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Disparities in the prevalence of child undernutrition in Malawi – a cross-sectional perspective

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Background. Child undernutrition is a significant public health problem in Malawi.

Objective. To determine the localisation of underweight, stunting and wasting in three main agricultural development divisions (ADDs) in Malawi.

Design. Descriptive population-based cross-sectional study.

Setting. Rural subsistence farming communities in Mzuzu, Lilongwe and Blantyre ADDs.

Subjects. Children aged 6 - 59.9 months.

Outcome measures. Anthropometric measurements were taken to determine the mean weight-for-age z-scores (WAZ), height-for-age z-scores (HAZ) and weight-for-height z-scores (WHZ). The prevalences of underweight, stunting and wasting were also determined.

Results. The mean WAZ of children from Mzuzu ADD was significantly higher than that of children from Lilongwe ADD (–1.04 v. –1.43, $p = 0.001$) and Blantyre ADD (–1.04 v. –1.32, $p = 0.03$). Similarly, children from Mzuzu ADD had significantly higher WHZ than their counterparts from Lilongwe (0.22 v. –0.04, $p = 0.021$) and Blantyre ADDs (0.22 v. –0.09, $p = 0.003$). There were no significant between-group differences in mean HAZ ($F = 2.73$, $p = 0.07$). The prevalence of underweight was significantly lower in Mzuzu ADD (16.9%) than Blantyre (25.3%) and Lilongwe (31.3%) ADDs ($\chi^2 = 11.95$, $p = 0.003$). Likewise, stunting was significantly lower in Mzuzu ADD (46.6%) than Blantyre (53.8%) and Lilongwe (61.3%) ADDs ($\chi^2 = 8.71$, $p = 0.013$). There were no differences in the prevalence of either stunting or underweight between Lilongwe and Blantyre ADDs.

Conclusion. The differences in prevalence of malnutrition among preschool children in the three agro-ecological zones may result from differences in ecological, demographic, social, economic and other pressures that these populations are exposed to. As Malawi decentralises most of its public services, there is a need for nutrition and health managers in specific areas to formulate uniquely localised programmes to deal effectively with the gravity and presumed diverse causes of nutrition problems. Some blanket national interventions are less likely to help in addressing local problems.

Protein energy malnutrition is one of the leading nutrition problems of public health concern in Malawi, and it continues to exert negative impact on the health and survival of Malawian children. Recent estimates have shown that nationally, 47.8% of preschool children are stunted (22.2% severely), 22% are underweight, and 5.2% are wasted.[1] While rates of malnutrition have been steadily declining in some parts of the world such as in South East Asia,[2] Malawi has registered very little or no change at all. For example, 48.7% of preschoolers were stunted in 1992,[3] and 12 years later there has been virtually no change: 47.8% in 2004.[1] Within the same period, underweight has only declined by 5.2% to 22% in 2004.[1,3] On the basis of these trends, it can safely be concluded that programmes such as nutrition education, infant and child feeding, and targeted food and nutrition programmes have largely been ineffective in reducing undernutrition in Malawi.

Generally, 56% of childhood deaths in developing countries result from the potentiating effects of underweight.[4] This would help to explain why the under-5 mortality rate (133/1 000) remains high in Malawi,[1] partly owing to low immunity to infectious diseases, which in turn worsens the vicious cycle of malnutrition and infection.[4] Hence, reducing undernutrition is recognised as a vital step to improve child survival, which is one of the indicators for achieving the Millennium Development Goals.[2]

In Malawi, disparities in the prevalence of undernutrition have been noted before; however, such reports remain in the grey literature, and have often escaped the attention of policy makers and nutrition and health managers. For that reason, we analysed anthropometric data from Mzuzu, Lilongwe and Blantyre agricultural development divisions (ADDs) to determine the localisation of underweight, stunting and wasting. The data we used are part of a larger dataset that was compiled through the Surveillance of Micronutrient Programmes in Malawi. The three ADDs were chosen because (*i*) they are the largest in Malawi, providing the most potential diversity in agricultural production and endowment of resources to the inhabitants;[5] and (*ii*) anthropometric data from these ADDs constituted 80% (N = 598) of the original dataset. We hypothesised that there were no significant differences in the mean z-scores and prevalence of malnutrition among preschoolers in the three ADDs.

Materials and methods

Study area and population

The data used in this study were collected as part of Surveillance of Micronutrient Programmes in Malawi, in which cross-sectional surveys are periodically done, primarily targeting subsistence farming households in ADDs. Malawi has eight ADDs, which are the major geographical areas within which planning and implementation of agriculture and related programmes are done. Each ADD consists of several rural development projects (RDPs), each of which is further broken down into extension planning areas (EPAs). The EPAs are the smallest units of operation in the hierarchical order of the Ministry of Agriculture, and are manned by a cadre of front-line extension workers who have been trained in agriculture, natural resources, home economics and related disciplines.

From the initial dataset (N = 757), anthropometric data for Mzuzu, Lilongwe and Blantyre ADDs were isolated for further analysis (N = 598). These agro-ecological zones were chosen because they are the largest of the eight ADDs in Malawi, having the most potential diversity in agricultural production and endowment of resources to their inhabitants.[5] Furthermore, anthropometric data from the three ADDs constituted 80% of the original dataset.

From the eight ADDs, we used a multistage cluster sampling technique to randomly sample RDPs (stage I), EPAs (stage II), and households (stage III). In the Northern region, 6 EPAs were randomly selected, and 10 in each of the Central and Southern regions. Five clusters were then selected from each EPA in the north, whereas 3 clusters were selected in each EPA in the centre and south. This resulted in 30 clusters per region, and a pre-tested household questionnaire was administered to 7 households randomly selected from each cluster. The inclusion criteria were: being resident in the sampled area; having at least one 6 - 59.9-month-old child; being randomly selected; giving verbal consent to be interviewed on a wide range of nutrition issues related to micronutrients; and accepting that children's anthropometric measurements should be taken.

Survey arrangements

Three teams of enumerators were recruited and trained, and were responsible for all data collection, including taking anthropometric measurements under the supervision of nutritionists (the authors) from the University of Malawi. The children's dates of birth were recorded from either child health cards or health passport booklets. The study protocols were approved by the Ministries of Health and Agriculture in Malawi.

Anthropometric measurements

All anthropometric measurements were taken according to standard methodologies.[6] Weight was measured using standardised 25 kg Salter spring balances (Salter Weight-Tronix Ltd, West Bromwich, West Midlands, UK) for younger children who were unable to stand on their own, and Seca Uniscales (Seca, Calif., USA) for older children. A Shorr stadiometer (Irwin Shorr, Md, USA) was used to measure the children's length or height. All children < 24 months old had recumbent length taken, and standing height was measured for all those ≥ 24 months old.[7]

Derivation of nutrition indices

Conventional anthropometric indices of height-for-age, weight-for-age, and weight-for-height were derived for all children using Epi Info 6.04d (Centers for Disease Control and Prevention, Atlanta, Ga, USA). Using standard deviation scores (z-scores), the children's nutritional indices of WAZ, HAZ and WHZ were derived according to the National Center for Health Statistics/World Health Organization (NCHS/WHO) international references for the growth of children aged zero to 18 years.[7] Z-scores were preferred to percent of median or percentiles because they can be accurately computed beyond the limits of the reference population[8] and are suitable for use in Malawi because, as in most poor countries, extreme forms of undernutrition are common. As well, use of z-scores helps to compare the present results with previous national or localised studies that used the same indices. According to the WHO,[7] a child is considered malnourished on a particular indicator if their z-score is < –2, while severe malnutrition is indicated at z-scores < –3.

Data analysis

The data were entered in Epi Info 6.04d and analysed in SPSS for Windows 12.0 (SPSS Inc., Chicago, Ill., USA). The three nutritional indices (WAZ, HAZ and WHZ) were used as dependent variables, with ADD as the fixed factor. The homogeneity of variance for each index was examined using Levene's test. All three indices yielded non-significant results ($p > 0.05$), suggesting that there was equality of variance for each index across the three ADDs. Further, we examined normality of the data by plotting histograms and fitting normal distribution curves around them. Overall, we observed no serious violations of the normality assumption, hence we proceeded with the rest of the analysis.

One-way analysis of variance (ANOVA) was run to examine differences in mean WAZ, HAZ and WHZ among children from the three ADDs. Where significant differences between group effects existed, multiple comparisons of the means were performed using Bonferroni *post hoc* tests to find pairs of means that were significantly different from one another. Proportional differences in the prevalence of underweight, stunting and wasting were determined using the chi-square statistic. The critical value for statistical significance was set at $p \leq 0.05$.

Results

Eighty per cent ($N = 598$) of the original data ($N = 757$) were used in this analysis. Overall, the three groups of children were comparable with respect to demographic and anthropometric characteristics (Table I). However, when age distribution was taken into account, Lilongwe ADD had significantly fewer children ($p = 0.05$) in the 18 - 23-month-old bracket than Blantyre ADD. In terms of anthropometric measurements, 24 - 35-month-olds from Mzuzu ADD were significantly heavier than their Blantyre ADD counterparts ($p = 0.04$).

Examination of the between-group effects showed that only WAZ ($F = 6.94$, $p = 0.001$) and WHZ ($F = 6.30$, $p = 0.001$) were significant, while HAZ was not ($F = 2.73$, $p = 0.066$). Results of multiple comparisons (Table II) showed that the mean WAZ was significantly higher in Mzuzu ADD than either Lilongwe ADD ($p = 0.001$) or Blantyre ADD ($p = 0.03$). However, the mean difference in WAZ between Lilongwe and Blantyre ADDs was not significant ($p > 0.05$). Similarly, mean WHZ for Mzuzu ADD was significantly higher than both Lilongwe ADD ($p = 0.021$) and Blantyre ADD ($p = 0.003$), with no discernible difference between Lilongwe and Blantyre ADDs ($p > 0.05$).

Prevalence of malnutrition

Results of the prevalence of stunting, underweight and wasting in each ADD are shown in Fig. 1. Overall, there were significant differences in underweight ($\chi^2 = 11.95$, $p = 0.003$) and stunting ($\chi^2 = 8.71$, $p = 0.013$). It was not possible to calculate the chi-square for wasting because of inadequate count in some cells. The prevalence of underweight was significantly lower in children from Mzuzu than Lilongwe ADD ($\chi^2 = 11.72$, $p = 0.0006$) and Blantyre ADD ($\chi^2 = 4.62$, $p = 0.03$). There was no significant difference between Lilongwe and Blantyre ADDs. For stunting, the results showed significant differences only between Mzuzu and Lilongwe ADDs ($\chi^2 = 8.61$, $p = 0.003$). There were no significant differences in severe underweight and stunting among the ADDs, although the rates were consistently lower in Mzuzu than either Lilongwe or Blantyre ADDs (data not shown). Severe wasting was non-existent in Mzuzu and Lilongwe ADDs, and negligible (0.5%) in Blantyre ADD.

The distributions of HAZ, WAZ and WHZ relative to the NCHS/WHO reference population are shown in Figs 2 - 4. Because of the high proportion of stunted children in the three ADDs, the HAZ curves are highly dispersed away from the reference population (Fig. 2). On the contrary, the low prevalence of wasting in all ADDs has shifted the curves close to the reference population (Fig. 4). The comparatively higher prevalence of undernutrition in children from Lilongwe ADD is evident as their distributions appear more dispersed to the left of the reference population than those of children from Blantyre and Mzuzu ADDs.

Discussion

Child malnutrition is a significant problem of public health concern in Malawi as a whole, particularly in rural subsistence farming households where the rates of underweight (23%) and stunting (52.5%)[9] are *high* to *very high* according to the World Health Organization classification.[7] This implies that the populations from which the samples were drawn are equally at risk of the consequences of malnutrition, which include increased morbidity and mortality[10] due to compromised immunity to infections.[11]

For more than 10 years, the prevalence of stunting has remained high and static in Malawian preschoolers: 48.7% in 1992,[3] 49% in 2000,[12] and 47.8% in 2004.[1] Similarly, the prevalence of wasting has not shown any improvements, with rates of 5.4%, 5.5% and 5.2%, respectively. However, underweight has been declining: 27.2% in 1992,[3] 24.5% in 2000,[12] and, 22% in 2004.[1] In the present study, we found that both stunting and underweight are significantly lower in Mzuzu ADD than Lilongwe and Blantyre ADDs. Demographically, the Northern region (which encompasses Mzuzu ADD) has a lower population density than the Central and Southern regions which encompass Lilongwe and Blantyre ADDs, respectively.[13] Furthermore, the Northern region has higher literacy levels, a lower incidence of malaria, a lower proportion of chronically ill persons, and a higher proportion of children who attend under-5 clinics than the other two regions.[14]

Table I. Demographic and anthropometric characteristics of children from Mzuzu, Lilongwe and Blantyre ADDs (mean ± standard deviation)

Children's characteristics	ADD: Mzuzu (*N* = 249)	ADD: Lilongwe (*N* = 163)	ADD: Blantyre (*N* = 186)	All ADDs (*N* = 598)	Significance
% female children	50.2	47.9	54.8	51.0	NS
Age (mo.)					
Mean	27.5 ± 14.7	28.7 ± 15.2	29.5 ± 13.6	28.5 ± 14.5	NS
Distribution (%)					
6 - 11 mo.	16.5	17.8	10.8	15.1	NS
12 -17 mo.	18.5	15.3	12.4	15.7	NS
18 - 23 mo.	10.8[a,b]	5.5[b]	13.4[a]	10.2	$p = 0.05$
24 - 35 mo.	24.5	28.2	30.1	27.3	NS
36 - 47 mo.	18.1	19.6	23.1	20.1	NS
48 - 59 mo.	11.6	13.5	10.2	11.7	NS
Anthropometric characteristics					
Mean height (cm)	80.7 ± 10.3	80.2 ± 10.2	81.7 ± 9.7	80.9 ± 10.1	NS
Mean weight (kg)	11.2 ± 2.7	10.9 ± 2.9	11.2 ± 2.7	11.1 ± 2.7	NS
Height distribution (cm) by age					
6 - 11 mo.	66.5 ± 3.4	66.7 ± 5.0	66.9 ± 4.1	66.6 ± 4.1	NS
12 -17 mo.	73.2 ± 4.0	72.2 ± 3.2	73.8 ± 4.4	73.1 ± 3.9	NS
18 - 23 mo.	77.4 ± 3.4	76.0 ± 4.9	76.6 ± 2.8	76.9 ± 3.4	NS
24 - 35 mo.	83.0 ± 3.5	82.1 ± 4.9	81.6 ± 0.3	82.3 ± 4.6	NS
36 - 47 mo.	89.9 ± 5.1	87.8 ± 4.8	89.6 ± 5.4	89.2 ± 5.2	NS
48 - 59 mo.	96.4 ± 4.7	94.0 ± 5.3	96.4 ± 4.3	95.7 ± 4.9	NS
Weight distribution (kg) by age					
6 - 11 mo.	8.0 ± 0.9	7.7 ± 1.3	7.7 ± 1.1	7.8 ± 1.1	
12 -17 mo.	9.3 ± 1.6	8.5 ±1.2	9.0 ± 1.4	9.0 ± 1.5	NS
18 - 23 mo.	10.3 ± 1.4	9.4 ± 1.8	9.7 ± 1.4	9.9 ±. 1.5	NS
24 - 35 mo.	11.8 ± 1.1[a]	11.3 ± 1.7[a, b]	11.1 ± 1.8[b]	11.4 ± 1.5	$p = 0.04$
36 - 47 mo.	13.3 ± 1.6	13.2 ± 1.8	13.5 ± 1.7	13.3 ± 1.7	NS
48 - 59 mo.	15.4 ± 1.7	14.5 ± 2.1	14.8 ± 1.2	14.9 ± 1.7	NS

Mean differences were examined using one-way ANOVA; proportional differences by chi-square. Within the same row, means with different superscripts are significantly different at $p < 0.05$.

NS = non-significant.

Table II. Mean differences in z-scores of children from Mzuzu, Lilongwe and Blantyre ADDs

Nutritional status indicator	ADD: Mzuzu (*N* = 249)	ADD: Lilongwe (*N* = 163)	ADD: Blantyre (*N* = 186)	All ADDs (*N* = 598)
Mean HAZ (95% CI)	–1.93 (–2.07, –1.79)	–2.23 (–2.43, 2.02)	–2.04 (–2.23, –1.84)	–2.04 (–2.14, –1.94)
Mean WAZ (95% CI)	–1.04 (–1.17, –0.91)[a]	–1.43 (–1.61, –1.25)[b]	–1.32 (–1.48, –1.15)[b]	–1.23 (–1.32, –1.14)
Mean WHZ (95% CI)	0.22 (0.10, 0.34)[a]	–0.04 (–0.20, 0.11)[b]	–0.09 (–0.23, 0.05)[b]	0.05 (–0.03, 0.13)

Mean differences were examined using one-way ANOVA. Within the same row, means with different superscripts are significantly different at $p < 0.05$. Pairwise comparisons were adjusted for multiple comparisons using Bonferroni *post hoc* tests.

Considering that malnutrition has many underlying causes such as insufficient access to food, inadequate maternal and child care, poor water and sanitation, and inadequate health services,[15] it appears that, comparatively, children from Mzuzu ADD are less affected by the socio-economic insults in their agro-ecological zone than their Lilongwe and Blantyre ADD counterparts. This could explain the relatively lower prevalence of stunting and underweight in Mzuzu than Lilongwe and Blantyre ADDs.