situation continues to deteriorate. World food program (WFP) reported that about one third of families have gaps in their diets, and hardly ever consume foods like pulses, vegetables, fruit, dairy products or meat. Malnutrition rates among children in Yemen remain among the highest in the world, with 2.3 million children under five years requiring treatment for acute malnutrition.⁵

Another study among children under five years of age identified that the high malnutrition level (the prevalence of stunting was 47%, wasting was 16%, and underweight was 39%).⁶

Recent study in 2022 reported that more than 2.3 million children under the age of five in Yemen suffer from acute malnutrition. Approximately 450,000 are expected to suffer from severe acute malnutrition and may die if they do not receive urgent treatment.⁷

Cases of acute malnutrition among children under five have risen to the highest levels recorded in parts of Yemen. More than half a million cases recorded in the southern districts. Analysis of acute malnutrition in 2018 in Yemen for the Integrated Phase Classification of Food Security issued by the Organization Food and Agriculture of the United Nations (FAO), the United Nations Children's Fund (UNICEF), the World Food Program and their partner identified high rate of malnutrition. The most affected areas included in this analysis are Abyan governorate (23%), Lahj governorate (21%),⁸ in another two studies the global acute malnutrition in Abyan was 10%.⁹ And in lahj was 27.3%.¹⁰

Malnourished children are more vulnerable to illnesses, including diarrhea, respiratory infections, and malaria, which are a major concern in Yemen¹¹ Disease-related malnutrition in children is the consequence of different factors. For example, food intake due to anorexia, feeding difficulties or the effects of medications or due to the hyper metabolic state caused by the underlying disease.¹²⁻¹⁴

Identification of malnutrition among hospitalized children is important because most pediatricians have no concern on the impact of malnutrition on the clinical outcome of the sick child. Mostly, they neglect the malnutrition as a determinant of the disease prognosis. This study aimed is to assess the malnutrition among sick children in two governorates in the southern Yemen of high malnutrition prevalence. The specific objective is to assess the prevalence of acute and chronic malnutrition among hospitalized children aged 12 to 59 months.

Methodology

A cross-sectional, multi-center study was designed in to determine the prevalence of malnutrition and related morbidity among hospitalized children under the age of five years in Abyan and Lahj governorates. The assessment of the nutritional status was measured by standardized anthropometry within the first 24 hours after admission or at attendance in outpatient clinic. Body mass index (BMI) and height/length <-2 standard deviation scores (SDS, WHO reference) are the primary outcome variables, frequency of gastrointestinal (diarrhea and vomiting) and respiratory tract infections and the period of stay are the secondary outcomes. Gender, Family income, mother's education, access to health facility, feeding practice and history of measles vaccination are the independent variables.

The study population are children at age 1-4 years who attend the health facility to seek care for certain health problem, mothers were interviewed while a trained nurse measured the weight and height and upper mid-arm circumference of the sick child.

From each governorate; five health facilities were selected. These facilities were: the main governorate hospital, two district hospitals and two health centers from two different villages in two different districts.

Data was collected through a group of enumerators and two field supervisors. Training of two days were conducted in Lahj (Al-Hottah city) in 28th of February, 2022 and in Abyan (Zunjibar city) in 3rd of March, 2022 where enumerators were trained about the questionnaire and the selection of the targeted children (sick children seeking care in the selected health facility within the age of 12-59 months). IT personal trained the enumerators about applying the KOBO toolbox and upload the digital questionnaire to their mobiles. This method is most effective method to make the research team monitors in daily basis the process of data collection.

Sample size calculation: The formula that is used to calculate the sample size is Danieal formula of cross-sectional study in infinite population.¹⁵

The following simple formula (Daniel, 1999) can be used:

$$N = \frac{Z^2 P(P-1)}{D^2}$$

where n = sample size, Z = Z statistic for a level of confidence (1.96) , P = expected prevalence or proportion, here is 10% based on the prevalence of malnutrition in Abyan,⁹ and d = precision (d= 2). Accordingly; the sample size will be:

$$N = \frac{1.96^2 * 0.10 * (1-0.10)}{2^2} = 3457/4 = 864$$

We add 10% to avoid non response, so the final sample size was 864 + 86 = 950

The samples size will be distributed equally for Lahj and Abyan (475 from each) then was distributed proportional to health facility category (175 children from each governorate hospital, 100 children from each district hospital and 50 children from each health center.)

Anthropometric measurements:¹⁶

- **Weight:** Children were weighed standing on the weight scale to the nearest 0.1kg. For the children who could not stand, weight was measured in infant weight scale.
- **Height/Length:** Height and length of children were measured using height scale and recorded to the nearest 0.1cm. Children equal or less than 87.0 cm were measured lying down, and children greater than or equal to 87.0 cm were measured in standing position.
- **MUAC:** Mid-upper arm circumference measurements were made using a flexible and non-stretch tape. MUAC measurements was taken on the mid-point of the left upper arm. All the selected sick children in the aged 12-59 months were measured to the nearest 0.1 cm. The MUAC is interpreted as both for graduated and color labeled. Red color [MUAC <115 mm], and <125 mm] were considered a moderately malnourished. While the green color [MUAC ≥ 125 mm] were categorized as normal according to WHO classification.

Operational definition of the Outcome indicators:¹⁷

Wasting: Weight-for-height (wasting) provides the clearest picture of acute malnutrition

Moderate Acute Malnutrition (MAM) is identified by moderate wasting WFH ≤ -2 z score and ≥ -3 z-score for children 0-59 months (or for children 6-59 months, MUAC <115 mm and ≥ 125 mm). Table 1.

Severe Acute Malnutrition (SAM) is identified by severe wasting < -3 z-score for children 12-59 months (or for children 12-59 months, MUAC <115 mm) or the presence of bilateral pitting edema.

Global Acute Malnutrition (GAM) is the presence of both MAM and SAM in a population. A GAM value of more than 10 percent indicates an emergency. If GAM is exceeding 15% it is considered critical while at 11-14% is severe GAM and if GAM at level of >5% and less than 10% is considered poor indicator.

Chronic malnutrition (Stunting) (Height-for-age Z score (HAZ)) The HAZ measure indicates if a child of a given age is chronically malnourished (stunted). The height-for-age index of a child from the studied population is expressed in Z-score (HAZ).

Table 1. Anthropometric measurements and indicators

Measurement	Indicator	Nutritional status
Weight-for-height index (W/H)	≥ -2 z-score	Normal nutrition status
	(<-3 z-score and/or oedema and/or < 115 mm (MUAC)	Acute severe malnutrition (SAM)
	WHZ ≥ -3 and <-2	Acute moderate malnutrition (MAM)
MUAC	> or = 125	Normal nutrition status
	< 125 and > or = 115	Acute moderate malnutrition (MAM)
	< 115	Acute severe malnutrition (SAM)
Stunting (Height for Age -HAZ)	≥ -2 z-score	Normal nutrition status
	3 z-score \leq H/A < -2 z-score	Stunting (moderate)
	< -3 z-score	Stunting (Severe)

The indicators:

1. proportion of wasting (MAM, SAM and GAM) among the hospitalized children in Lahj and Abyan

= Number of hospitalized children have MAM/ all hospitalized children under study

= Number of hospitalized children have SAM/ all hospitalized children under study

2. Proportion of stunting (Chronic malnutrition) among the hospitalized children in Lahj and Abyan

= Number of hospitalized children have stunting/ all hospitalized children under study

Results

Socio-demographic characteristics of the studied children.

The total number of sick children seeking care in the selected 10 health facilities in Lahj and Abyan during the study period (1-13, March 2022) are 951 children at the age of 12-59 months. The mean age is 29.5 years old (± 14 years). The median age is 26 years old and the range from 12 to 59 months. A total of 491 female children (51.6%) while male children are 460 children (48.4%). There are 474 children from Lahj governorate (49.8%) and 477 children from Abyan governorate (50.2%). Most of the children's mothers are either illiterate (37.4%) or has primary /essential education (36/1%) while most of the fathers had primary or essential education (39.2%). About 64% of children's fathers are employed, but about 35% is unemployed; most of the mothers reported that their family monthly income is not enough (88.1%). About 75% of the children are of

resident families and 23.7% of internal displaced people (IDPs). Most of the households of the children (62%) has irregular drinking water supply. Table 2.

Table 2. Socio-demographic characteristics of the sick children involved in the study (N = 951)

Socio-demographic characteristics		Number of the studied sick children (N=951)	%
Sex	Male	460	48.4%
	Female	491	51.6%
Governorate	Lahj	474	49.8%
	Abyan	477	50.2%
Mother educational level	Illiterate	356	37.4%
	Primary/elementary/preparatory	343	36.1%
	Secondary/diploma	186	19.6%
	University +	66	6.9%
Father educational level	Illiterate	161	16.9%
	Primary/elementary/preparatory	373	39.2%
	Secondary/diploma	283	29.8%
	University +	134	14.1%
Father job	Unemployed	332	34.9%
	Employed	617	64.9%
	Student	2	0.2%
Family monthly income	Enough	112	11.9%
	Not enough	838	88.1%
Residency	resident	713	75%
	IDPs	225	23.7%
	Refugees	8	0.8%
	Muhamseen	5	0.5%
Drinking water supply in the house	Available and Regular	262	27.5%
	Available but not regular	647	68%
	Not available	42	4.5%

Prevalence of acute malnutrition among sick children

The prevalence of Global acute malnutrition (GAM) among the sick children seeking care in health facilities in Lahj and Abyan is 21% (203/951) Figure 1. More specifically; the prevalence of moderate acute malnutrition (MAM is 15.1% (144/951) while the prevalence of severe acute malnutrition (SAM) is 6.2%. (59/951) Figure 2

The prevalence of acute malnutrition (wasting) among the studied sick children in lahj is 23.4% while in Abyan is 19.3%. The prevalence of MAM in Lahj is 17.7% and the prevalence of SAM is 5.7%. The prevalence of acute malnutrition (wasting) among the studied sick children in Abyan is 12.6% while the prevalence of SAM in Abyan is 6.7% but these differences are not significant (P-value 0.113)

The prevalence of the chronic malnutrition (Stunting)

The prevalence of the chronic malnutrition (Stunting) in the studied sick children is 41.3%; the prevalence of stunting in Lahj is 41.5% while in Abyan is 41.7%. The prevalence of moderate stunting in all the studied sick children is 24.3% and the prevalence of severe stunting is 17.2%. Prevalence of moderate stunting is higher in Abyan 26.4% while the prevalence of severe stunting is higher in Lahj (19.2%) but these differences are not significant (P-value 0.117). Table 3.

Table 3. Prevalence of acute malnutrition among the sick children seeking care in health facilities by governorate, March 2022

Category of malnutrition		Lahj (n= 474)		Abyan (n= 477)		Total (N=951)		χ ²	P-value
		No of children	%	No of children	%	No of children	%		
Acute malnutrition (Wasting)	MAM	84	17.7%	60	12.6%	144	15.1%	0.24	0.113
	SAM	27	5.7%	32	6.7%	59	6.2%		
	GAM	111	23.4%	92	19.3%	203	21.3%		
Chronic malnutrition (Stunting)	Moderate stunting	103	21.7%	126	26.4%	229	24.1%	0.42	0.117
	Severe stunting	91	19.2%	73	15.3%	164	17.2%		
	Overall stunting	194	41%	199	41.7%	393	41.3%		

Gender and malnutrition

The prevalence of acute malnutrition among male children (25.2%) is significantly higher than prevalence of acute malnutrition among female children (17.55). Moreover, Prevalence of MAM and SAM among males (17.6% & 7.6% respectively) are significantly higher than females (12.8% & 4.9% respectively) (P-value 0.004). The prevalence of stunting in males (45.3%) is significantly higher than females (37.7%). Moreover,

Prevalence of moderate stunting and severe stunting among males (25.5% & 19.8% respectively) are significantly higher than females (22.6% & 15.1% respectively) (P-value 0.05). Table 4.

Table 4. Gender and malnutrition

Category of malnutrition		Male (n= 460)		Female (n= 491)		χ^2	P-value
		No of children	%	No of children	%		
Acute malnutrition (Wasting)	MAM	81	17.6%	63	12.8%	8.42	0.004*
	SAM	35	7.6%	24	4.9%		
	GAM	116	25.2%	86	17.5%		
Chronic malnutrition (Stunting)	Moderate stunting	118	25.5%	111	22.6%	5.99	0.005^
	Severe stunting	90	19.8%	74	15.1%		
	Overall stunting	208	45.3%	185	37.7%		

***Statistically significant at 0.05 significant level**

The socio-economic characteristics and malnutrition

Table 5 shows that high prevalence of acute malnutrition among the Mahamasheen (37%) than residents (21%) and IDPs (21.3%) but the difference is not significant (P-value 0.732). Prevalence of stunting is very high among IDPs is (52%) and Al-Mahamasheen (50%) than the prevalence among residents (37.8%), this difference is high significant (P value 0.002). The high prevalence of stunting is also observed among children living in houses where the drinking water is not available (54.8%) than children living in houses where the drinking water is available and regular (42.8%), but the difference is not significant (P-value 0.163). Table 6.

Table 5. Association of acute malnutrition and socio-economic characteristics

Item		Acute malnutrition	Well nourished	Total	Prevalence of acute malnutrition	χ^2	P-value
Residency	Resident	150	563	713	21%	1.28	0.732
	IDPs	48	177	225	21.3%		
	Refugees	1	4	5	20%		
	Mahmasheen		3	8	37%		
Monthly family income	Enough	26	87	113	23%	0.24	0.625
	Not enough	176	662	838	21%		
Availability of drinking water in the house	Not available	9	33	42	21.4%	0.08	0.958
	Available but not regular	139	508	647	21.5%		
	Available and regular	54	208	262	20.6%		

Table 6. Association of chronic malnutrition and socio-economic characteristics

Item		stunting	Normal	Total	Prevalence of Stunting	χ^2	P-value
Residency	Resident	270	443	713	37.8%	20.9	0.002*
	IDPs	119	106	225	52.9%		
	Refugees	0	5	5	0%		
	Mahmasheen	4	4	8	50%		
Monthly family income	Enough	38	75	113	33.6%	5.49	0.064
	Not enough	355	483	838	42.3%		
Availability of drinking water in the house	Not available	33	19	42	54.8%	6.53	0.163
	Available but not regular	258	389	647	49.9%		
	Available and regular	112	150	262	42.8%		

*Statistically significant at 0.05 significant level

Discussion

This health facility-based study was conducted in two southern governorates in Yemen (Lahj and Abyan) where facing armed conflicts since 2015 affecting negatively upon the provision of the health services and exacerbate the existing malnutrition problem among children under five years. Out of the scope of the routine measurements of malnutrition in the community; this study focused on sick children seeking care in the health facilities for other health problems rather than malnutrition.

In this study; results revealed high prevalence of acute and chronic malnutrition (21.3% & 41.3% respectively) among studied sick children at the age of 1–4 years in Lahj and Abyan governorates. This study focused on sick children observed in the outpatient clinics in both primary health care centers and hospitals. The reported rates of malnutrition in this study are higher than what, were reported in other developed or developing countries. Studies in developed countries reported significant proportion of malnutrition among hospitalized patients, Groleau V (2014) in their study in Canada reported that the prevalence of acute and chronic malnutrition among hospitalized children was 13.3%.¹⁸ In another study in Canada in 2014; it was found that prevalence of acute malnutrition among children admitted to pediatric department was 6.9% while prevalence of chronic malnutrition was 13.4%.¹⁹ Hulst J et al, (2004) concluded in their study in Netherlands that among critically ill patients it was found that the prevalence of malnutrition among children admitted to intensive care units (ICU) was 24%.²⁰ In developing countries, one study in Malaysia reported that the prevalence of acute and chronic under-nutrition among hospitalized children were 11% and 14% respectively.²¹ In Pakistan the prevalence of stunting among children attending out-patient clinics was 21%.²² In one controversial result from Tanzania; the prevalence of stunting and wasting was 8.37% & 1.41% respectively among children attending hospitals and primary care centers with predominance of boys' malnutrition over females.²³ This controversial results of low prevalence are due to methodological issue; investigators targeted all children attend to the health facilities either for seeking care or to attending to well child clinic for vaccination.

Severe acute malnutrition (SAM) has a significant contribution to child death if untreated, and may be exceeded the minimum Sphere standard (< 10%) especially in developing countries like Yemen and Ethiopia.^{24–25}

in this study; the prevalence of SAM and MAM in sick children were 6.2% and 12.8% respectively, these figures are higher than the same indicators from community-based survey in Yemen (SAM 4.9%, MAM 8.4%)²⁶ and Ethiopia (SAM 3.6%, MAM 10.6%) prevalence of SAM in children under 5byears in Ethiopia.²⁷

Male children are more exposed to both acute and chronic malnutrition than females.^{28–29} in one study in Pakistan authors reported that significant higher prevalence of stunting in males than female children.²²

Poverty is a critical determinant of malnutrition.^{30–32} Yemen is a poor country, with poverty rates in Yemen increasing in recent years. For example, in 2018; the country ranked 178th out of 188 countries in the global Human Development Index ranking. Poverty can be both a cause and a consequence of malnutrition. Republic of Yemen.³³ In this study; high prevalence of acute and chronic malnutrition among all social classes are identified (residents, IDPs, refugees and marginalized groups (so-called in Yemen Al-Mahmashen) where prevalence of acute malnutrition is 37% comparing with 21% in residents and IDPs), but the difference is not significant.

The implication of this study is to give more attention for screening malnutrition among sick children as a routine examination. Studies reported that this routine screening is ignored in the routine medical care of sick children in many developing countries. In one study in Burundi (2019) it was found that only 3% of health workers screened children (6–59 months) for malnutrition.³⁴

There are certain limitations of this study. The study was limited to a selected health facilities in two governorates in southern Yemen due to logistics and accessibility issues. The study limited to patients attending health facilities in outpatient clinics, so critically ill-children were not included in the study.

Conclusions

High acute and chronic malnutrition rates were identified among sick children seeking care in health facilities in lahj and Abyan governorates in Yemen. These higher malnutrition rates exceeded the SPHERE indicators of malnutrition. Boys are more exposed than girls to acute and chronic malnutrition. High prevalence rates were observed in the children from marginalized groups, but it is not significantly different from other social groups. To avoid ignorance of the early detection of malnutrition in children under five and to treat appropriately and to reduce mortality, authors recommended every sick child observed in outpatient or in-patients pediatric departments should be screening for malnutrition.

Abbreviations

GAM Global Acute Malnutrition

H/A Height for Age

HAZ Height for Age Z score

HUCOM Hadhramout University College of Medicine

FAO Food and Agriculture Organization

IDPs Internally Displaced people

IPC Integrated Phase Classification of Food Security

IRVD The International War and Disaster Victims Protection Association

MAM Moderate Acute Malnutrition

MUAC Mid-upper arm circumference

SAM Severe Acute Malnutrition

SPSS Statistical Package for Social Sciences

UNICEF United Nations Children's Fund

WFP World Food Program

W/H Weight for Height

WHO World health Organization

Declarations

Ethics approval and consent to participate

The research proposal was approved by Research ethics committee of Hadramout University College of Medicine (HUCOM). The objectives of the study were clarified for the participant. We ensured that the information of those who agreed to participate in this study was kept in the strictest confidence and used for the benefit of the community. Writing informed consent was obtained from mothers of studied children. All methods were carried out in accordance with relevant guidelines and regulations.

Consent for publication

Not Applicable

Availability of data and materials

All data sets are available and can be shared by requesting it from the corresponding author by email.

Competing interests

Authors declared that there is no conflict of interest.

Funding

The research team obtained fund from The International War and Disaster Victims Protection Association (IRVD).

Author's Contribution: Alwaleedi AA and Bin-Ghouth AS participated in proposal development. Bin-Ghouth design the questionnaire and participated in training of data collectors. Al-Waleedi reviewed the questionnaire, organized and supervised the fieldwork. Both authors participated in data analysis, writing the first draft of the final report and reviewed and approved the manuscript.

Acknowledgments

This study is implemented in Lahj and Abyan governorates in Yemen and aimed to investigate the malnutrition among children at the age of 1-4 years and seeking care in the health facilities. This work can't accomplish without cooperation and coordination with different actors from funding to implementation to finalize of this report. Here, the investigators appreciated the support of The International War and Disaster Victims Protection Association (IRVD) who grant this study, the investigators thank a lot this funding agency for their great support.

The investigators thank Mr. Ahmed Qiad for his great work during the preparation the digital questionnaire, using the KOBO application. Mr Ahmed trained the enumerators in Lahj and Abyan about the electronic monitoring system which developed that makes our daily follow-up easy and more flexible quick.

Regarding the fieldwork at the governorate level; Investigators appreciated the great role of Mr. Fahd Abdu (lahj supervisor) and Mr. Kamal Jubran (Abyan supervisor) for their close supervision of the fieldwork. Our thanks extended to the enumerators who did a hard duty in data collection. They collected data from mothers and take the anthropometric measurements of the sick children who attended the selected health facilities in Abyan and Lahj governorates.

Finally, the investigators thank mothers who participated in this study by giving valuable data about their children and hope their children receiving a good care and being cured.

References

1. McCarthy A, Delvin E, Marcil V, et al. Prevalence of Malnutrition in Pediatric Hospitals in Developed and In-Transition Countries: The Impact of Hospital Practices. *Nutrients*. 2019;11(2):236. Published 2019 Jan 22. doi:10.3390/nu11020236 Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6412458/>
2. Ghouth ASB. The Multi-Epidemics in Yemen: the Ugly Face of the War. *Ann Infect Dis Epidemiol*. 2018; 3(2): 1033. Available at: <http://www.remedypublications.com/open-access/the-multi-epidemics-in-yemen-the-ugly-face-of-the-war-1171.pdf>
3. UNICEF. Yemen Humanitarian Situation Report. http://www.unicef.org/mena/UNICEF_Yemen_Crisis_SitRep_-_8_July_to_21_July_2015.pdf. (accessed Feb 28, 2022).
4. Abdulaziz M Eshaq, Ahmed M Fothan, Elyse C Jensen, Tehreem A Khan, Abdulhadi A AlAmodi. Malnutrition in Yemen: an invisible crisis. *The Lancet*. 2017. (389): 10064:31-32. DOI: [https://doi.org/10.1016/S0140-6736\(16\)32592-2](https://doi.org/10.1016/S0140-6736(16)32592-2) Available at: [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(16\)32592-2/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(16)32592-2/fulltext) Accessed Feb 11, 2022
5. WFP. Yemen emergency. Available at: <https://www.wfp.org/emergencies/yemen-emergency> Accessed Feb 11,2022
6. Al-Zangabila K, Poudel Adhikari S, Wang Q, Sunil TS, Rozelle S, Zhou H. Alarming high malnutrition in childhood and its associated factors: A study among children under 5 in Yemen. *Medicine (Baltimore)*. 2021 Feb 5;100(5):e24419. doi: 10.1097/MD.00000000000024419. PMID: 33592890; PMCID: PMC7870187.
7. Nélio Barreto Vieira, Sionara Melo Figueiredo de Carvalho, Modesto Leite Rolim Neto, Hildson Leandro de Menezes. The silence of the lambs: Child morbidity and mortality from malnutrition in Yemen. *Journal of pediatric nursing*. January 05, 2022. DOI:<https://doi.org/10.1016/j.pedn.2021.12.006> (Article in Press). Available at: [https://www.pediatricnursing.org/article/S0882-5963\(21\)00374-2/pdf](https://www.pediatricnursing.org/article/S0882-5963(21)00374-2/pdf) Accessed Feb 11, 2022

8. UNICEF. Increasing the cases of malnutrition in young children in Yemen within the deteriorated situation. Available at: <https://www.unicef.org/yemen/ar/> Accessed 11/2/2022 (in Arabic)
9. UNICEF & Action contra la faim. NUTRITION AND RETROSPECTIVE MORTALITY SURVEY HIGHLANDS AND LOWLANDS LIVELIHOOD ZONES OF ABYAN GOVERNORATE. Final survey report. 2018. Available at: https://reliefweb.int/sites/reliefweb.int/files/resources/smart_survey_abyan_jan_2018.pdf Accessed Feb 12, 2022.
10. OCHA. NUTRITION AND RETROSPECTIVE MORTALITY SURVEY HIGHLANDS AND LOWLANDS LIVELIHOOD ZONES OF LAHJ GOVERNORATE. Final survey report. 2018. Available at: <https://www.humanitarianresponse.info/en/operations/yemen/document/smart-survey-lahj-jul-2017> Accessed Feb 21,2022
11. Alves RNP, de Vasconcelos CAC, Vieira NB, Pereira YTG, Feitosa PWG, Maia MAG, de Carvalho SMF, Neto MLR, de Menezes HL. The silence of the lambs: Child morbidity and mortality from malnutrition in Yemen. *J Pediatr Nurs.* 2022 Jan 5:S0882-5963(21)00374-2. doi: 10.1016/j.pedn.2021.12.006. Epub ahead of print. PMID: 34998655. Available at: <https://pubmed.ncbi.nlm.nih.gov/34998655/> Accessed April 16, 2022
12. Hecht C., Weber M., Grote V., Daskalou E., Dell'Era L., Flynn D., Gerasimidis K., Gottrand F., Hartman C., Hulst J., et al. Disease associated malnutrition correlates with length of hospital stay in children. *Clin. Nutr.* 2015;34:53–59. doi: 10.1016/j.clnu.2014.01.003.
13. Pawellek I., Dokoupil K., Koletzko B. Prevalence of malnutrition in paediatric hospital patients. *Clin. Nutr.* 2008;27:72–76. doi: 10.1016/j.clnu.2007.11.001.
14. Marino L.V., Thomas P.C., Beattie R.M. Screening tools for paediatric malnutrition: Are we there yet? *Curr. Opin. Clin. Nutr. Metab. Care.* 2018;21:184–194. doi: 10.1097/MCO.0000000000000464
15. L. Naing, T. Winn, B.N. Rusli. Practical Issues in Calculating the Sample Size for Prevalence Studies. *Archives of Orofacial Sciences* 2006; 1: 9-14. Available at: <https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.504.2129&rep=rep1&type=pdf> Accessed Feb 12, 2022
16. MOPH&P. GUIDELINES FOR THE MANAGEMENT OF THE SEVERELY MALNOURISHED IN YEMEN. 1st version. 2008
17. WHO. Understanding the Difference Among MAM, SAM, and GAM and their Importance on a Population Basis in: WHO. 2000. *The Management of Nutrition in Major Emergencies.* Available at: <https://www.globalhealthlearning.org/sites/default/files/page-files/MAM%2C%20SAM%2C%20and%20GAM.pdf> Accessed Feb 13, 2022
18. Groleau V, Thibault M, Doyon M, Brochu EE, Roy CC, Babakissa C. Malnutrition in hospitalized children: prevalence, impact, and management. *Can J Diet Pract Res.* 2014 Spring;75(1):29-34. doi: 10.3148/75.1.2014.29. PMID: 24606957.
19. Baxter JA, Al-Madhaki FI, Zlotkin SH. Prevalence of malnutrition at the time of admission among patients admitted to a Canadian tertiary-care pediatric hospital. *Pediatric Child Health.* 2014;19(8):413-417. doi:10.1093/pch/19.8.413.
20. Hulst J et al. Malnutrition in critically ill children from admission to 6 months after discharge. *Clinical nutrition.* 2004. 23:223-232. Available at:

- https://d1wqtxts1xzle7.cloudfront.net/44323778/Malnutrition_20critically Accessed 13/4/2022.
21. Lee WS, Ahmad Z. The prevalence of undernutrition upon hospitalization in children in developing country: a single hospital study from Malaysia. *Pediatric and neonatology*. 2017. 58; 5: 415-420 DOI: <https://doi.org/10.1016/j.pedneo.2016.08.010> available at: [https://www.pediatr-neonatal.com/article/S1875-9572\(17\)30101-8/fulltext](https://www.pediatr-neonatal.com/article/S1875-9572(17)30101-8/fulltext) Accessed 13/4/2022.
 22. Fatima, Sehrish et al. "Stunting and associated factors in children of less than five years: A hospital-based study." *Pakistan journal of medical sciences* vol. 36,3 (2020): 581-585. doi:10.12669/pjms.36.3.1370
 23. Juma, O.A., Enumah, Z.O., Wheatley, H. *et al.* Prevalence and assessment of malnutrition among children attending the Reproductive and Child Health clinic at Bagamoyo District Hospital, Tanzania. *BMC Public Health* **16**, 1094 (2016). <https://doi.org/10.1186/s12889-016-3751-0>
 24. Bitew, Z.W., Ayele, E.G., Worku, T. *et al.* Determinants of mortality among under-five children admitted with severe acute malnutrition in Addis Ababa, Ethiopia. *Nutr J* **20**, 94 (2021). <https://doi.org/10.1186/s12937-021-00750-0>
 25. Organization WH. Pocket book of hospital care for children: guidelines for the management of common childhood illnesses: World Health Organization; 2013. <https://apps.who.int/iris/handle/10665/81170>.
 26. Dureab F, Al-Falahi E, Ismail O, et al. An Overview on Acute Malnutrition and Food Insecurity among Children during the Conflict in Yemen. *Children (Basel)*. 2019;6(6):77. Published 2019 Jun 5. doi:10.3390/children6060077
 27. Yeshaneh A, Mulu T, Gasheneit A, Adane D (2022) Prevalence of wasting and associated factors among children aged 6-59 months in Wolkite town of the Gurage zone, Southern Ethiopia, 2020. A cross-sectional study. *PLoS ONE* 17(1): e0259722. <https://doi.org/10.1371/journal.pone.0259722>
 28. Dukhi N. Global Prevalence of Malnutrition: Evidence from Literature. OPEN ACCESS PEER-REVIEWED CHAPTER. available at: <https://www.intechopen.com/chapters/71665> DOI: 10.5772/intechopen.92006.
 29. Sand A, Kumar R, Shaikh BT, Somrongthong R, Hafeez A, Rai D. Determinants of severe acute malnutrition among children under five years in a rural remote setting: A hospital-based study from district Tharparkar-Sindh, Pakistan. *Pak J Med Sci*. 2018;34(2):260-265. doi:10.12669/pjms.342.14977
 30. Siddiqui F, Salam RA, Lassi ZS, Das JK. The Intertwined Relationship Between Malnutrition and Poverty. *Front Public Health*. 2020 Aug 28;8:453. doi: 10.3389/fpubh.2020.00453. PMID: 32984245; PMCID: PMC7485412.
 31. Panda, B.K., Mohanty, S.K., Nayak, I. *et al.* Malnutrition and poverty in India: does the use of public distribution system matter?. *BMC Nutr* **6**, 41 (2020). <https://doi.org/10.1186/s40795-020-00369-0>
 32. Rahman MA, Halder HR, Rahman MS, Parvez M. Poverty and childhood malnutrition: Evidence-based on a nationally representative survey of Bangladesh. *PLOS ONE*. 2021; 16(12): e0261420. <https://doi.org/10.1371/journal.pone.0261420>.
 33. YEMEN MULTISECTORAL NUTRITION ACTION PLAN 2020–2023. Official report. 2020. Available at: https://mqsunplus.path.org/wp-content/uploads/2020/08/Yemen-MSNAP-FINAL_29April2020.pdf accessed 14/4/2022.

34. Nimpagaritse, M., Korachais, C., Nsengiyumva, G. *et al.* Addressing malnutrition among children in routine care: how is the Integrated Management of Childhood Illnesses strategy implemented at health centre level in Burundi?. *BMC Nutr*5, 22 (2019). <https://doi.org/10.1186/s40795-019-0282-y>

Figures

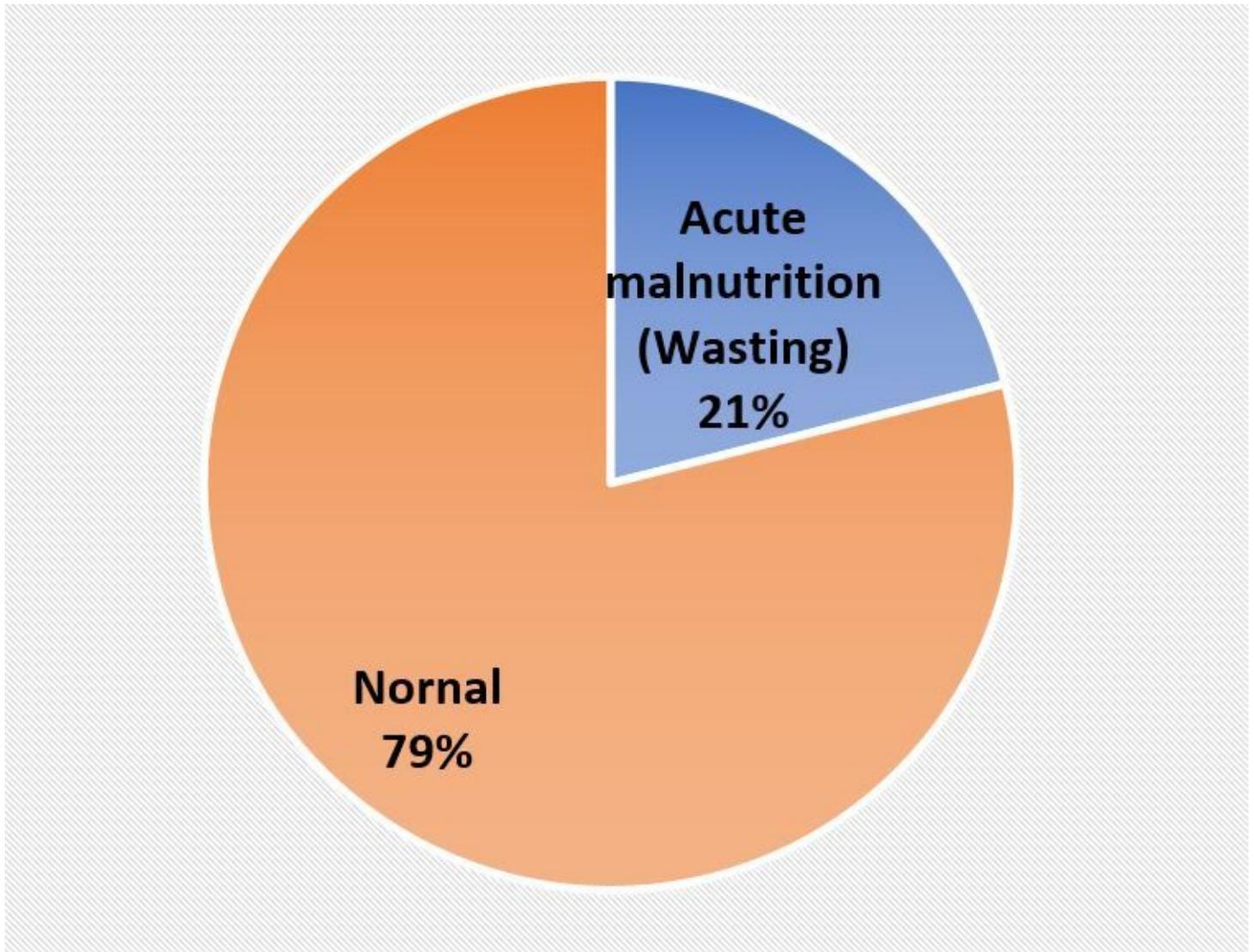


Figure 1

Prevalence of acute malnutrition (Wasting) among 951 sick children seeking care in health facilities in Lahj and Abyan, March 2022

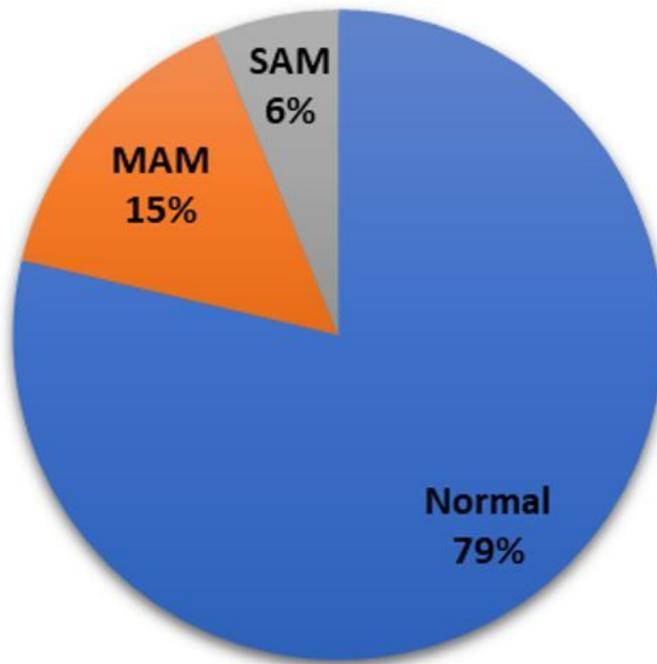


Figure 2. Prevalence of MAM and SAM among sick children seeking care in health facilities in Lahj and Abyan, March 2022.

■ Normal ■ MAM ■ SAM

Figure 2

See image above for figure legend.