ORIGINAL PAPER

Nagoya J. Med. Sci. **78**. 41 ~ 53, 2016

# Acute malnutrition among under-five children in Faryab, Afghanistan: prevalence and causes

Muhammad Kamel Frozanfar[1], Yoshitoku Yoshida[1], Eiko Yamamoto[1], Joshua A. Reyer[1], Suraya Dalil[2], Abdullah Darman Rahimzad[3] and Nobuyuki Hamajima[1]

[1]*Department of Healthcare Administration, Nagoya University Graduate School of Medicine, Nagoya, Japan*
[2]*Former Minister of Public Health, Ministry of Public Health, Kabul, Afghanistan*
[3]*Department of ENT, Faculty of Medicine, Balkh University, Balkh, Afghanistan*

## ABSTRACT

Acute malnutrition affects more than 50 million under-five (U5) children, causing 8.0% of global child deaths annually. The prevalence of acute malnutrition (wasting) among U5 children in Afghanistan was 9.5% nationally and 3.7% in Faryab province in 2013. A cross-sectional study was conducted for 600 households in Faryab to find the prevalence and causes of acute malnutrition. Odds ratios (ORs) and 95% confidence intervals (CIs) were estimated using a logistic model. Demographic results of this study showed that 54.0% of the household heads and 92.3% of the mothers had no education. Three-fourths of households had a monthly income ≤ 250 USD. According to the measurement of weight for height Z-score (WHZ), 35.0% (210/600) of the children had acute malnutrition (wasting, WHZ < −2). In more than half of the households, water, sanitation, and hygiene (WASH) conditions were poor. When adjusted, a significant association of acute malnutrition among U5 children was found with the education level of household heads (OR=1.49; 95% CI, 1.02–2.17), age of household heads (OR=2.01; 95% CI, 1.21–3.35), income (OR=1.66; 95% CI, 1.04–2.27), education level of mothers (OR=2.21; 95% CI, 1.00–4.88), age of children (OR=1.99; 95% CI, 1.32–2.93), history of children with diarrhea in the last two weeks of data collection (OR=1.57; 95% CI, 1.10–2.27), feeding frequency (OR=3.01; 95% CI, 1.21–7.46), water sources (OR=1.89; 95% CI, 1.26–2.83), and iodized salt (OR=0.59; 95% CI, 0.39–0.88). The present study indicated that an increase in education level of parents, household income, and quality of WASH would result in a significant decrease in prevalence of wasting among U5 children.

Key Words: acute malnutrition, incidence, cause, under-five children, Afghanistan

## INTRODUCTION

The nutritional status of children is a reflection of their overall health. Undernutrition in childhood, causing wasting, fetal growth restriction, stunting, and micronutrient deficiencies, is one of the main burdens of the health system and also affects the economic and sociocultural status of society.[1-4] Poverty and malnutrition play a crucial role in increasing morbidity and mortality, impairing cognitive development in children, and increasing common childhood infections.[5-7] In addition, it reduces the capacity of economic productivity in adulthood.

Acute malnutrition is the clinical term for undernutrition, a major concern of the health sector.[8]

Received: August 25, 2015; accepted: November 30, 2015
Corresponding author: Muhammad Kamel Frozanfar MD
Department of Healthcare Administration, Nagoya University Graduate School of Medicine, 65 Tsurumai-cho, Showa-ku, Nagoya 466-8550, Japan
Phone: +81-52-744-1982, Fax: +81-52-744-1982, E-mail address: dr.kamel.f.r@gmail.com

It is defined as a weight-for-height Z-score (WHZ) < −2 (wasting). Acute malnutrition affects more than 50 million under-five (U5) children, causing 8.0% of child deaths globally each year.[9,10] Acutely malnourished children are categorized into severe acute malnutrition (SAM) and moderate acute malnutrition (MAM) on the basis of body measurements.[3] SAM is defined as WHZ < −3,[11] affecting approximately 19 million children under the age of five worldwide annually. Focusing on it is a moral and ethical imperative.[12-14] Children with MAM are defined as having WHZ < −2 and ≥ −3, accounting for 11.0% of undernourished children worldwide; these children face a higher risk of morbidity from infectious disease, which puts them at three times more risk of death than their counterparts with sufficient nutrition.[13,15] The findings show that more than 400,000 child deaths can be prevented each year by adequate identification and proper management of acute malnutrition.[16]

Acute malnutrition is one of the main concerns of the health sector in Afghanistan. It is caused by poor maternal nutrition before and during pregnancy, inappropriate infant feeding practices, and repeated episodes of infections. Other contributing factors include lack of food (due to lower purchasing power or destruction of crops during natural disasters and conflicts) and lack of resources and information.[17-20] The existing situation of health and nutrition in Afghanistan indicates that progress towards achievement of Millennium Development Goals (MDG) 2015 has been relatively slow, with an U5 mortality rate of 102 deaths per 1,000 live births.[17,18] A high percentage of illiterate mothers, limited access to safe drinking water, and poor hygiene and sanitation have also contributed to undernutrition and child morbidity in the country.[21,22] The prevalence of acute malnutrition among U5 children was 9.5% in the country overall and 3.7% in Faryab province in 2013.[18]

Growing evidence suggests that 80% of childhood disease is related directly or indirectly to unsafe drinking water, inadequate sanitation and hygiene practices.[23] Also it has been revealed in existing studies that there is strong link in child linear growth and WASH practices.[24] Approximately 25% of malnutrition cases can be attributed to children suffering five or more episodes of diarrhea before the age of 24 months.[25] Recent studies show that, diarrheal mortality rate is fourth highest in Afghanistan, and approximately 9% of all deaths among U5 children are due to diarrheal diseases in the country. Although the hygiene has been improved, water supply and sanitation could further prevent 95% of all diarrhea cases.[26]

Past studies in malnutrition have focused more on the prevalence of malnutrition rather than its causes. Thus, there has been a need for studies consisting of both prevalence and causes in order to provide a clearer picture of nutritional status of U5 children in the country. The current study was conducted to find the prevalence and causes of acute malnutrition among U5 children in Faryab, Afghanistan.

## MATERIALS AND METHODS

The target of anthropometry was children aged 6–59 months and mothers giving care to target children. Information on the heads of household was also collected. The head of household was defined as the person in the household who makes the major decisions for all the household members, such as financial expenditures, schooling, medical care, and food. According to the Afghanistan Research and Evaluation Unit 2013, the population of Faryab province was 948,000. In this survey, the sample size was set to be about 600, a similar sample size of the Nutrition Baseline Survey 2011 and National Nutrition Survey 2013, run in Faryab province. The ages of the target children were determined by asking the mother and head of household about the children's birth dates. To improve accuracy, different sources (such as identification cards, immunization cards, and birth certificates) were also used to ascertain the ages of eligible children.

A stratified two-stage sampling design was adopted for this study. Three (Pashtonkot, Dawlat Abad, and Belcheragh) out of 14 districts in the province were chosen to cover a wide variety of demographic characteristics. From each target district, four villages were selected randomly by lottery. Each village was divided into 8 to 12 clusters according to population distribution, and 1 cluster was selected randomly as the target cluster. In each target cluster, data collection of households started from the center of the cluster. To collect data from households, Standardized Monitoring and Assessment of Relief and Transitions (SMART) methodology was used. In this method, when the first household was chosen randomly, the data collectors moved to the adjacent households until reaching the target sample size from the target cluster (one U5 child from each household).[20] Data collection started on August 5, 2014, simultaneously in all three provincial districts and completed on August 17, 2014.

Data collection was carried out by the community health supervisors from Solidarity for Afghan Families, a national non-governmental organization that implements the provincial Basic Package of Health Service (BPHS). The survey team consisted of one male team leader and two members (one male and one female). In each of the three target districts, one team was assigned to collect the data.

Training was conducted for all three teams from August 1 to August 3, 2014 in Maimana city of Faryab province. The questionnaire used in Nutrition Baseline Survey 2011 was used in this study to collect the data. This study collected information on the household demographics, anthropometric measurements of the children and mothers, and amount of iodine in the kitchen salt to understand the amount of iodine in the daily used salt, which is strongly linked with linear growth of U5 children.

To determine the nutritional status of children; the youngest child in the household was selected and measured three times for all four indicators: height, weight, measurement of upper arm circumference (MUAC), and edema. The middle of the left upper arm circumference was chosen for MUAC. MAM was defined as being < 12.5 cm and ≥ 11.5 cm, and SAM was < 11.5 cm at 6–59 months old age ranges for both boys and girls. To inspect the bipedal edema, the examiner pressed the lateral side of the child's feet with the thumb for 5 seconds. If the soft tissue did not return to the previous condition within 5 seconds, the child was considered edematous. For the mothers, only MUAC was measured; MAM as < 23 cm. There is no definition of SAM for adults according to the WHO guideline on MUAC.

Teams were instructed to test kitchen salt from each of the households for iodine quantity by using rapid salt test kits. If there was a dark purple color change from the salt, this indicated that the salt had a sufficient amount of iodine. If there was only a light purple color change, the salt did not have the proper amount of iodine. If there was no color change, the salt was not iodized. Properly iodized salt was defined as kitchen salt with ≥ 15 ppm iodine as per the 2003 WHO bulletin.

The means and standard deviations (SD) of continuous variables were calculated. Categorical variables were expressed as numbers and percentages, with differences in percentages examined using a Fisher's exact test. A logistic regression model was applied to estimate odd ratios (ORs) and 95% confidence intervals (CIs) of factors for acute malnutrition. Associations were considered statistically significant when the p-value was < 0.05. Statistical Package for the Social Sciences (SPSS) version 22.0 was used for analyses.

The study design, sampling strategy, instruments, and analytical plans were reviewed and approved by Institutional Review Board of the Afghanistan Ministry of Public Health. Confidentiality of all collected data was assigned with a high priority during each stage of data handling. Individual names and personal information of respondents were kept confidential, being anonymous for analyses. All data files were protected by passwords. The purpose of the study was explained to, and written consent was obtained from, the heads of all selected households.

## RESULTS

The data was obtained from 600 (0.37% of the whole households in the province) out of 638 households approached by interviewers. As shown in Table 1, regarding the sociodemographic characteristics of household heads and mothers, 69.3% of the household heads were male. Those aged more than 25 years comprised 88.5% of the male heads and 83.2% of the female heads; 48.8% of male heads and 65.8% of female heads were without education ($p<0.001$); 22.6% of male heads and 23.9% of female heads had monthly income ≤ 250 USD, which is defined as a low income by the tax bureau of the Afghanistan Ministry of Finance. The mean of household monthly income was 204.9 USD (SD, 172.0 USD); 93.5% of the male heads and 77.7% of the female heads were married ($p<0.001$); 32.8% had four to six U5 children, and 62.2% had three children or less. The mean age of the mothers was 30.9 years (SD, 7.2 years). The great majority of the mothers had no education (92.3%). At the interview, 57.3% of the mothers were pregnant or lactating, and 26% had MAM.

Table 2 shows the characteristics of 600 children (281 boys and 319 girls); 55.5% were aged < 24 months. The mean age of children was 24.2 months (SD, 14.6 months). Among male children, 45.6% had a history of diarrhea within the two weeks before data collection, as did 40.1% of female children; 38.8% were treated for diarrhea; 31.2% had had a fever within the two weeks before data collection; 93.7% had received drops of polio vaccine; 9.3% of male children and 8.5% of female children were currently registered in a nutrition program. Based on WHZ measurements, 35.0% (95% CI, 31.2–39.0%) had acute malnutrition, including 6.7% (95% CI, 4.8–9.0%) for SAM and 28.3% (95% CI, 24.7–32.1%) for MAM; 36.0%, 7.5%, and 28.5% among the male children and 34.2%, 6.0%, and 28.2% among the female children, respectively. Based on MUAC, SAM was 5.8% (95% CI, 4.1–8.0%) and MAM was 25.7% (95% CI, 22.2–29.3%). Bipedal edema was found 3.0% (95% CI, 1.8–4.7%) of children. There were no significant differences in the characteristics listed in Table 2 between male and female children.

Table 3 demonstrates the WASH practices in the household; 52.2% of households with male heads and 72.3% of the households with female heads were using unprotected water sources ($p<0.001$). Treatment of water using methods such as boiling or adding chlorine had been done in 87.0% of male-headed households and 77.2% in female-headed households ($p=0.004$). Unsanitary toilets were being used in 84.5% of the households. Washing facilities near the toilets were available in 42.2% of the households. Only 15.8% of the households were disposing of their refuse (garbage) sanitarily. Soap use in the 24 hours prior to data collection was less frequent ($p<0.001$) in male-headed households (60.6%) than in female-headed households (81.0%). In the majority of the households, soap usage was not common in activities such as before food preparation, before eating, before feeding the children, and after cleaning children who had defecated; the differences in soap use between male and female heads was significant before eating ($p<0.001$), before feeding the children ($p<0.001$), and after cleaning children who had defecated ($p=0.021$). Washing hands with soap after defecation was done in 49.2% in the households. Only 25.0% of the male- and 19.0% of the female-headed households were using salt with the proper amount of iodine ($p=0.001$).

Table 4 shows ORs and 95% CIs of acute malnutrition among U5 children according to sociodemographic and household characteristics. In the adjusted binary regression analysis, there was a significant association between acute malnutrition among U5 children and education level, age category of household heads, household monthly income, education level of mothers, age category of U5 children, diarrhea among children in the last two weeks, and 24-hour feeding frequency. U5 children of households with uneducated heads (OR=1.49; 95% CI, 1.02–2.17),

**Table 1** Sociodemographic characteristics of household heads and mothers [a] (n = 600)

| Characteristics | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | n | (%) | n | (%) | n | (%) |
| Total | 416 | (100) | 184 | (100) | 600 | (100) |
| Age group of household head | | | | | | |
| ≤ 25 years | 48 | (11.5) | 31 | (16.8) | 79 | (13.2) |
| > 25 years | 368 | (88.5) | 153 | (83.2) | 521 | (86.8) |
| Education level [b] of household head | | | | | | |
| With education [c] | 213 | (51.2) | 63 | (34.2) | 276 | (46.0) |
| No education | 203 | (48.8) | 121 | (65.8) | 324 | (54.0) |
| Income of the household | | | | | | |
| ≤ 250 USD | 322 | (77.4) | 140 | (76.1) | 462 | (77.0) |
| > 250 USD | 94 | (22.6) | 44 | (23.9) | 138 | (23.0) |
| Marital status [b] of household head | | | | | | |
| Currently married | 389 | (93.5) | 143 | (77.7) | 532 | (88.7) |
| Widowed | 9 | (2.2) | 40 | (21.7) | 49 | (8.2) |
| Single | 4 | (1.0) | 1 | (0.5) | 5 | (0.8) |
| More than one couple [d] | 14 | (3.4) | 0 | (0) | 14 | (2.3) |
| Number of children in household | | | | | | |
| ≤ 3 children | 264 | (63.5) | 109 | (59.2) | 373 | (62.2) |
| > 3 children | 152 | (36.5) | 75 | (40.8) | 227 | (37.8) |
| Age group of mothers | | | | | | |
| ≤ 25 years | 104 | (25.0) | 49 | (26.6) | 153 | (25.5) |
| 26–35 years | 200 | (48.1) | 98 | (53.3) | 298 | (49.7) |
| > 35 years | 112 | (26.9) | 37 | (20.1) | 149 | (24.8) |
| Education level of mothers | | | | | | |
| With education [c] | 36 | (8.7) | 10 | (5.4) | 46 | (7.7) |
| No education | 380 | (91.3) | 174 | (94.6) | 554 | (92.3) |
| Obstetric factors of mothers at interview | | | | | | |
| None | 175 | (42.1) | 81 | (44.0) | 256 | (42.6) |
| Pregnant | 83 | (20.0) | 35 | (19.0) | 118 | (19.7) |
| Lactating | 158 | (38.0) | 68 | (37.0) | 226 | (37.7) |
| Nutritional status of mothers | | | | | | |
| Normal | 317 | (76.2) | 127 | (69.0) | 444 | (74.0) |
| Moderately acute malnutrition [e] | 99 | (23.8) | 57 | (31.0) | 156 | (26.0) |

[a] Caregivers of the target children
[b] $p < 0.001$ using Fisher's exact test
[c] Primary or higher education
[d] Respondents who had more than one wife
[e] Measurement of upper arm circumference < 23 cm

**Table 2** Characteristics of under-five children [a] (n = 600)

| Characteristics | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | n | (%) | n | (%) | n | (%) |
| Total | 281 | (100) | 319 | (100) | 600 | (100) |
| Age category | | | | | | |
| 6–23 months | 162 | (57.7) | 171 | (53.6) | 333 | (55.5) |
| 24–59 months | 119 | (42.3) | 148 | (46.4) | 267 | (44.5) |
| Diarrhea in last two weeks | | | | | | |
| Yes | 128 | (45.6) | 128 | (40.1) | 256 | (42.7) |
| No | 153 | (54.4) | 191 | (59.9) | 344 | (57.3) |
| Received treatment for diarrhea | | | | | | |
| Yes | 109 | (38.8) | 113 | (35.1) | 222 | (36.8) |
| No | 171 | (60.9) | 207 | (64.9) | 378 | (63.2) |
| Fever in last two weeks | | | | | | |
| Yes | 85 | (30.2) | 102 | (32.0) | 187 | (31.2) |
| No | 196 | (69.8) | 217 | (68.0) | 413 | (68.8) |
| Received polio drops | | | | | | |
| Yes | 266 | (94.7) | 296 | (92.8) | 562 | (93.7) |
| No | 15 | (5.3) | 23 | (7.2) | 38 | (6.3) |
| 24-hour feeding frequency | | | | | | |
| ≤ 3 times | 15 | (5.0) | 10 | (3.1) | 25 | (4.2) |
| > 3 times | 266 | (94.7) | 309 | (96.9) | 575 | (95.8) |
| Currently registered in nutrition program | | | | | | |
| Yes | 26 | (9.3) | 27 | (8.5) | 53 | (8.8) |
| No | 255 | (90.7) | 292 | (91.5) | 547 | (91.2) |
| Acute malnutrition (WHZ) | | | | | | |
| Normal | 180 | (64.0) | 210 | (65.8) | 390 | (65.0) |
| MAM [c] | 80 | (28.5) | 90 | (28.2) | 170 | (28.3) |
| SAM [d] | 21 | (7.5) | 19 | (6.0) | 40 | (6.7) |
| Acute malnutrition (MUAC) | | | | | | |
| Normal | 190 | (67.7) | 221 | (69.2) | 411 | (68.5) |
| MAM [e] | 76 | (27.0) | 78 | (24.5) | 154 | (25.7) |
| SAM [f] | 15 | (5.3) | 20 | (6.3) | 35 | (5.8) |
| Acute malnutrition (Bipedal edema) | | | | | | |
| Absent | 270 | (96.1) | 312 | (97.8) | 582 | (97.0) |
| Present | 11 | (3.9) | 7 | (2.2) | 18 | (3.0) |

[a] Those who are the youngest (6–59 months old) child of the household

[b] Diarrhea is defined as the passage of three or more loose or liquid stools per day (or more frequent passage than is normal for the individual). Frequent passing of formed stools is not diarrhea, nor is the passing of loose, "pasty" stools by breastfed babies (WHO face sheet 2013)

[c] Moderate acute malnutrition (WHZ ≥ –3 and <–2)

[d] Severe acute malnutrition (WHZ<–3)

[e] Moderate acute malnutrition (MUAC <12.5 and >11.5 cm)

[f] Severe acute malnutrition (MUAC <11.5 cm)

*p*-value of all indicators found not significant using Fisher's exact test

**Table 3** WASH practices in the household (n=600)

| WASH practices | Male | | Female | | Total | |
|---|---|---|---|---|---|---|
| | n | (%) | n | (%) | n | (%) |
| Total | 416 | (100) | 184 | (100) | 600 | (100) |
| Main drinking water source [a] | | | | | | |
| Protected water source | 199 | (47.8) | 51 | (27.7) | 250 | (41.7) |
| Unprotected water source | 217 | (52.2) | 133 | (72.3) | 350 | (58.3) |
| Water treatment [b] | | | | | | |
| Yes | 362 | (87.0) | 142 | (77.2) | 504 | (84.0) |
| No | 54 | (13.0) | 42 | (22.8) | 96 | (16.0) |
| Method of water treatment [c] | | | | | | |
| Boiling | 356 | (85.6) | 172 | (93.5) | 528 | (88.0) |
| Add chlorine | 36 | (8.7) | 8 | (4.3) | 44 | (7.3) |
| Other methods | 24 | (5.8) | 4 | (2.2) | 28 | (4.7) |
| Type of toilet | | | | | | |
| Sanitary toilet [d] | 70 | (16.2) | 23 | (12.5) | 93 | (15.5) |
| Unsanitary toilet | 346 | (83.2) | 161 | (87.5) | 507 | (84.5) |
| Hand washing facility near to the toilet | | | | | | |
| Yes | 169 | (40.6) | 84 | (45.7) | 253 | (42.2) |
| No | 247 | (59.4) | 100 | (54.3) | 347 | (57.8) |
| Disposal of household refuse | | | | | | |
| Sanitary disposal | 66 | (15.9) | 29 | (15.8) | 95 | (15.8) |
| Unsanitary disposal | 350 | (84.1) | 155 | (84.2) | 505 | (84.2) |
| Used soap in last 24 hours [a] | | | | | | |
| Yes | 252 | (60.6) | 149 | (81.0) | 401 | (66.8) |
| No | 164 | (39.4) | 35 | (19.0) | 199 | (33.2) |
| Use soap before food preparation | | | | | | |
| Yes | 303 | (72.8) | 137 | (74.5) | 440 | (73.3) |
| No | 113 | (27.2) | 47 | (25.5) | 160 | (26.7) |
| Use soap before eating [a] | | | | | | |
| Yes | 179 | (43.0) | 50 | (27.2) | 229 | (38.2) |
| No | 237 | (57.0) | 134 | (72.8) | 371 | (61.8) |
| Use soap before feeding the child [a] | | | | | | |
| Yes | 179 | (43.0) | 47 | (25.5) | 226 | (37.7) |
| No | 237 | (57.0) | 134 | (74.5) | 374 | (62.3) |
| Use soap after defecation | | | | | | |
| Yes | 274 | (65.9) | 126 | (68.5) | 400 | (66.7) |
| No | 142 | (34.1) | 58 | (31.5) | 200 | (33.3) |
| Use soap after cleaning child defecation [c] | | | | | | |
| Yes | 218 | (52.4) | 77 | (41.8) | 295 | (49.2) |
| No | 198 | (47.6) | 107 | (58.2) | 305 | (50.8) |
| Iodine in the kitchen salt [e] | | | | | | |
| No iodine | 122 | (29.3) | 34 | (18.5) | 156 | (26.0) |
| Improper amount | 190 | (45.7) | 115 | (62.5) | 305 | (50.8) |

| | | | | | | |
|---|---|---|---|---|---|---|
| Proper amount | 104 | (25.0) | 35 | (19.0) | 139 | (23.2) |

[a] $p$<0.001, [b] $p$=0.004, [c] $p$=0.021, [e] $p$=0.001 using Fisher's exact test. [d] Sanitary toilets are those that hygienically separate human excreta from human contact. Types of sanitary toilets include flush or pour-flush toilets to a piped sewer system, septic tank or pit, ventilated improved pit latrine, pit latrine with slab, and composting toilet.

**Table 4** Odds ratio (OR) and 95% confidence interval (CI) of acute malnutrition among under-five children based on sociodemographic and household characteristics

| Variables | Unadjusted | | | Adjusted [a] | | |
|---|---|---|---|---|---|---|
| | OR | (95% CI) | *p*-value | OR | (95% CI) | *p*-value |
| Education level of household head | | | | | | |
| With education [b] | 1 | Reference | | 1 | Reference | |
| No education | 1.86 | (1.32–2.62) | <0.001 | 1.49 | (1.02–2.17) | 0.038 |
| Age of household head | | | | | | |
| > 25 years | 1 | Reference | | 1 | Reference | |
| ≤ 25 years | 2.00 | (1.24–3.22) | 0.005 | 2.01 | (1.21–3.35) | 0.007 |
| Monthly income of household | | | | | | |
| > 250 USD [c] | 1 | Reference | | 1 | Reference | |
| ≤ 250 USD | 2.19 | (1.41–3.40) | 0.001 | 1.66 | (1.04–2.27) | 0.034 |
| Number of children in the household | | | | | | |
| ≤ 3 children | 1 | Reference | | 1 | Reference | |
| > 3 children | 1.44 | (1.01–2.05) | 0.044 | 1.24 | (0.85–1.80) | 0.272 |
| Education level of mother | | | | | | |
| With education [b] | 1 | Reference | | 1 | Reference | |
| No education | 2.34 | (1.11–4.96) | 0.026 | 2.21 | (1.00–4.88) | 0.049 |
| Nutrition status of mother | | | | | | |
| Normal | 1 | Reference | | 1 | Reference | |
| Moderate acute malnutrition [d] | 1.32 | (0.91–1.92) | 0.149 | 1.03 | (0.69–1.55) | 0.877 |
| Age category of children | | | | | | |
| ≥ 24 months | 1 | Reference | | 1 | Reference | |
| < 24 months | 2.40 | (1.69–3.41) | <0.001 | 1.99 | (1.32–2.93) | 0.001 |
| Diarrhea of child in last two weeks | | | | | | |
| No | 1 | Reference | | 1 | Reference | |
| Yes | 1.84 | (1.31–2.59) | <0.001 | 1.57 | (1.10–2.27) | 0.014 |
| 24-hour feeding frequency of child | | | | | | |
| ≥ 4 times | 1 | Reference | | 1 | Reference | |
| ≤ 3 times | 3.93 | (1.65–9.34) | 0.002 | 3.01 | (1.21–7.46) | 0.017 |
| Child ever breastfed | | | | | | |
| Yes | 1 | Reference | | 1 | Reference | |
| No | 2.30 | (1.40–3.77) | 0.001 | 1.06 | (0.60–1.88) | 0.850 |

[a] Adjusted for education level of heads of household, monthly income of households, age category of heads of household, number of under-five children in the households, education level of mothers, nutrition status of mothers, age category of children, diarrhea among children, frequency of child feeding, and children ever breastfed.
[b] Primary or higher education
[c] Households which have ≤ 250 USD monthly income are recognized as low income according to the Afghanistan tax law.
[d] MUAC is <23cm

income ≤ 250 USD per month (OR=1.66; 95% CI, 1.04–2.27), and heads aged ≤ 24 years old (OR=2.01; 95% CI, 1.21–3.35) were about two times more likely to be acutely malnourished than their counterparts. The children who had history of diarrhea in the last two weeks of data collection (OR=1.57; 95% CI, 1.10–2.27) and those aged ≤ 24 months (OR=1.99; 95% CI, 1.32–2.93) were more like to be acutely malnourished than their counterparts. Children of uneducated mothers (OR=2.21; 95% CI, 1.00–4.88) and children who were fed three times or less in 24 hours (OR = 3.01; 95% CI, 1.21–7.46) were about three times more likely to be acutely malnourished than their counterparts. Although we found significant associations between U5 acute malnutrition and breast-fed children and the number of children in the household, the significance was lost after the adjusted regression analysis.

Table 5 shows ORs and 95% CIs of acute malnutrition among U5 children for WASH practices in the households. In the adjusted binary regression analysis, there were significant associations between acute malnutrition among U5 children and the main drinking water source and iodine in the kitchen salt. In households that had been using unprotected water sources, the U5 children were about two times more likely to be acutely malnourished than those who had been using protected water sources (OR=1.89; 95% CI, 1.26–2.83). U5 children of households

**Table 5** Odds ratio (OR) and 95% confidence interval (CI) of acute malnutrition among under-five children for WASH practices in the household

| Variables | Unadjusted | | | Adjusted [a] | | |
|---|---|---|---|---|---|---|
| | OR | (95% CI) | *p*-value | OR | (95% CI) | *p*-value |
| Main drinking water source | | | | | | |
| Protected water source | 1 | Reference | | 1 | Reference | |
| Unprotected water source | 2.15 | (1.51–3.07) | <0.001 | 1.89 | (1.26–2.83) | 0.002 |
| Use soap before feeding the child | | | | | | |
| Yes | 1 | Reference | | 1 | Reference | |
| No | 1.73 | (1.21–2.48) | 0.003 | 1.12 | (0.70–1.78) | 0.639 |
| Use soap after cleaning child after defecation | | | | | | |
| Yes | 1 | Reference | | 1 | Reference | |
| No | 1.67 | (1.19–2.34) | 0.003 | 1.20 | (0.81–1.78) | 0.364 |
| Use soap after using the toilet | | | | | | |
| Yes | 1 | Reference | | 1 | Reference | |
| No | 1.34 | (0.943–1.907) | 0.103 | 1.11 | (0.76–1.63) | 0.592 |
| Use soap before food preparation | | | | | | |
| Yes | 1 | Reference | | 1 | Reference | |
| No | 1.25 | (0.86–1.82) | 0.246 | 1.05 | (0.70–1.57) | 0.806 |
| Disposal of household refuse | | | | | | |
| Sanitary disposal | 1 | Reference | | 1 | Reference | |
| Unsanitary disposal | 2.11 | (1.26–3.54) | 0.005 | 1.49 | (0.81–2.75) | 0.197 |
| Type of toilet | | | | | | |
| Sanitary | 1 | Reference | | 1 | Reference | |
| Unsanitary | 2.35 | (1.38–4.02) | 0.002 | 1.50 | (0.79–2.84) | 0.219 |
| Iodine in the kitchen salt | | | | | | |
| No iodine | 1 | Reference | | 1 | Reference | |
| Improper amount | 0.56 | (0.38–0.56) | 0.004 | 0.68 | (0.39–1.16) | 0.154 |
| Proper amount | 0.45 | (0.28–0.74) | 0.001 | 0.59 | (0.39–0.88) | 0.010 |

a Adjusted for main drinking water source, use of soap before feeding the child, use of soap after cleaning child who had defecated, disposal of refuse, type of toilet, and kitchen salt iodine in the household.

that had been using kitchen salt with the proper amount of iodine were two times less likely to be acutely malnourished than those that had been using salt without iodine (OR=0.59; 95% CI, 0.39–0.88). There was a significant association between U5 acute malnutrition and washing hands with soap after cleaning a child who had defecated, washing hands with soap before feeding the child, disposal of household refuse, and type of toilet, but significance was lost after adjusted regression analysis.

## DISCUSSION

To the best knowledge of the authors, studies describing the prevalence and causes of acute malnutrition in Afghanistan have been limited. Based on the data, we can assume the prevalence and risk factors of U5 acute malnutrition in Faryab province of Afghanistan, but this study design is a cross-sectional study, so more studies should be conducted in this research field to replicate its results. This study showed a 31.3% increase in the prevalence of acute malnutrition (wasting) in Faryab province compared to a previous study conducted in 2013. It also showed that the prevalence of acute malnutrition, when assessed using bipedal edema as an index, was lower than that in previous studies conducted in Malawi and India.[27,28] Associations of acute malnutrition among U5 children with the sociodemographic characteristics of parents, health status of children, and sanitation in the household found in this study were similar to the findings of previous research in Afghanistan, Iran, and Malawi.[18,29,30] From the three anthropometric measurements for screening the nutritional status of children, WHZ was chosen as a dependent variable because of its reliability and common usage in previous studies.[31]

The education level of the parents had a direct impact on the nutrition status of children. In this study, it was observed that head of household education had a significant effect on nutritional status of children. Household heads who had primary or higher education might have more knowledge of a balanced dietary intake for the family and awareness of the importance of family planning in regard to improving the U5 nutritional status and child health. This is consistent with findings of previous study in Ethiopia.[32] This study also showed that children who were members of households with an income of ≤ 250 USD per month were more likely to be acutely malnourished than their counterparts. U5 wasting might occur because of low purchasing power and limitations in food commodities and resources of the household.[10,32]

As presented in this study, U5 children of households in which the heads were aged ≤ 25 years old were more prone to be undernourished than their counterparts aged > 25 years. Early marriage of both sexes before they finish their higher education has been a tradition in Afghanistan. This may suggest that because of early marriage, they might still be dependent on their parents, and may not have a steady income to support their family financially. It also draws doubts about their knowledge of dietary management and child health in the family.[22] Present study indicates that the mother’s education is also an important predictor for child wasting. It further suggests that providing education for mothers at the primary or higher level may bring more than a two-fold decrease in the incidence of wasting among U5 children. Educated mothers might be more nutritionally literate and might have more knowledge of child feeding practices. A study conducted in Cambodia suggested similar findings.[33] More than one-fourth of mothers in this study had been suffering from moderate acute malnutrition. No significant association was found between nutrition status of mothers and U5 acute malnutrition in our study. However, it has been reported as a risk factor for U5 acute and chronic malnutrition in previous studies.[32,34]

Diarrhea has been a major cause of malnutrition in U5 children in resource-poor countries like Afghanistan. Our study showed that children who had a history of diarrhea in the last two weeks were about two times more prone to be acutely malnourished than their counterparts with no such history. The synergistic relationship between under-nutrition and diarrheal episodes might be exacerbated, as children tend to eat less and their ability to absorb nutrition and physical activity might be decreased during the episodes. Previous similar studies have suggested that the combination of fever and pneumonia with diarrhea might increase the risk of U5 wasting and mortality, and it was strongly associated with household sanitation and hygiene practices.[35)]

The current study showed that U5 children whose frequency of food intake was three times or less in one 24-hour period were more than three times as likely to be acutely malnourished. The mother's knowledge and attitude regarding child feeding might play an important role in child's eating frequency and behavior. Studies from Cambodia and Kenya suggest parallel results.[2,33)] Analysis of this study showed that wasting was more than two times as pronounced among children who were aged < 24 months. This may be because of early weaning and obstetric factors of the mothers, as 57.3% of them were found to be either pregnant or lactating, and they might not be able to feed the U5 children properly and sufficiently.[34)]

The WHO estimates that 50% of child undernutrition cases are the result of repeated diarrheal and intestinal infections due to poor sanitation and hygiene, and a lack of safe drinking water.[36)] This study indicated that U5 children of households that had been using unprotected water sources were two times more likely to be acutely malnourished than their counterparts. The main reason for acute malnutrition in these children might be repeated diarrheal disease and intestinal parasites because of unsafe drinking water. In previous studies it was declared that the source and distance of water collection in rural areas of developing countries have a significant role in the quality and quantity of the water, as in most rural settings, the farther the distance to the water source is, the more residents decrease their water use. These practices may have a direct impact on U5 children nutritional status. Previous studies have also suggested similar results.[37,38)]

This study also showed that the U5 children in the households that had been using kitchen salt with the proper amount of iodine were two times less likely to be acutely malnourished. The majority (76.9%) of households has been using kitchen salt without iodine or with an improper amount of iodine. This might be one of the underlying causes of undernutrition among the children due to micronutrient deficiency.[32)]

There were several limitations in this study. First, the data may not reflect each cluster, because data collection of households started from the center of the cluster, although the sampling method has been commonly used elsewhere. Second, in assessing knowledge of household heads and caregivers, the respondents might guess desirable answers, which may show good scores, but not reflect reality. Third, the sample size was relatively small, so that the acute malnutrition frequency was not estimated among subgroups, because the 95% CI of the percentage would be wider for the subgroups.

There has been remarkable progress toward reducing U5 malnutrition and mortality in last decade; however, the health sector still could not achieve the MDG 2015 guidelines. To improve results from all national and international efforts toward managing malnutrition, the following actions should be considered. First, nutrition programs should be horizontally implemented to the body of the BPHS to allow community management of acute malnutrition. Second, efforts should be made toward community mobilization and creation of demand. Third, funding the WASH sector should be done at a level that reflects its impact on undernutrition. Fourth, strategies and programs for fighting undernutrition must incorporate a long-term multi-sectorial component. Fifth, food fortification should be considered as one of the key strategies for improving the nutrition quality of the nation. Sixth and perhaps the most important, health knowledge skills should be included in school curricula. This may lead to substantial improvement in child nutritional status by directly enabling the girls and boys who will be future mothers and household heads to have improved health knowledge, practice, and health-seeking behavior.

In conclusion, the present study indicated that education of parents, household income and age of household head had a strong relation with the nutritional status of children; a further increase in these factors may result in a remarkable decrease in wasting of U5 children. In addition, WASH had a significant association with the nutritional status of U5 children. Moreover, low water quality might be a major risk factor for wasting among children. Iodized salt also had a significant association with the nutrition status of children.

## ACKNOWLEDGMENTS

We are grateful to Dr. Bashir Noormal, Dr. Ghulam Rahim Awab, Dr. Sayed Murtaza Hofiani, Dr. Naim Musammem, and the cooperative staff of the provincial office of Solidarity for Afghan Families in Faryab province for their technical support and assistance with the data collection process.

## CONFLICT OF INTEREST

The authors declare that they have no competing interests that might affect the results of this study.

## REFERENCES

1) Manyike PC, Chinawa JM, Ubesie A, Obu HA, Odetunde OI, Chinawa AT. Prevelance of malnutrition among pre-school children in, South-east Nigeria. *Ital J Pediatr*, 2014; 40: 75.
2) Jones KD, Thitiri J, Ngari M, Berkley JA. Childhood malnutrition: toward an understanding of infections, inflammation, and antimicrobials. *Food Nutr Bull*, 2014; 35: S64–70.
3) Langendorf C, Roederer T, de Pee S, Brown D, Doyon S, Mamaty AA, Touré LW, Manzo ML, Grais RF. Preventing acute malnutrition among young children in crises: a prospective intervention study in Niger. *PLoS Med*, 2014; 11: e1001714.
4) Park SE, Kim S, Ouma C, Loha M, Wierzba TF, Beck NS. Community management of acute malnutrition in the developing world. *Pediatr Gastroenterol Hepatol Nutr*, 2012; 15: 210–219.
5) Pace N, Seal A, Costello A. Food commodity derivatives: a new cause of malnutrition. *Lancet*, 2008; 371: 1648–1650.
6) Habicht JP. Malnutrition kills directly, not indirectly. *Lancet*, 2008; 371: 1749–1750.
7) Abuya BA, Ciera J, Kimani-Murage E. Effect of mother's education on child's nutritional status in the slums of Nairobi. *BMC Pediatr*, 2012; 12: 80.
8) Kerac M, Seal A. Preventing acute malnutrition in young children: improving the evidence for current and future practice. *PLoS Med*, 2014; 11: e1001715.
9) Jones KD, Hünten-Kirsch B, Laving AM, Munyi CW, Ngari M, Mikusa J, Mulongo MM, Odera D, Nassir HS, Timbwa M, Owino M, Fegan G, Murch SH, Sullivan PB, Warner JO, Berkley JA. Mesalazine in the initial management of severely acutely malnourished children with environmental enteric dysfunction: a pilot randomized controlled trial. *BMC Med*, 2014; 12: 133.
10) Fuchs C, Sultana T, Ahmed T, Iqbal Hossain M. Factor associated with acute malnutrition among children admitted to a diarrhoea treatment facility in Bangladesh. *Int J Pediatr*, 2014; 2014: 267806.
11) Maurya M, Singh DK, Rai R, Mishra PC, Srivastava A. An experience of facility-based management of severe acute malnutrition in children aged between 6–59 months adopting the world health organization recommendation. *Indian Pediatr*, 2014; 51: 481–483.
12) Aguayo VM, Badgaiyan N, Singh K. How do the new WHO discharge criteria for the treatment of severe acute malnutrition affect the performance of therapeutic feeding programs? New evidence from India. *Eur J Clin Nutr*, 2015; 69: 509–513.

13) Lenters LM, Wazny K, Webb P, Ahmed T, Bhutta ZA. Treatment of severe and moderate acute malnutrition in low- and middle-income settings: a systematic review, meta-analysis and Delphi process. *BMC Public Health*, 2013; 13: S23.
14) Bhutta ZA. Addressing severe acute malnutrition where it matters. *Lancet*, 2009; 374: 94–96.
15) Chang CY, Trehan I, Wang RJ, Thakwalakwa C, Maleta K, Deitchler M, Manary MJ. Children successfully treated for moderate acute malnutrition remain at risk for malnutrition and death in the subsequent year after recovery. *J Nutr*, 2013; 143: 215–220.
16) Laillou A, Prak S, de Groot R, Whitney S, Conkle J, Horton L, Un SO, Dijkhuizen MA, Wieringa FT. Optimal screening of children with acute malnutrition requires a change in current WHO guidelines as MUAC and WHZ identify different patient groups. *PLoS One*, 2014; 9: e101159.
17) Afghan Public Health Institute, Ministry of Public Health Kabul. Afghanistan Mortality Survey. pp. 89–102, 2010, Central Statistics Organization, Kabul, Afghanistan.
18) Public Nutrition Department, Ministry of Public Health Kabul, National Nutrition Survey Afghanistan, pp. 19–42, 2013, Ministry of Public Health, Kabul, Afghanistan.
19) Public Nutrition Department, Ministry of Public Health. National Nutrition Survey: Afghanistan. pp. 29–63, 2004, Ministry of Public Health, Kabul Afghanistan.
20) Bello G, Nutrition Department Oxfam Novib Kabul. Nutrition baseline survey report. pp. 26–39, 2011, Oxfam Novib, Kabul, Afghanistan.
21) Munroe S. Children, nutrition and food security in Afghanistan: final evaluation report. pp. 5–13, 2013, Food and Agriculture Organization, MDG Achievement Fund, Kabul, Afghanistan.
22) Central Statistics Organization Kabul, UNICEF. Afghanistan multiple indicator cluster survey. pp. 18–87, 2012, Central Statistics Organization, Kabul, Afghanistan.
23) Harvey PA. Water, sanitation and hygiene: sector case statement. pp. 3–7, 2011, World Vision, Loughborough, UK.
24) Rah JH, Cronin AA, Badgaiyan B, Aguayo VM, Coates S, Ahmed S. Household sanitation and personal hygiene practices are associated with child stunting in rural India: a cross-sectional analysis of surveys. *BMJ Open*, 2015; 5: e005180.
25) Denis C, Lapeguen J, Lellouche K, Lozano R, Rodriguez E. Greater investment in water, sanitation and hygiene is key to the fight against undernutrition. pp. 3–7, 2014, Action Contre la Faim, Paris, France.
26) Aluisio AR, Maroof Z, Chandramohan D, Bruce J, Masher MI, Manaseki-Holland S, Ensink JHJ. Risk factors associated with recurrent diarrheal illnesses among children in Kabul Afghanistan: a prospective cohort study. *PLoS One*, 2015; 10: e0116342.
27) Claus SP. Fighting under nutrition: don't forget the bugs. *Cell Host Microbe*, 2013; 13: 239–240.
28) Kapil U, Sareen N. Management of children with severe acute malnutrition. *Indian Pediatr*, 2014; 51: 587–588.
29) Sharifzadeh G, Mehrjoofard H, Raghebi S. Prevalence of malnutrition in under 6-year olds in South Khorasan, Iran. *Iran J Pediatr*, 2010; 20: 435–441.
30) Kerac M, Bunn J, Seal A, Thindwa M, Tomkins A, Sadler K, Bahwere P, Collins S. Probiotics and prebiotics for severe acute malnutrition (PRONUT study): a double-blind efficacy randomized controlled trail in Malawi. *Lancet*, 2009; 374: 136–144.
31) Mwangome MK, Berkley JA. The reliability of weight-for-length/height Z scores in children. *Matern Child Nutr*, 2014; 10: 474–480.
32) Egata G, Berhane Y, Worku A. Predictors of acute undernutrition among children aged 6–36 months in eat rural Ethiopia: a community based nested case-control study. *BMC Pediatr*, 2014; 14: 91.
33) SDK Research and Development, Ministry of Health Phnom Penh. Infant and young child feeding practices in selected provinces of the Kingdom of Cambodia: a report. pp. 33–40, 2006, Health Sector Support Project, Ministry of Health Phnom Penh, Cambodia.
34) Silveira KB, Alves JF, Ferreira HS, Sawaya AL, Florêncio TM. Association between malnutrition in children living in favelas, maternal nutritional status, and environmental factors. *J Pediatr*, 2010; 86: 215–220.
35) Ejemot RI, Ehiri JE, Meremikwu MM, Critchley JA, Ehiri JE, Meremikwu MM, Critchley JA. Hand washing for preventing diarrhea (Review). *Cochrane Database Syst Rev*, 2008; 1: CD004265.
36) Prüss-Üstün A, Bos R, Gore F, Bartram J. Safer water, better health: water, sanitation and hygiene – a composite risk factor. pp. 15–19, 2008, World Health Organization, Geneva, Switzerland.
37) Dangour AD, Watson L, Cumming O, Boisson S, Che Y, Velleman Y, Cavill S, Allen E, Uauy R. Interventions to improve water quality and supply, sanitation and hygiene practices, and their effects on the nutritional status of children. *Cochrane Database Syst Rev*, 2013; 8: CD009382.
38) Curtis V, Cairncross S. Effect of washing hands with soap on diarrhea risk in the community: a systematic review. *Lancet Infect Dis*, 2003; 3: 275–281.