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Malnutrition associated factors on children under 5 years old in Lhaviyani Atoll, Maldives

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Abstract

In this report, we aimed to analyze the prevalence of undernutrition and associated factors among children under 5 years of age in Lhaviyani Atoll, Maldives. A total of 800 children (under 5 years old) and their mothers were selected for this study. Data was collected by using a pretested questionnaire and anthropometric measurements were taken from the hospital record book. Chi-square tests and multivariate logistic regression were used to find the association between nutritional status and determinants. The distribution of height for age and weight for age in surveyed children in Maldives was skewed to the left compared with the WHO standard. The prevalence of undernutrition based on underweight (10.75%), stunting (13.5%), and wasting (9.60%) was estimated to be 23.85% among children. Child age, gender and mother's education were significantly associated with undernutrition (P<0.05). Our survey highlighted that better nutritional interventions are needed to improve child health in this region.

Keywords: Maldives, undernutrition, stunting

Introduction

Early childhood development, especially within the first 1 000 days from the date of conception until 2 years of age, helps to determine the nutrition and health status of their whole life course¹. According to United Nations International Children's Emergency Fund (UNICEF) (2009), globally, over one-third of child deaths are due to undernutrition². Undernutrition increases the possibility of falling sick and severity of disease. Malnutrition during infancy and toddler stage can also lead to irreversible delays in growth and cognitive development. Children suffering from stunting not only have a problem with their height but also their brains may never develop to their full cognitive potential³. Some of the major child growth factors are related to malnutrition, inappropriate parent behavior, parenting issues,

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inappropriate social and cultural practices and inadequate environments[4].

Underlining the importance of promoting healthy living to children in the Maldives, UNICEF conducted a survey in the year 2013 to identify the situation of children in the Maldives. In this UNICEF survey report, issues regarding children's social, emotional and cognitive development in Maldives were highlighted[5]. There is a wide range of factors that determine the health status of children. These can be broadly categorized into household characteristics and social factors that hinder children from attaining their full development. Nevertheless, growth retardation among children is also a well-known problem in the Republic of Maldives, which may be linked with the availability of dietary intake and nutrition status. Yet, there are a variety of locally available foods, of which fish and rice are Maldivian staples. Most of the other products like flour, sugar, oil, rice and milk powder are imported. The supply of fresh foods to the islands can be affected by high costs and delays in transportation, which makes it troublesome for people living in islands to access fresh and healthy food products, and then leads to higher undernutrition rates[6].

The current research aims to evaluate malnutrition and associated factors among children less than 5 years of age. This study will help policymakers to develop and improve on contextual interventional measures, to address and solve the influencing factors of growth in children of this age group.

Materials and methods

Study design and setting

This community-based cross-sectional survey was conducted between June and November 2017 in four islands of Lhaviyani Atoll, Maldives (Naifaru, Hinnavaru, Kurendhu, and Olhuvelifushi). The sample size was determined by cluster sampling; it covered children under five years of age, who were further sub-grouped into 5 different age groups. The total population of children under 5 years old in Lhaviyani Atoll was 1173 at the end of November 2017. Mothers who voluntarily agreed to have their children anthropometrically assessed, and children with no chronic diseases and who had no history of low birth weight or prematurity, were aged 0–59 months, and lived in these four islands for at least six months were eligible for this study. Using cluster sampling, 800 children were determined for this study. Ethical approval for the study was obtained from the ethical committee of Nanjing Medical University. The mothers or child's legal guardians were informed about the aim of the study, and written consent was obtained before data collection. Using the WHO conceptual framework on Childhood Stunting: Context, Causes, and Consequences[7], we identified the factors contributing to malnutrition and related to our research area. After that, we made a conceptual framework based on Maldives community and then developed a questionnaire, which includes socio-demographic characteristics and anthropometries. A panel of nutrition experts and researchers, from the Department of Maternal, Child and Adolescent Health, assisted in further refining the questionnaire content.

Data collection

A pretested questionnaire and anthropometric measurements were used for data collection. The characteristics of socioeconomic status, family size, breastfeeding practices, and illness history were obtained by filling out the pretested questionnaires through face-to-face interviews in local language. Anthropometric data including weight and height were taken from the record book. Bodyweight of subjects was taken while they were in light clothing and wore no shoes, by using the same digital weighing scales with a 0.10 kg accuracy. Height of children under 2-year-old was measured using an infant scale with an accuracy of 0.1 cm; and height for children of 24–59 months was measured using an audiometer with the same accuracy.

Definitions

According to children's length/height and weight, three evaluation indicators, namely, weight for age, length/height for age and weight for height, were used. To assess children's nutritional status, Z score was calculated according to WHO Child Growth Standard 2006[8]. A child whose length/height for age Z score (HAZ) is less than −2 was defined as stunting, and whose weight for age Z score (WAZ) is less than −2 was defined as underweight, while a child with weight for height Z score (WHZ) less than −2 was classified as waste. Any one or combination of the three conditions-stunting, underweight and wasting-was defined as undernutrition[9–10].

Statistical analyses

Data was entered in Epidata (v3.1), Z score was calculated by WHO Anthro (version 3.2.2, 2011) and further analysis was made using SPSS (version 21.0). Categorical variables were reported as proportion and were compared using χ² test. To determine associated risk factors of undernutrition, multivariate logistic regression analyses were performed. Factors with a
Relationship of malnutrition in Maldives

Results

The prevalence of child undernutrition

Eight hundred mother-child pairs were included in this study. The mean±SD age of the children was (31.8±16.3) months, and 50.13% were boys. Most (64.5%) of the mothers had completed secondary education; about 53.4% of them were housewives (Table 1). The graph showing the normal distribution of height for age and weight for age in studied children in Maldives was skewed to left compared with the WHO standard (Fig. 1 and 2). Among the 800 children in this study, 108 children (13.5%) had stunted (HAZ < –2), 86 children (10.75%) had underweight (WAZ < –2), and 75 children (9.6%) had wasted (WHZ < –2). The total prevalence of undernutrition based on stunting, underweight, and wasting was estimated at 23.85% (Fig. 3). Various

![Fig. 1](image1)

**Fig. 1** The graph of the normal distribution of height for age in studied children in Maldives. Mean±SD: –0.94±1.24 for boys, –0.53±1.26 for girls.

![Fig. 2](image2)

**Fig. 2** The graph of the normal distribution of weight for age in studied children in Maldives. Mean±SD: –0.90±1.09 for boys, –0.51±1.07 for girls.

| Table 1 Association between child malnutrition and socio-demographic variable | [n (%)] |
|---|---|
| Characteristics | Total | Stunting | Underweight | Total* | Wasting | Undernutrition | P |
| Child's age (months) | 0.01 | 0.06 | 0.05 | <0.001 |
| 0–12 | 214 (26.75) | 34 (15.89) | 19 (8.88) | 211 (26.91) | 11 (5.24) | 46 (21.80) |
| 13–24 | 157 (19.63) | 26 (16.36) | 14 (8.92) | 156 (19.90) | 13 (8.33) | 39 (25.00) |
| 25–36 | 150 (18.75) | 28 (18.67) | 25 (16.67) | 148 (18.88) | 20 (13.51) | 51 (34.46) |
| 37–48 | 172 (21.50) | 18 (10.47) | 21 (12.21) | 169 (21.56) | 22 (13.10) | 40 (23.67) |
| 49–59 | 107 (13.38) | 2 (1.87) | 7 (6.54) | 100 (12.76) | 9 (9.90) | 11 (11.00) |
| Gender | <0.001 | <0.001 | 0.01 | <0.001 |
| Boys | 401 (50.13) | 69 (17.20) | 55 (13.72) | 395 (49.38) | 48 (12.21) | 119 (30.13) |
| Girls | 399 (49.88) | 39 (9.77) | 31 (7.77) | 389 (48.63) | 27 (6.96) | 68 (17.48) |
| Maternal age at childbirth (years) | 0.02 | 0.22 | 0.90 | 0.18 |
| ≤35 | 686 (85.75) | 100 (14.58) | 70 (10.2) | 673 (84.13) | 64 (9.55) | 166 (24.67) |
| >35 | 114 (14.25) | 8 (7.02) | 16 (14.04) | 111 (13.88) | 11 (9.91) | 21 (18.92) |
| Mother's education | 0.77 | 0.02 | 0.09 | 0.04 |
| Illiteracy | 9 (1.13) | 2 (22.22) | 4 (44.44) | 9 (1.13) | 3 (37.50) | 6 (66.67) |
| Primary | 116 (14.50) | 18 (15.52) | 15 (12.93) | 114 (14.25) | 13 (11.40) | 31 (27.19) |
| Secondary | 516 (64.50) | 67 (12.98) | 50 (9.69) | 507 (63.38) | 45 (8.91) | 113 (22.29) |
| College | 138 (17.25) | 21 (13.21) | 17 (10.69) | 154 (19.25) | 14 (9.09) | 37 (24.03) |

The value of overweight children was not included; bold font presents P<0.05.
sociodemographic factors were analyzed to determine the risk factors leading to undernutrition in children.

**Stunting**

On univariate analysis, child age, gender, sleep time and maternal age at child birth were significantly associated with stunting ($P<0.05$) (Table 1). These variables and maternal marriage status, household size and family income were put into the multivariate logistic regression model. The final multivariate logistic regression analysis revealed that advanced age of children (49–59 months) (AOR, 0.11; 95% CI, 0.03–0.48) and girls (AOR, 0.52; 95% CI, 0.34–0.80) were significantly associated with reduced odds of stunting. However, children's sleep time of more than 8 hours (AOR, 1.82; 95% CI, 1.13–2.94) was significantly associated with increased rate of stunting (Table 2).

**Underweight**

Children's gender and mother's education were significantly associated with underweight ($P<0.05$). Initiation of breastfeeding ($P=0.056$) and child age ($P=0.065$) might be associated with underweight on univariate analysis (Table 1). In the multivariate logistic regression model, we found that girls (AOR, 0.50; 95% CI, 0.31–0.81) with highly educated mothers (Primary; Secondary; College) (AOR, 0.16; 95% CI, 0.04–0.67; AOR, 0.11; 95% CI, 0.03–0.45; AOR, 0.13; 95% CI, 0.03–0.55) had significantly reduced rate of underweight, but initiation of breastfeeding after 6 hours of child birth (AOR, 2.20; 95% CI, 1.09–4.47) had significantly increased the prevalence of underweight (Table 3).

**Wasting**

On univariate analysis, the prevalence of wasting in girls was significantly lower (6.96% vs. 12.21%, $P=0.013$) than that among boys. The child age ($P=0.052$) was also associated with wasting (Table 1). Child age, gender, sleep time and mother's education were put in the multivariate logistic regression model. From the model, we found that girls (AOR, 0.52; 95% CI, 0.32–0.86) and highly educated mothers (Primary; Secondary; College) (AOR, 0.19; 95% CI, 0.04–0.91; AOR, 0.14; 95% CI, 0.03–0.64; AOR, 0.15; 95% CI,

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**Table 2** Odd ratios (95% CI) for child stunting status

| Variable              | Crude OR (95% CI) | $P$   | B  | AOR (95% CI) | $P$   |
|-----------------------|-------------------|-------|----|--------------|-------|
| Child's age (months)  |                   |       |    |              |       |
| 0–12                  | 1.00 (Reference)  | 0.01  |    | 1.00 (Reference) | 0.01  |
| 13–24                 | 0.95 (0.54–1.66)  | 0.86  | −0.09 | 1.10 (0.62–1.95) | 0.74  |
| 25–36                 | 0.82 (0.47–1.43)  | 0.48  | −0.36 | 1.44 (0.80–2.58) | 0.22  |
| 37–48                 | 1.62 (0.88–2.98)  | 0.12  | 0.30 | 0.74 (0.39–1.39) | 0.34  |
| 49–60                 | 9.92 (2.33–42.12) | 0.00  | 2.19 | 0.11 (0.03–0.48) | <0.001|
| Gender                | 1.92 (1.26–2.92)  | 0.00  | 0.66 | 0.52 (0.34–0.80) | <0.001|
| Sleep time (hours)    |                   |       |    |              |       |
| <8                    | 1.00 (Reference)  | 0.01  | −0.08 | 1.00 (Reference) | 0.04  |
| >8                    | 1.05 (0.59–1.88)  | 0.86  | −0.59 | 1.09 (0.60–1.97) | 0.78  |
| Mothers' marital status| 5.19 (0.70–38.36) | 0.07  | −    | −             | −     |
| Household size        | 1.47 (0.97–2.23)  | 0.07  | −    | −             | −     |
| Family income         | 0.53 (0.26–1.09)  | 0.07  | −    | −             | −     |
| Mothers' age          | 2.26 (1.07–4.78)  | 0.03  | −    | −             | −     |

OR: odds ratio; CI: confidence interval; AOR: adjusted odds ratio. Bold font presents $P<0.05$. 

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Fig. 3 The prevalence of undernutrition in Maldives.
0.03–0.72) significantly reduced the rate of wasting (Table 4).

**Undernutrition**

Child age, gender and mother's education were significantly associated with undernutrition (P<0.05) (Table 1). These variables as well as household size and maternal occupation were put into the multivariate logistic regression model. Finally, the results showed that girl (AOR, 0.48; 95% CI, 0.34–0.68), highly educated mothers (primary, secondary, and college) (AOR, 0.14; 95% CI, 0.03–0.64; AOR, 0.10; 95% CI, 0.02–0.45; AOR, 0.11; 95% CI, 0.02–0.50) and the children aged 49–60 months (AOR, 0.38; 95% CI, 0.18–0.79) significantly reduced the prevalence of undernutrition. However, the children aged 25–36 months (AOR, 1.81; 95% CI, 1.12–2.91) was significantly associated with increased odds of undernutrition (Table 5).

**Discussion**

In this study, the prevalence of underweight, stunting, wasting, and undernutrition was found to be 10.75%, 13.5%, 9.6%, and 23.85%, respectively. According to UNICEF, in Maldives, 26% of children under the age of five are underweight, 32% are stunted and 13% are wasted[11]. A study conducted in West Azerbaijan province by Farrokh-Eslamlou revealed that the prevalence of underweight, stunting, and wasting was estimated to be 4.3%, 8.7%, and 7.5%, respectively[12]. For weight and height, the trend showed an increasing prevalence of stunting with age, though the difference was only significant between the 0–12 months' and 25–36 months' age groups[13–14]. As shown by another research conducted in Nigeria, children aged 0–5 months and 6–23 months are most affected by wasting and severe wasting[15], respectively, while children aged 6–23 months and 24–59 months are most affected by underweight and severe underweight, respectively[16]. In our current research, children aged 0–5 months and 36–47 months were most affected by stunting and underweight; and stunting was found more frequently in boys than among girls. The results of two studies also revealed
### Table 4  Odd ratios (95% CI) for child wasting status (weight for height)

| Variable             | Crude OR (95% CI) | P     | B    | AOR (95% CI) | P     |
|----------------------|-------------------|-------|------|--------------|-------|
| Gender               | 1.86 (1.14–3.05)  | **0.01** | –0.65 | 0.52 (0.32–0.86) | **0.01** |
| Maternal education   |                   |       |      |              |       |
| Illiteracy           | 1.00 (Reference)  | 0.09  | 1.00 (Reference) | 0.07  |
| Primary              | 4.66 (1.00–21.82) | 0.05  | –1.66 | 0.19 (0.04–0.91) | **0.03** |
| Secondary            | 6.13 (1.42–26.51) | **0.01** | –1.93 | 0.14 (0.03–0.64) | **0.01** |
| College              | 6.00 (1.30–27.8)  | **0.02** | –1.89 | 0.15 (0.03–0.72) | **0.02** |
| Child’s age (months) |                   |       |      |              |       |
| 0–12                 | 1.00 (Reference)  | 0.05  | –     | –             |       |
| 13–24                | 0.61 (0.26–1.40)  | 0.24  | –     | –             |       |
| 25–36                | 0.35 (0.16–0.76)  | <0.001 | –     | –             |       |
| 37–48                | 0.37 (0.17–0.78)  | <0.001 | –     | –             |       |
| 49–60                | 0.55 (0.22–1.38)  | 0.20  | –     | –             |       |
| Sleep time (hours)   |                   |       |      |              |       |
| 8                    | 1.00 (Reference)  | 0.07  | –     | –             |       |
| <8                   | 1.32 (0.71–2.44)  | 0.38  | –     | –             |       |
| >8                   | 2.01 (1.09–3.69)  | **0.02** | –     | –             |       |

OR: odds ratio; CI: confidence interval; AOR: adjusted odds ratio. Bold font presents P<0.05.

### Table 5  Odd ratios (95% CI) for child undernutrition status

| Variable             | Crude OR (95% CI) | P     | B    | AOR (95% CI) | P     |
|----------------------|-------------------|-------|------|--------------|-------|
| Child’s age (months) |                   |       |      |              |       |
| 0–12                 | 1.00 (Reference)  | <0.001 | –     | 1.00 (Reference) | <0.001 |
| 13–24                | 0.84 (0.51–1.36)  | 0.47  | 0.10 | 1.11 (0.67–1.82) | 0.69  |
| 25–36                | 0.53 (0.33–0.85)  | **0.01** | 0.59 | 1.81 (1.12–2.91) | **0.01** |
| 37–48                | 0.90 (0.56–1.46)  | 0.66  | 0.02 | 1.02 (0.62–1.67) | 0.94  |
| 49–60                | 2.26 (1.11–4.57)  | **0.02** | –0.97 | 0.38 (0.18–0.79) | **0.01** |
| Gender               | 2.04 (1.45–2.86)  | <0.001 | –0.74 | 0.48 (0.34–0.68) | <0.001 |
| Maternal education   |                   |       |      |              |       |
| Illiteracy           | 1.00 (Reference)  | 0.04  | –     | 1.00 (Reference) | 0.01  |
| Primary              | 5.35 (1.26–22.74) | **0.02** | –1.97 | 0.14 (0.03–0.64) | **0.01** |
| Secondary            | 6.97 (1.72–28.32) | **0.01** | –2.28 | 0.10 (0.02–0.45) | <0.001 |
| College              | 6.32 (1.51–26.54) | **0.01** | –2.20 | 0.11 (0.02–0.50) | <0.001 |
| Sleep time (hours)   |                   |       |      |              |       |
| 8                    | 1.00 (Reference)  | 0.57  | –     | –             |       |
| <8                   | 1.21 (0.78–1.89)  | 0.39  | –     | –             |       |
| >8                   | 0.94 (0.65–1.37)  | 0.75  | –     | –             |       |
| Occupation           |                   |       |      |              |       |
| None                 | 1.00 (Reference)  | 0.09  | –     | –             |       |
| Government job       | 0.98 (0.56–1.71)  | 0.94  | –     | –             |       |
| Self employed        | 1.84 (1.14–2.97)  | **0.01** | –     | –             |       |
| Private job          | 1.16 (0.74–1.82)  | 0.52  | –     | –             |       |
| Household size       | 1.39 (0.99–1.94)  | 0.05  | –     | –             |       |

OR: odds ratio; CI: confidence interval; AOR: adjusted odds ratio. Bold font presents P<0.05.
that the prevalence of stunting was higher in boys as compared to girls.[17–18] In our study, the prevalence of underweight, stunting and wasting was higher in male children as compared to girls, which was similar to the study that reported in early infancy, male has a higher prevalence rate (percentage) of underweight, stunting and wasting than girls.[19] The study findings of Mozambique showed that the child gender is a strong determinant of childhood stunting. In that study, males were more likely to be stunted. This is consistent with the findings of other studies conducted in Sub-Saharan Africa, as they have reported mixed findings on the effects of gender, suggesting that males are more affected by undernutrition as compared to females.[20–21].

Around the world, early initiation of breastfeeding, specifically within one hour of birth, has been reported to reduce neonatal mortality by 19.1%--22%. In our study, child's gender and mother's education were significantly associated with underweight and initiation of breastfeeding. A study done in Nepal has shown that mother's education and breast milk initiation were significantly associated with each other and highly educated mothers were more likely to initiate feeding breast milk within the first hour of birth.[23] Our findings also show that initiation of breastfeeding after 6 hours has significantly increased the prevalence of underweight.

Malnutrition based on height and weight for age was high in both girls and boys, and was significantly associated with mother's age and educational level. Our findings show that children's ages of 0–12 months, 25–36 months, 49–60 months, child's gender and mother's education levels were found statistically significantly associated with children's undernutrition in multiple logistic regression models (P<0.05). It's important for mothers to be more educated so that they will be aware of balanced diets and nutritious foods, which influence children's nutritional status. A study done in a rural area of mid-western China shows that the risk factors for stunted children were the caregiver's education levels and child's gender.[24] Similar findings were reported in other studies conducted in Burundian of children aged 6–23 months; they reveal that mothers assessing the child nutrition status correctly was less likely to have stunted children than those who did not assess the nutrition status correctly.[25] Children whose mother reached secondary school and higher were less likely to be stunted than those whose mother had no schooling, which also have been shown in previous studies elsewhere.[26]

Inadequate nutrition in the first two years of life leads to acute weight loss and prevents the child from developing at a rate where their body weight is proportionate to their height.[16] Our finding is consistent with the WHO recommendation, that infants should start receiving adequate complementary foods at 6 months of age in addition to breast milk to avoid being malnourished. Most of the study found that stunting was high in the age group of 6 months to 12 monst's of age, which is related to feeding practices.[27] In 2013, in China, the prevalence of stunting was reported to be 18.7% in poor areas.[28] The findings of another research conducted with Chinese children under 5 years of age among 26 counties show the prevalence was 8.4%.[10] In our study, the prevalence of stunting was high in 0–12 months and 25–36 months' age groups.

The study was done by conducting quantitative data analysis, so there is no question included in the questionnaire that need detailed answers. Due to the way the questionnaire was designed, the respondent's reasons for their answers were not obtained. In addition, some information may be biased because the results were obtained according to the answers of the respondents. Moreover, this study is not generalized to the whole population of Maldives, because this research is focused on only one atoll. The study was a cross-sectional design, which thus could not explain the causal relationships between child malnutrition and the risk factors. Further prospective study design was needed. Moreover, factors at the community-level were not included, and only a few individual-level factors were considered in the present study.

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