Determinants of stunting among under-five children in Malawi

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Abstract

Background: Malnutrition among under-five children remains a public health problem that has been associated with preventable childhood diseases and deaths. There is paucity of information on stunting as the main indicator of children well-being. The present study investigated determinants of stunting among under-five children in Malawi.

Methods: The study utilised data on 5,707 under-five children extracted from the 2015-16 Malawi Demographic and Health Survey. Data were analysed using descriptive statistics and generalised linear models. Odds (OR) and adjusted odds (aOR) ratios with their respective 95% confidence interval (CI) and/or p-values were reported.

Results: The prevalence of stunting was 37.1 %. Mean age of under-five children was 30.0±17.1 months and stunted under-five was 30.9±15.6 months. Nearly half (48.6%) of the children were male, of which 39.0% were stunted. Unlike child age, proportion of stunted children diminished by mother's age at birth; increased by mother's education, weight and parity. Most stunted under-five were anaemic (40.8%) and had mother having uninsured health coverage (36.7%). Female (OR=0.85; 95% CI: 1.02–1.10) were less likely but anaemic (OR=1.27; 95% CI: 1.13–1.44) children were more likely to be stunted compared with their counterparts. Children who were female (aOR=0.80, p=0.001), lived in urban (aOR=0.72, p=0.024), middle wealth quintile household (aOR=0.78, p=0.005) and had primary (aOR=0.77, p=0.008) educated mothers were protective of being stunted. Likelihood to be stunted were 1.4 and 2.7 times as likely among anaemic and aged >23 months children, respectively. Being twins/multiple by birth and having small size at birth increased the risks of being stunted compared with their respective counterparts. Mothers' weight was also a significant predictor of stunting among under-five children.

Conclusions: Prevalence of stunting was very high. The study showed that the significant risk factors for stunting among children below age five were: type of residence, wealth status, child age, sex of children, size at birth, multiple birth, had anaemia, mother's education and weight status of the mother. Public health programs that seek to increase knowledge on benefits of nutrition should be strengthened and should target high-risk subpopulations.

Keywords: under-five children, stunting, chronic malnutrition, generalised linear model, Malawi

Introduction

Malnutrition among under-five children remains a global public health problem that is a risk factor to most preventable childhood diseases and deaths. Globally, nearly 45% of all child deaths are associated with malnutrition [1, 2]. At the same time malnutrition contributed to about three-quarters (73%) of diarrhoea, and nearly half of Pneumonia (44%), measles (47%) and severe neonatal infections (45%) related under-five mortality [3]. According to United Nation System Standing Committee on Nutrition[4], children malnutrition is the first and the fourth contributing factor to the burden of disease respectively in the UNICEF sub-Saharan Africa and South Asian regions. The recent joint malnutrition report showed sub-Saharan Africa bears a huge burden for malnourished children worldwide of which over one-third were stunted [5].

As the most prevalence form of under-five malnutrition, chronic malnutrition (stunting) is a devastating risk factor for growth faltering and poor psychosocial development. Often described as short height-for-age, stunting is a product of in-utero and /or early childhood nutrition deficiencies [5], which may result to a severe long-term challenges. Worrisome, stunted children usually have learning challenges at childhood while they are liable to be psycho-socially and economically deprived in their adulthood. By and large, stunting has been implicated as a catalyst to under-five mortality and morbidity in previous studies[6–8] In particular, de Onis and colleagues submitted that there is sufficient evidence of a statistical significance relationship between stunting and child death - as severe and moderate stunting respectively constitute about 4.1 and 1.6 times higher risk of mortality [3, 8]. Although efforts have been put in place by various stakeholders to ameliorate these negative impacts through several nutrition interventions [5, 6, 9], there is yet to be a landmark reduction in the trend of under-five malnutrition in Malawi and many other sub-Saharan Africa countries.

The pattern of stunted children is largely unevenly distributed across all the regions of the world despite the present global malnutrition decline from 32.5% in 2000 to 21.9% in 2018. Of 149 million under-five stunted children, more than half and nearly two-fifth lived in Asia and Africa regions respectively, in 2018 [5]. Only these regions' prevalence of stunting could be classified as very high based on the newly developed prevalence thresholds classification [5, 8]. However, only sub-Saharan Africa witnessed an increase in the burden of stunted under-five children (from 50 in 2000 to 58 million in 2018), in about the last two decades[5]. About 50% global under-five mortality occurred in sub-Saharan Africa [10]; yearly, over 3 million of them die of malnutrition [2, 6, 11].

A recent number of studies on the determinants of stunting have been conducted in sub-Saharan Africa [12–16]. In Ethiopia, Teferi and colleagues conducted a community-based cross sectional study to examine determinants of stunting among 356 children aged 6–59 months in Southwest Ethiopia [12]. They reported 33.3% prevalence of stunting; opined that child age, age at commencement of complementary as well as birth interval were associated factors of stunting. With a national prevalence of 36.2% [13], a case-control study conducted among 282 children aged 0–59 months in Central Region of Mozambique reported that birth-weight, mother's educational status, maternal occupation, rural residence, family size, number of children living in the household, duration breastfeeding, timing of complementary feeding initiation, among others were the associated factors of stunting. These results clearly suggest that emergence of varying factors, though with some similarity, attest to individual setting or country peculiarity and to multifaceted nature of the associated risk factors. However, specific determinants of under-five chronic malnutrition in Malawi has not been documented to the best of our knowledge which could informed necessary nutritional strategies.

Sadly, despite several short- and long-term detrimental adverse effects of stunting, Malawi is 10th to the last of all countries in the race to actualising the Sustainable Development Goals set target for 2030 [9]; aimed at freeing the world from malnutrition. With nearly one-fifth Malawi population, 2015/16 Malawi Demographic Health Survey (MDHS) report revealed a worrisome prevalence of 37.1% stunted under-five [5]. The reported prevalence is not only considered as "very high" but also higher than the global prevalence of 21.9%. These data clearly suggest that stunting is a public health problem in Malawi. To this end, identifying potential risk factors of stunting could enhance a necessary robust nutritional intervention strategies to eradicate or ameliorate the alarming under-five nutritional challenges. In this present study, therefore, we identified the potential risk factors of stunting among under-five children in Malawi using a generalised linear model approach.

Methods

Study design and setting

The present analysis used the 2015-16 MDHS, a cross-sectional design and nationally representative sample aimed at providing population and maternal and child health indicators' estimates [17]. The study was carried out in Malawi with a population of over 18.1 million of which about 2.9 million were under-5 children, as at the year 2016 [18]. Malawi is predominantly rural with only 16% of the population residing in urban areas [9, 17]. Malawi is grouped into three main regions namely: Northern, Central and Southern.

Sampling and study population

The multistage cluster sampling techniques was used for the survey based on the sampling frame adopted from the 2008 Malawi Population and Housing Census, as provided by the Malawi National Statistical Office (NSO). The Standard Enumeration Areas, referred to as clusters, were the primary sampling units; 850 (173 urban; 677 rural) clusters were sampled for the survey. Thereafter, a total of 63 households comprising on average 30 and 33 households respectively each from urban and rural clusters were selected as the secondary sampling units.

Of 6,033 under-5 children in the 2015-16 MDHS subsample of households who were eligible for anthropometric measurements, about 94%, 95% and 96% of the measurements carried out respectively for height-for-age, weight-for-height and weight-for-age were complete and valid. As such the study population consisted of 5,707 children who had valid and complete information on date of birth, height and weight.

Study variables

The outcome of interest in the present analysis is the stunting of under-five children that are very short for their age in the 2015-16 MDHS data. According to the recent WHO guideline, the height-for-age variable was transformed into a binary variable coded as stunted (1) and otherwise (0) if a child had height-for-age Z-scores below minus two standard deviations from the median of the WHO reference population [17]. In view of the tendency of children having the same mother and /or living in the same household, the choice of the selected explanatory variables included in the analysis based on empirical literature on under-five malnutrition [19] were grouped as household, child and maternal characteristics.

The variables included according to household characteristics were regions, residence, wealth quintile (recoded poor, average and rich), source of drinking water and type of toilet facility (each recoded as improved and not improved). Those included based on the child characteristics were child age (recoded as aged 0–11 months, 12–23 months and 24–59 months), sex, size at birth (recoded as small, average and large), birth order (recoded as 1^{st} birth, 2^{nd}–4^{th} birth and >4^{th} birth), child is twin, birth interval, had anaemia (recoded as yes (1) and otherwise (0)), child is sick defined as having had fever or cough in the last two weeks (coded as yes (1) and zero otherwise). For maternal characteristics, the included variables were as follows: mother’s age at birth (recoded into aged <20 years, 20-29 years and ≥30 years), mothers’ educational status (recoded as none, primary and secondary/higher), mother’s nutritional status (coded as normal, underweight, overweight/obese and unknown (pregnant/postpartum)), current marital/relationship status (recoded as not married (0) and married (1)), total number of children ever born or parity (recoded as ≤4 children and >4 children) and breastfeeding status.

Statistical data analysis

Participants with missing data were excluded from the analysis since there were minimal missing data on the extracted variables based on the initial exploration of data. The data were weighted appropriately to adjust for differences in population sizes vis-à-vis rural and urban residence as well as in each of the region in Malawi.

Descriptive statistics and generalised linear methods (GLM) were used for the analysis. Descriptive statistics used were mean (±standard deviation), median (minimum – maximum) and frequency (percentage) as the case may be. At univariate level, descriptive statistics was used to describe under-five children background characteristics. While at bivariate level, GLM was used to examine individual explanatory variable's influence on the stunting, as a measure of nutritional status. Generalised linear model with a binomial random distribution and logit link function was further used to identify the determinants of stunted among under-five children, using a series of models. At this stage of multivariate analysis, four models were used to describe the relationship between stunting and background characteristics of the studied subjects. The description of the four models are as follows. Models 1, 2 and 3 included variables grouped as household, child and maternal characteristics respectively. The significant predictors from the three preceding models were included in the final model 4. The odds ratio, 95% confidence interval and / or the p-values were reported. All analyses were carried out at 5% level of significance, using IBM SPSS version 25.

Model Description

A GLM is characterised by three main components, namely random (independent), systematic (linear predictors) and a link function [20]. These are briefly explained as follows.

Let Y_j, $j = 1, 2, \cdots, n$ be the independent j^{th} chronically malnourished under-5 child defined as

$$Y = \begin{cases} 1, & \text{stunted (with probability } \pi) \\ 0, & \text{otherwise (with probability 1-}\pi) \end{cases}$$

$$\pi = \Pr(Y = 1 / X = x_1, \cdots, X = x_r) \text{ and } \pi(\underline{x}) = \frac{e^{\alpha+\beta_1 x_1+\cdots+\beta_r x_r}}{1+e^{\alpha+\beta_1 x_1+\cdots+\beta_r x_r}} \equiv \frac{1}{e^{-(\alpha+\beta_1 x_1+\cdots+\beta_r x_r)}}$$

The binary outcome variable (Y_j) is the random component; the selected background characteristics (X_i) is the random component; and the link function which relates the expected outcome with the linear predictors is the logit link function defined as:

$$h(\mu = \pi) = \log_e(\frac{\pi}{1-\pi})$$

(i.e., the natural logarithms function of odds of a child being chronically malnourished).

For $E(Y / X = x_1, \cdots, X = x_r) = \pi$, the GLM of binomial distribution with a logit link function can be described as follows.

$$y_j = \log_e(\frac{\pi}{1-\pi}) = \alpha + \beta_1 x_{j1} + \cdots + \beta_r x_{jr}$$

where π is the proportion of children who were chronically malnourished, β_i $(i = 1, 2, \cdots, r)$ and e^{β_i} are regression coefficient and odds ratio to be estimated respectively and X_{ij} is the i^{th} explanatory variable for the j^{th} subject .

Results

Background characteristics of under-5 children

Table 1 shows that children and their mother's (age at birth) mean ages were 30.0 (±17.1) months and 26.0 (±6.6) years, respectively. While aged 24 months and above (61.8%) were the majority, infant and aged 12 – 23 months were nearly the same. Slightly above half (54.1%) of the children had mother aged 20 - 29 years at birth while 767 (16.4%) had teenager mothers at birth. Most children were female (51.4%), had anaemia (62.6%) and had fever or diarrhoea (51.0%) in the last 2 weeks prior to the survey. Most children were from southern (46.6%) and central (42.3%) regions, and majority lived in rural area (87.4%), as shown in Table 1. Nearly half of the children (46.9%) were from poor household, while majority had improved source of drinking water (86.0%) and type of toilet facility (80.9%). Only 52 (1.0%) of the children's mothers had health insurance covered and about one-tenth (20.1%) had secondary or higher education; majority were married or in union (85.5%), working (66.3%) and had less than four (73.4%) number of children ever born.

Pattern of stunting by child age

Of 5707, 2119 (37.1%) were stunted: 26.1%, moderate and 11.0% - severe, as shown in figure 1. Stunted children mean age was 30.9±15.6. The prevalence of stunting was very high at birth (32.1%), diminished in the first 6 months to 19.0% but rose thereafter and peaked at aged 24-47 months (Figure 1).

Pattern of stunting by some selected household, child and maternal characteristics

Percentage distribution of stunted under-five children is presented in Table 2. The percentage of stunting was highest in Central Region (38.2%) followed by Southern Region (36.6%) and lowest in Northern Region (35.1%).Most stunted children lived in rural (38.9%) and were from poor wealth quintile (43.1%). Besides, children who resided in household with "not improved" source of drinking water (42.7%) and types of toilet facility (39.4%) had the highest proportion of stunting compared with their counterpart with “improved’. The proportion of stunting increases by child age but decreases by their birth size, with children aged ≥ 24 months (40.9%) and of small size (47.3%) having the highest, respectively. Most stunted children were male (39.0%), twins or multiple in birth (61.0%) and had anaemia (40.8%). Unlike child age, proportion of stunted children diminish by mother’s age at birth (<20 years – 40.6%; ≥ 30 years – 35.5%); however, it increases by mother’s highest education attainment (no education –42.7%; secondary/higher education –29.7%) and mother’s weight (underweight – 48.9%; overweight/obese – 27.7%).

Determinants of stunting among under-five

The GLM analyses to obtain the crude and adjusted OR of factors influencing stunting are also presented in Table 2. The study found children from the urban area (OR=0.49; 95% CI: 0.40–0.60) to have a lower odds of being stunted compared to those from the urban areas. Children from middle and rich wealth quintile were 22.0% and 48.0% times less likely to be stunted compared to those in the poor wealth quintile. Meanwhile, compared to household with “improved” source of drinking water, children from “not improved” source of drinking water (OR=1.27; CI: 1.09 - 1.49) household were about 1.27 times more likely to be stunted. The stunting seems to have increased with child age, with OR=2.32 (95% CI: 1.98 - 2.72) among children aged >23 months compared with infant children. But, as shown in Table 2, stunted tends to have decreased by size at birth, with children of small size having OR=1.55 (95% CI: 1.31 - 1.82) compared with children of normal size at birth. Female (OR=0.85; 95% CI: 1.02–1.10) were less likely to be stunted than their male counterparts; while children with twins/multiple birth (OR=2.47; 95% CI: 1.78–3.44) and those who had anemia (OR=1.27; 95% CI: 1.13–1.44) were more likely to be stunted respectively compared with those having a single birth and those who had no anemia. Meanwhile, at every one month increase in birth interval among the under-five children the likelihood of being stunted decreased by 0.3%.

Children stunting tends to decrease by their mother's age at birth, education attainment and weight. Children whose mother aged 20-29 years (OR = 0.81; CI: 0.69 - 0.96) and aged ≥30 years (OR = 0.82; CI: 0.68 - 0.98) at birth were about 19% and 18% less likely to be stunted compared with those whose mothers were teenagers at birth. Those whose mother had primary (OR = 0.81; CI: 0.69 - 0.96) and secondary/higher (OR = 0.50; CI: 0.41 - 0.61) education had lower tendency of being stunted compared with those whose mothers had no education. While children of underweight mothers (OR=1.55; CI: 1.18 - 2.04) were had higher odds to be stunted, children of overweight/obese mothers (OR=0.63; CI: 0.53 - 0.74) tends to have lower tendency of being stunted compared with those who had normal weight mothers. Besides, stunted were more likely with children whose mothers had "> 4" children ever born (OR=1.17; CI: 1.03 – 1.33) and those whose mothers were not covered by health insurance (OR=2.31; CI: 1.16 – 5.11).

While controlling for confounders, the GLM model 1 of Table 2 shows that residence and household wealth status had a significant relationship with stunted children. Children living in urban (aOR=0.49; 95% CI: 0.55 - 0.86) were about 50% times less likely to be stunted compared to those from rural area. Compared to poor, children from household with middle (aOR=0.79; 95% CI: 0.68 - 0.92) and rich (aOR=0.58; 95% CI: 0.50 - 0.67) wealth quintiles had less tendencies to be stunted.

Model 2, while the influence of other variables were removed, stunting was 2.14 and 2.68 times higher among children aged 12-23 months (aOR=2.14; 95% CI: 1.68 - 2.75) and aged >23 months (aOR=2.68; 95% CI: 2.14 - 3.37) respectively compared to infants. The likelihood of being stunted is about 19% lower among female children (aOR=0.81; 95% CI:

0.71- 0.92) compared to their male counterpart. While small size (aOR=1.59; 95% CI: 1.33 - 1.89) is a risk to children stunting, large size (aOR=0.81; 95% CI: 0.70 - 0.93) is protective. The likelihood of a chid being chronically malnourished increases by birth order: children with 2^{nd} – 4^{th} (aOR=1.27; 95% CI: 1.03 - 1.57) and >4^{th} (aOR=1.42; 95% CI: 1.12 - 1.78) birth order were respectively about 1.3 and 1.4 times more likely to be stunted than first born children. Children who were twins/multiple in birth and those who had anaemia had increased odds of being stunted. For every one month delay in birth interval among the children, the risk to be stunted reduced by 0.6%.

In model 3, the likelihood of children to be stunted decreases by mother's age at birth, as children whose mother's aged 20-29 years (aOR=0.81; 95% CI: 0.68 - 0.97) and aged >30 (aOR=0.65; 95% CI: 0.51 - 0.82) years were 19% and 35% less likely to be stunted compared to their counterpart who had teenager mothers at birth. Likewise, the tendency of children to be stunted decreases by mother's education attainment, with children whose mother had primary (aOR=0.74; 95% CI: 0.62 - 0.88) and secondary/higher (aOR=0.53; 95% CI: 0.42 - 0.67) education being respectively 26% and 47%% less likely to be chronically malnourished compared to those whose mother had no education. While having overweight mothers and mothers with >4 ever born children being protective, having underweight mothers is a risk for children to be stunted.

Having controlled for all significant household, child and maternal characteristics, Table 3 revealed the outcome from model 4 (the concluding model). In this model, n=3951 subjects were used to sum up the determinants of children stunting. Children from urban (aOR=0.72, p=0.024) were 28% significantly less likely to be stunted compared to those from rural area. Also, children whose household wealth quintile were middle (aOR=0.78, p=0.005) and rich (aOR=0.55, p<0.001) are protective of children being stunting compared to having poor wealth quintile. Meanwhile, the likelihood to be stunted were about 2.0 and 2.7 times as likely respectively among children aged 12-23 months (aOR=2.02, p<0.001) and aged >23 months (aOR=2,71, p<0.001), compared to the infants. While the tendency to be stunted decreased among female children compared to male children, being twins/multiple child by birth increased the risk of being stunted compared to a single birth. Again, small size at birth is a risk of being stunted while large size is protective of stunting. As expected, mother's education is protective to children stunting; children whose mother had primary (aOR=0.77, p=0.008) and secondary/higher (aOR=0.72, p=0.014) respectively were 23% and 28% less likely to be stunted, compared to those whose mother had no education. Children's mother weight was also a significant predictor of stunting among under-five children.

Discussion

The present study examined and identified risk factors of stunting among under-five children in Malawi using data from the 2015-16 MDHS. Although the available literature indicates that stunting has declined from 55% in 2000 to 47% in 2010 and 37% in 2015-16 [17], the prevalence of stunting in Malawi is still very high. It is higher than 29.2% found in a cross sectional study conducted among children under-five in Harare suburbs, Zimbabwe [16]; but lower than 40% in Zambia [21] and 44% in Mozambique [22]. To the best of our knowledge, the present study is the only study that have examines the associated factors of stunting among under-five children in Malawi, using a representative national data. This study has shown that stunting among under-five children in Malawi is influenced by type of residence, wealth status, child's age, sex of child, size of child, multiple birth, had anaemia, maternal highest education and mother nutritional status.

In particular, this study showed that the proportion of stunting increased as a child advanced in age. This implied older under-five were most stunted; this might be accounted for by inappropriate feeding practices[17]. Although a very high prevalence at birth (32.1%) was reported; it declined to as low as 19% in the sixth month and increased thereafter. In agreement with this study, de Onis & Branca [23] opined that growth faltering commences early in life right from the utero and continues through a minimum of the first 24 months in life. Having the least prevalence of stunting at the sixth month is in contrary to the outcome of a study among children aged 0-36 months in Malawi, about a decade ago, which found that prevalence of stunting was peaked at age 6 month [24].

Of course, the sharp decline in proportion of stunting witnessed in this study during the first six months in life may be attributed to the immense advantage of exclusive breast feeding compare to any other food supplements. As reported in 2015-16 MDHS, nearly two-third of the children were exclusively breastfed [17] though it reduces by 10% compared 2010 prevalence[9]. Asides, the result showed high tendency of being stunted at older age which is consistent with a case-control study conducted in Kenya among pregnant women and their children [7]. This is evident from a high average age 31 months of stunted children; meanwhile, it may partially be attributed to the decline of about 2.3 total fertility rate over two decades [17].

Besides, household status revealed that most children resided in rural, raised in poor household but had improved source of water. In all these, stunting was respectively more prevalent except for those who had improved source of water, as expected. This is an evidence of nutritional deficiency resulting in growth faltering that negatively impacted on child’s development in deprived population setting. This result is in agreement with a previous study [19] conducted in Kenya on trends and determinants of malnutrition among under-five children. Other children maternal status showed that majority were of aged 20–29 years at birth, at most four siblings ever born, educated, normal weight, and health uninsured mother. However, highest proportion of stunting were respectively indicated among children having teenage, uneducated, underweight, more than four siblings ever born, and health uninsured mothers.

On the other hand, child characteristics indicated that majority of the children were female, of average size at birth, of single birth and had anaemia. Children who were male, of small size at birth and of multiple birth respectively had the highest proportion of stunting; not surprising, those who had anaemia were the most stunted. These results were already established in the literature [13, 14, 25, 26]. Interestingly, the outcome of males being most likely stunted is supported by a similar study in Malawi [25], using 2004 and 2010 MDHS data. However, this disagrees with a previous finding [16] in which most children were male but female most stunted. Apart from the disparities across regions and countries, the opposing result might be as a result of the cross sectional study using only 342 participants within Harare suburbs, in Zimbabwe.

The outcomes of generalised linear models (both univariate and multivariate models) expatiate further on the association between the selected background characteristics and stunting. These models were necessitated in order to account for the correlated responses that might arise as a result of children having the same mother and /or living in the same household [19]. Saliently, the models collectively demonstrate a holistic predictors of stunting using a statistical method that meticulously control for potential confounders. As presented in the final model 4, having adjusted for all significant household, child and maternal characteristics, the study showed type of residence as a significant predictor of stunting. Residing in rural potent higher risks of being stunted. Some of the previous studies are in conformity with this finding [26, 27]. Frequent opportunity to public health information in relation to appropriate feeding practices, often being absent in rural area, in urban centres might partly be responsible for the increased risks of being stunted in rural compared to urban areas.

Corroborating earlier studies [19, 26, 28, 29], wealth quintile is significant in the present study. The study revealed that living in either middle or rich wealth quintile household is protective of stunting but poor household is a risk. This has been established in the literature already [19, 28]. This may be attributed to inability of the household to procure or purchase needed food as a result of poverty; hence, children are left malnourished. The study also revealed child age as a significant determinant of stunting. Studies in other sub-Saharan African countries such as Kenya, Rwanda, Nigeria, Ethiopia, and Zimbabwe have also reported similar findings [13, 19, 26, 29, 30]. It is reported in the study that the likelihood to be stunted increased with the child age. This explains stunting as a menace which impedes child's development right from the uterus with possible devastating consequences that linger at adulthood.

Child sex is another important predictors of stunting as revealed in this study in which being a male child is a potential risk factor to be malnourished. These findings have important implications for nutritional intervention implementation. In view of future healthy society and robust developmental stride, focusing alone on girl child to the detriment of their male counterpart need to be tread with caution. This result corroborates finding of a study [7] which submitted that sex is a significant predictor of stunting. In contrast, a systematic review study of journals published on malnutrition in sub-Saharan Africa reported that female children were the most affected [28]. Besides the countries variation of associated risk factors of stunting, time differences may be the root of the opposing result.

As shown in the adjusted-concluding model 4, small size at birth and being anaemic are another significant potential risks of being malnourished chronically. Under-five born with small size had higher risks to be stunted compared with those with large size at birth. This may be partly influenced by maternal nutritional and health status on or before conception. Likewise, anaemic children were more prone to be stunted; this may be as a result of exposure to other infections and loss of appetite for food. This is consistent with previous literature [15, 19, 23] that have demonstrated significant relationship between infection, and degenerative diseases and being malnourished. And, of course, this may have untold severe devastating effect on child growth and development. The result further buttresses the importance of maternal nutritional and health status in combating children stunting in Malawi.

Maternal education was a significant risk factor of stunting as revealed by this study. This supports early established literature[19, 29]. According to Bain et al., women education is a crucial driving force of poor feeding practices in sub-Saharan Africa[28]. This implies that maternal education is linked to empowerment that can eradicate poverty; in turn induces appropriate feeding practices and eliminate adverse effects of stunting among under-five. Similarly, the study reported maternal weight has been a significant predictor of stunting. While maternal underweight is insignificant risk factor, maternal overweight/obese is a significant protective of being stunted. This has been corroborated in the literature [19, 31]. Maternal underweight, though insignificant statistically, identified has a predictor of child stunting is an important pointer to maternal nutritional well-being before, during and after pregnancy. In contrast to this result, Masibo [19] in a study among under-five in Kenya reported that children whose mothers were overweight had higher tendency of being stunted. The reason to this emerging trend is unclear; however, the burden of overweight in recent time particularly in developing countries of the world has been alarming [6].

Limitation of the study

The present study acknowledges its own limitation. First, the study design is cross-sectional. Second, there may be possibility of recall bias as the study entailed self-reported data without any means of verification. However, the strength of the study which lies in the use of large nationally representative data has overcome this. Not only that, the strength of the work includes carefully adjusting for the potential confounders of stunting; the importance of this approach has been highlighted [23]. Beyond this, under-five stunting is the best overall indicator of any child well-being but its determinants is yet to be investigated by previous established literature.

Conclusion

In conclusion, the prevalence of stunting is relatively very high but varied across the children background characteristics. Saliently, proportion of stunting at birth is very high, least at aged 6 month, rise thereafter and peaked between aged 35-47 months. This further reiterates the importance of maternal nutritional well-being - before, during and after pregnancy, exclusively breastfeeding in the early 6 months from birth, and appropriate infant and young child feeding practices. As all these may bring about rebirth of society free from stunted brain and stunted lives in general. Under-five male, of older age, of small size at birth, having maternal lower educational attainment, having underweight mother, raised in poor household and largely in the rural parts of the country had higher significant tendency to be stunted. In all these, poverty has been implicated has a reason behind low education and poor nutrition practices. This is a clear indication in support of the proposition that effort to reduce stunting shall necessitate improvements in food and nutrition security and education. The policy implication is that improvement in education complements nutrition interventions and by an extension, nourished children. There is a need to empower the entire population in the aspect of education and health in addition to scaling up nutrition intervention and implementation for the overall national development.

List of Abbreviations

OR – odds ratio; aOR - adjusted odds ratio; ; GLM – generalised linear model; MDHS – Malawi demographic and health survey; WHO – world health organisation; UNICEF -

Declarations

Ethics approval and consent to participate

Ethical approval for the parent study was obtained from the National Health Sciences Research Committee, Malawi. At the time of data collection, informed consent was obtained from all study participants and all participants were free to withdraw from the study at any point without consequence ([17]. All participants were made to sign written agreement form prior to the interview while all data collection and measurement activities were conducted in strict confidence. Besides, the Demographic and Health Surveys (DHS) Program, ICT International, USA approved the use of dataset for the present analysis

Consent for publication

Not applicable

Availability of data and materials

All relevant data can be made available by the corresponding author based on reasonable request.

Competing interest

The authors declare that they have no competing interest financial or otherwise.

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Authors' contributions

MEP and RFA conceptualised, designed and coordinated the study. RFA conducted the data analysis and interpretation, drafted the manuscript. MEP and RFA reviewed the manuscript. All authors read and approved the final manuscript before submission.

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References

1. World Health Organisation. Malnutrition. 2018. https://www.who.int/news-room/fact-sheets/detail/malnutritio.

2. Black RE, Harold A, Bhutta ZA, Gillespie S, Haddad L, Horton S, et al. Maternal and child nutrition: building momentum for impact. Lancet (London, England). 2013;382:372–5. doi:10.1016/S0140-6736(13)60988-5.

3. USAID O of N. Role of Nutrition in Preventing Child and Maternal Deaths. 2014. https://www.usaid.gov/sites/default/files/documents/1864/role-of-nutrition-preventing-child-maternal-deaths.pdf. Accessed 15 Apr 2019.

4. Webb P. Nutrition and the post-2015 Sustainable Development Goals (SDGs). 2014. www.unscn.org. Accessed 23 Apr 2019.

5. UNICEF, WHO, and World Bank group. Levels and trends in child malnutrition: key findings of the 2019 Edition of the Joint Child Malnutrition Estimates. Geneva; 2019. https://data.unicef.org/wp-content/uploads/2019/04/Joint-malnutrition-estimates-March2019-1.pdf. Accessed 10 Apr 2019.

6. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? Lancet. 2013;382:452–77. doi:10.1016/S0140-6736(13)60996-4.

7. De Vita MV, Scolfaro C, Santini B, Lezo A, Gobbi F, Buonfrate D, et al. Malnutrition, morbidity and infection in the informal settlements of Nairobi, Kenya: an epidemiological study. Ital J Pediatr. 2019;45:1–11. doi:10.1186/s13052-019-0607-0.

8. de Onis M, Borghi E, Arimond M, Webb P, Croft T, Saha K, et al. Prevalence thresholds for wasting, overweight and stunting in children under 5 years. Public Health Nutr. 2019;22:175–9. doi:10.1017/S1368980018002434.

9. USAID. Malawi: Nutrition Profile. 2018.

10. UNICEF. Levels & Trend in Child Mortality: Estimates Developed by the UN Inter-agency Group for Child Mortality Estimation. 2018.

11. UNICEF. Manultrition in children. 2018. https://data.unicef.org/topic/nutrition/malnutrition/.

12. Teferi MB, Hassen HY, Kebede A, Adugnaw E, Gebrekrstos G, Guesh M, et al. Prevalence of Stunting and Associated Factors among Children Aged 06-59 Months In Southwest Ethiopia: A Cross-Sectional Study. J Nutr Heal Food Sci. 2016;4:1–6. doi:10.15226/jnhfs.2016.00180.

13. García Cruz LM, González Azpeitia G, Reyes Súarez D, Santana Rodríguez A, Loro Ferrer JF, Serra-Majem L. Factors associated with stunting among children aged 0 to 59 months from the central region of Mozambique. Nutrients. 2017;9:1–16.

14. Wirth J. Determinants of stunting in East Africa. 2018. https://tel.archives-ouvertes.fr/tel-01815996. Accessed 13 Apr 2019.

15. Moges B, Feleke A, Meseret S, Doyore F. Magnitude of Stunting and Associated Factors Among 6-59 Months Old Children in Hossana Town, Southern Ethiopia. J Clin Res Bioeth. 2015;6:4–11. doi:10.4172/2155-9627.1000207.

16. Maradzika J, Makwara IP, Chipunza S. Factors Associated with Stunting among Children Aged 0 to 59 Months in Harare City, Zimbabwe. Int J Child Heal Nutr. 2016;5:31–44. https://www.lifescienceglobal.com/media/zj_fileseller/files/IJCHNV5N1A5-Maradzika.pdf. Accessed 10 Apr 2019.

17. (NSO) NSO, ICT. Malawi Demographic and Health Survey 2015-16. Zomba, Malawi, and Rockville, Maryland, USA; 2017. doi:http://www.measuredhs.com/.

18. UNICEF / WHO / World Bank Group. Levels and Trends in Child malnutrition: Key findings of the 2017 edition. Geneva; 2017.

19. Masibo PK. Trends and Determinants of Malnutrition among Children Age 0-59 Months in Kenya (KDHS 1993, 1998, 2003 and 2008-09). Calverton, MD, USA: ICF International; 2013.

20. Rencher AC, Schaalje GB. Linear Models in Statistics. Second. Hoboken, New Jersey; 2008.

21. Mzumara B, Bwembya P, Halwiindi H, Mugode R, Banda J. Factors associated with stunting among children below five years of age in Zambia: evidence from the 2014 Zambia demographic and health survey. BMC Nutr. 2018;4:1–8.

22. Rose ES, Blevins M, González-Calvo L, Ndatimana E, Green AF, Lopez M, et al. Determinants of undernutrition among children aged 6 to 59 months in rural Zambézia Province, Mozambique: results of two population-based serial cross-sectional surveys. BMC Nutr. 2015;1:1–20.

23. de Onis M, Branca F. Childhood stunting: A global perspective. Maternal and Child Nutrition. 2016;12:12–26.

24. Thakwalakwa C, Phuka J, Flax V, Maleta K, Ashorn P. Prevention and treatment of childhood malnutrition in rural Malawi: Lungwena nutrition studies. Malawi Med J. 2009;21:116–9.

25. Ntenda PAM, Chuang Y-C. Analysis of individual-level and community-level effects on childhood nutrition in Malawi. Pediatr Neonatol. 2018;59:380–9.

26. Akombi BJ, Agho KE, Hall JJ, Wali N, Renzaho AMN, Merom D. Stunting, wasting and underweight in Sub-Saharan Africa: A systematic review. Int J Environ Res Public Health. 2017;14:1–18.

27. Kia AA, Rezapour A, Khosravi A, Abarghouei VA. Inequality in malnutrition in under-5 children in Iran: Evidence from the multiple indicator demographic and health survey, 2010. J Prev Med Public Heal. 2017;50:201–9.

28. Bain LE, Awah PK, Geraldine N, Kindong NP, Sigal Y, Bernard N, et al. Malnutrition in Sub - Saharan Africa: Burden, causes and prospects. Pan African Medical Journal. 2013;15.

29. Habyarimana F. Key determinants of malnutrition of children under five years of age in Rwanda: Simultaneous measurement of three anthropometric indices. African Popul Stud. 2016;30:2328–40.

30. Geze Malako B, Asamoah BO, Tadesse M, Hussen R, Gebre MT. Stunting and anemia among children 6-23 months old in Damot Sore district, Southern Ethiopia. BMC Nutr. 2019;5. doi:10.1186/s40795-018-0268-1.

31. Manggala AK, Wiswa K, Kenwa M, Me M, Kenwa L, Agung A, et al. Risk factors of stunting in children aged 24-59 months. 2018;58:205–12.