

Undernutrition and Mortality Risk Among Hospitalized Children

Aida H. Al-Sadeeq, Aidroos Z. Bukair

Department of Paediatric, Faculty of Medicine and Health Sciences, University of Aden, Yemen

ABSTRACT

Background: Malnutrition remains one of the most common causes of morbidity and mortality among children in low- and middle-income countries, being responsible for 45% of deaths among children younger than 5 years. **Objectives:** This study aimed to assess the frequency of undernutrition and to evaluate the effect of simultaneous presence of underweight, wasting, and stunting on child mortality. **Methods:** A retrospective observational review of files for patients admitted from September 1, 2015, to February 29, 2016, in a single ward treating children with diarrheal diseases and severe acute malnutrition (SAM). **Results:** A total of 299 patients aged 2 months–59 months were included in this study. There were 61.9% of males and 38.1% of females. The frequency of severe underweight, wasting, and stunting was 75.3%, 71.6%, and 37.8%, respectively. Nine SAM patients died (5.4%), the majority were 6–23 months old, males, from rural area, and were also had severe underweight and stunting. **Conclusion:** The majority of admitted children were undernourished and simultaneous coexistence of severe underweight, wasting, and stunting heightened the mortality risk of children during inpatient management of complicated SAM.

Key words: Child mortality, multiple anthropometric deficits, severe acute malnutrition

INTRODUCTION

Malnutrition remains one of the most common causes of morbidity and mortality among children in low- and middle-income countries, being responsible for 45% of deaths among children younger than 5 years.^[1,2] Globally, Yemen ranks among the top worst countries in child malnutrition, it is the first in severe underweight and the second in stunting rate.^[3] In 2013, the Yemeni National Health and Demographic Survey showed stunting (low height-for-age), wasting (low weight-for-height), and underweight (low weight-for-age) in under 5 children to be 47%, 14%, and 39%, respectively.^[4] Many studies have reported associations of stunting, wasting, and underweight with mortality, and these anthropometric deficits are estimated to individually account for, respectively, 14.5%, 14.6%, and 19.6% of deaths in children <5 years of age.^[5] However, estimates of the effects of individual anthropometric indicators overlook the fact

that multiple deficits may occur simultaneously, especially because all deficits are associated with poverty, poor dietary intake, and infectious diseases.^[6,7]

The association between simultaneous presence of multiple anthropometric deficits and the risk of mortality has not yet been analyzed in hospital-based studies because the child status is only evaluated for acute malnutrition for the purpose of starting management of acute malnutrition. Therefore, it is unclear whether or not multiple anthropometric deficits amplify the risk of mortality in our setting.

This study uses the WHO (2006 multicenter growth reference study) Z-score system^[8] to assess the nutritional status with a purpose of identifying the frequency of undernutrition and to evaluate the effect of simultaneous presence of underweight, wasting, and stunting on mortality among children admitted to diarrheal diseases (DD) and therapeutic feeding center (TFC) in Al-Sadaka General Teaching Hospital/Aden/Yemen.

Address for correspondence:

Aida Hussein Al-Sadeeq, Department of Paediatrics, Faculty of Medicine and Health Sciences, University of Aden, Yemen, Tel: +967771144531.

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PATIENTS AND METHODS

A retrospective observational study conducted in the DD and TFC of Al-Sadaka General Teaching Hospital/Aden and included children aged 2–59 months who were admitted from September 1, 2015, to February 29, 2016.

The pediatric department of Al-Sadaka GTH serves as a main and referral hospital for Aden and the neighboring governorates, and the DD and TFC is a single unit, has a bed capacity of 25, admits all children with DD who need admission, all severely malnourished 6–59 months old children with poor appetite and/or medical complications (including hypothermia, hypoglycemia, dehydration, sepsis, shock, abdominal distension, heart failure, and anemia) who need inpatient care and severely malnourished 2–5 months old infants whether they have medical complications or not, who are not assumed to be treated in outpatient therapeutic program (OTP).

On admission, all children got their weight, height/length, and mid-upper arm circumference (MUAC) measured and were examined for presence of edema. Children 6–59 months old who were found to have severe acute malnutrition (SAM) (bilateral pitting edema and/or weight-for-length/height below -3 z-score and/or MUAC <11.5 cm) with poor appetite and/or complication and those who were referred from OTP as per action protocol for outpatient care,^[9] plus SAM among 2–5 months old infants (bilateral pitting edema and/or weight-for-length below -3 z-score) were managed using the WHO Training Modules for Participants for Inpatient Care of SAM, the Yemeni version and WHO Guideline: Updates on the Management of SAM in Infants and Children.^[9,10]

Children with diarrhea who were not severely malnourished were managed according to the standard regimens of fluid therapy in pediatric textbooks.

Data collection

The following data were obtained from patients' files, in a pre-structured questionnaire: Age, gender, residence, measured weight in kilogram, and length/height in centimeter, (these measurements were recorded on the day of admission). In addition, the presence of bilateral pitting edema, date of admission, comorbidities of malnutrition, the duration of hospitalization, and the outcome of children during management were also recorded. The final cause of death was documented after mortality reviews by the managing specialists. The 2006 WHO Multicenter Growth Reference Study^[8] was used to assess every child's length/height-for-age, weight-for-length/height, and weight-for-age z-scores. Children were grouped into three age groups (2–5 months, 6–23 months, and 24–59 months). The frequency of undernutrition was assessed by conventional anthropometric indices of stunting, wasting, and underweight.

Death outcome among 6–59 month old children with SAM was evaluated in relation to gender (139 males and 93 females), residence, conventional indices, and time of death since admission. The death rate was compared to the SPHERE Minimum Standards for inpatient care outcome indicators of performance.^[11] Death among under 6-month-old infants was not evaluated as no agreed death outcome of performance indicator in the SPHERE Minimum Standards among these age groups.

All malnourished children were new admissions, grossly devoid of any deformities and had no underlying chronic ill conditions. Children with generalized edema were not included in this study as the fictitious weight masks the real weight measurement.

Definitions used

Conventional anthropometric indices:^[9]

- Severe wasting (SAM) is defined as a weight-for-height Z-score (WHZ) of < -3
- Severe stunting (severe chronic malnutrition) is defined as a height-for-age Z-score (HAZ) of < -3
- Severe underweight (mixed acute and chronic malnutrition) is defined as weight-for-age Z-score (WAZ) of < -3

Ethical consideration and data analysis

Ethical clearance was obtained from the management office of Al-Sadaka General Teaching Hospital/Aden, regarding the use of official registries and patients' files. Patient identifiers were not included; therefore, no ethical harm was inflicted on the patients.

The recorded data were analyzed using SPSS for Windows (Version 20.0). The descriptive statistics (mean and standard deviation) of height and weight were calculated. One-way analysis of variance was used to assess the differences in mean height and weight. A Chi-square analysis was performed to determine the sex difference in the prevalence of under nutrition. $P < 0.05$ was considered to be statistically significant.

RESULTS

A total of 303 patients aged 2–59 months were admitted to the DD and TFC from September 1, 2015, to February 29, 2016. Files of 299 patients were reviewed. Four patients with edema Grade 3 (generalized edema) were excluded. There were 185 (61.9%) males and 114 (38.1%) females. Severe underweight, SAM, and severe stunting were found among 75.3 %, 71.6%, and 37.8%, respectively. The frequency of severe underweight and severe wasting was nearly equal among males and females. The frequency of stunting was high among males than females, however, the difference was statistically not significant ($P = 0.14$) [Figure 1].

The age and sex distribution, mean and standard deviation of height and weight, and the frequency of severe undernutrition are shown in Table 1.

The age- and sex-specific means of height and weight increased with age among both sexes, the differences were found to be statistically significant among both boys (height $P < 0.05$; weight: $P < 0.05$) and girls (height: $P < 0.05$; weight: $P < 0.05$). The frequency of severe underweight, wasting, and stunting was higher among 2–5 and 24–59 months old females than males, however, the differences were not statistically significant. The frequency of severe undernutrition was significantly higher among 6–23 months old males than females (underweight: $P = 0.008$; wasting: $P = 0.012$; stunting: $P = 0.025$).

Table 2 Some of the background characteristics of children who died during management of SAM (the analysis was done only for 6–59 months old 106 males and 60 females). Nine SAM patients died (5.4%), the majority were male, 6–23 months old, from rural area, and were also severely underweight and stunted. It also showed that diarrhea was the major cause of admission and septicemia was the final cause of death (as documented by the managing specialists, not showed in the table). The majority of SAM cases died in the first 3 days of admission.

DISCUSSION

Our results provide evidence that in our setting, which delivers care for children with SAM, the frequency of mixed and chronic undernutrition was also high and the simultaneous presence of underweight, wasting, and stunting in the same patient heightened his risk of mortality.

Although our unit includes two centers (therapeutic feeding and DD other than cholera), the majority of admitted children were severely underweight and wasted, and a significant percentage of children was also severely stunted. Stunting was more among males compared to females.

The study has many strengths and limitations. It is the first hospital-based study in Aden/Yemen used the WHO multicenter growth reference study to assess children for underweight, wasting, and stunting, and it is the first which analyzed mortality in relation to the presence of multiple deficits in the conventional indices. Our TFC is a referral center receives malnourished children from outpatient therapeutic departments (OPDs) in Aden and referrals from OPDs and TFCs from nearby governorates, therefore, our findings could be a representation of prevalence of undernutrition and mortality in the country. However, being a referral center receiving very severe complicated cases, the high frequency of undernutrition it reflects could be higher compared to community-based studies, which might be considered as a limitation of the study.

Table 1: Age- and sex-specific descriptive statistics of height and weight (mean±SD), prevalence of undernutrition using the conventional indices among the study children

Variables	2–5 months			6–23 months			24–59 months		
	Male (n=46)	Female (n=21)	Sex combined (n=67)	Male (n=117)	Female (n=82)	Sex combined (n=199)	Male (n=22)	Female (n=11)	Sex combined (n=33)
Height (cm) Mean (SD)	57.25±5.46	54.74±4.81	56.46±5.23	68.79±4.87	67.00±5.86	68.05±5.29	82.43±10.15	81.18±4.68	82.02±8.63
Weight (kg) Mean (SD)	3.89±0.98	3.21±0.82	3.68±0.92	6.04±0.97	5.46±1.28	5.79±1.10	8.61±2.20	7.78±1.16	8.33±1.89
Severe underweight									
WAZ < -3	35 (76.1)	17 (81.0)	52 (77.6)	95 (81.2)	53 (64.6)	148 (74.4)	15 (68.2)	10 (90.9)	25 (75.7)
Severe wasting									
WHZ < -3	31 (67.4)	17 (81.0)	48 (71.6)	93 (79.5)	52 (63.4)	145 (72.9)	13 (59.1)	08 (72.7)	21 (63.6)
Severe stunting									
HAZ < -3	17 (36.9)	10 (47.6)	27 (40.3)	48 (41.0)	21 (25.6)	69 (34.7)	11 (50.0)	06 (54.5)	17 (51.5)

Table 2: Background characteristics of 6–59 months old children who died during the management of SAM

Characteristics	6–23 months <i>n</i> =7 (100)	24–59 months <i>n</i> =2 (100)	Total <i>n</i> =9 (100)
Sex			
Male	5 (71.4)	1 (50.0)	6 (66.7)
Female	2 (28.6)	1 (50.0)	3 (33.3)
Residence			
Rural	7 (100)	0 (000)	7 (77.8)
Urban	0 (000)	2 (100)	2 (22.2)
Comorbidities			
Diarrhea	7 (100)	0 (000)	7 (77.8)
Bronchopneumonia	0 (000)	1 (50.0)	1 (11.1)
Severe malaria	0 (000)	1 (50.0)	1 (11.1)
Nutritional status by			
WAZ < -3 (severe underweight)	7 (100)	2 (100)	9 (100)
WHZ < -3 (severe wasting)	7 (100)	2 (100)	9 (100)
HAZ < -3 (severe stunting)	6 (85.7)	1 (50.0)	7 (77.8)
Time of death since admission			
<24 h	2 (28.6)	0 (000)	2 (22.2)
2 nd –3 rd day	4 (57.1)	2 (100)	6 (66.7)
4 th –7 th day	1 (14.3)	0 (000)	1 (11.1)
7 th –10 th day	0 (000)	0 (000)	0 (000)

Figures in parentheses are percentages

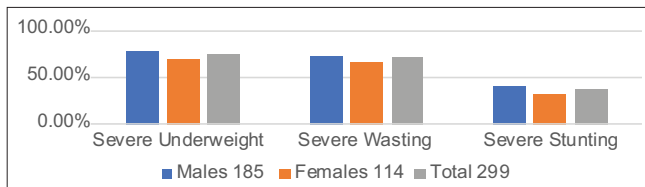


Figure 1: Frequency of undernutrition using conventional indices among the studied children

The study revealed that 66.7% of SAM patients who died were male, this consistent with the finding that in Yemen under 5 mortality was more common among male 59% (2015).^[12] Moreover, the high prevalence of stunting among males (41.1) at this critical age is associated with increased morbidity and mortality from infections, in particular diarrhea and pneumonia, and in recent large analysis from 10 studies in Asia, Africa, and South America, there was a clear dose-response relationship between low HAZ and mortality.^[13,14]

Death rate among 6–59 months old SAM patients was 5.4%, which is much lower than the acceptable cutoffs for death rate according to the SPHERE Minimum Standards for inpatient care outcome indicators of performance,^[11] and lower than the death rate occurred in phase one in a study done in Northwest Ethiopia (7.7%).^[15] However, the death rate our study revealed was higher than that in studies done in Uttar

Pradesh, India (2.5%),^[16] and New Delhi, India (0.42%).^[17] We noted that children with multiple severe deficits were more likely to develop septicemia and were more at risk of dying compared to those who admitted for diarrhea with normal nutrition, this finding was similar to a study done in rural Ethiopia.^[18]

CONCLUSION

Simultaneous coexistence of severe underweight, wasting, and stunting increases the risk of dead of children during inpatient management of complicated SAM. Current national policy of nutritional intervention targeting only acute malnutrition prevents identification and understanding the additional contribution of mixed and chronic undernutrition to the increased risk of mortality.

RECOMMENDATION

Further studies need to be conducted in other TFCs in Yemen to ascertain the relationship between multiple anthropometric deficits and mortality, when this relationship is confirmed, policy-makers concerned for the management of malnutrition ought to design special protocols targeting underweight, and stunting in addition to the current guidelines which concern only for acute malnutrition.

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