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RESEARCH

Estimated burden of aggregate anthropometric failure among Malawian children

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Background: The prevalence and trends of undernutrition among children below the age of five in Malawi are well known from a conventional (stunting, wasting and underweight) but not aggregate indicator perspective.
Objective: A study was undertaken to estimate the burden of undernutrition among Malawian children below the age of five, using the Composite Indicator of Anthropometric Failure (CIAF), which enables determination of an aggregate burden of malnutrition.
Setting: The study used secondary data from the Malawi Demographic and Health Surveys (MDHS) of 1992, 2000, 2004 and 2010.
Subjects: The subjects were caregivers and under-five children as sampled in the respective MDHS years considered for this study.
Method: The study employed CIAF as an alternative approach to describe undernutrition in four cohorts of Malawian children, in contrast to the more common evaluation of stunting, wasting and underweight. CIAF identifies seven mutually exclusive groups of possible anthropometric status in a population of children, with six of them representing potential anthropometric failure and the seventh group encompassing children not affected by any form of undernutrition. CIAF was calculated by difference, taking into account those children who did not reflect any form of undernutrition. CIAF was applied on four data sets from the Malawi Demographic and Health Surveys (MDHS) of 1992 ($n = 3\,174$), 2000 ($n = 10\,102$), 2004 ($n = 8\,934$) and 2010 ($n = 4\,586$) to generate anthropometric failure values.
Results: Until the 2010 MDHS, which registered a 51% value, the prevalence of CIAF approximated 59% in 1992, and 57% in both 2000 and 2004. These values are much higher than the prevalence of underweight (< 24%, in all years), a conventional indicator currently used as a proxy aggregate measure of undernutrition.
Conclusions: Compared with CIAF, conventional anthropometric indicators seriously underestimated the prevalence of anthropometric failure among Malawian children. This is due to the fact that CIAF gives an aggregate estimate of anthropometric failure, hence it is a better indicator of the magnitude of undernutrition. There is need for CIAF to be integrated in routine nutrition assessments, and it is suggested that cut-off values to assess the degree of its severity be developed to make it more relevant.

Keywords: anthropometric failure, composite, underestimation

Introduction

Changes in body dimensions reflect the aggregate health and welfare of individuals and populations, hence anthropometry is used to assess and predict their performance, health and survival.[1] Although the most common anthropometric indicators of stunting (height-for-age), underweight (weight-for-age) and wasting (weight-for-height) reflect distinct biological processes, none of them is able to give an aggregate estimate of undernutrition in a population, because they overlap.[2] This has important implications for policy-makers and organisations seeking to meet international targets in nutrition, because they miss out on a platform on which to base and evaluate nutrition interventions as well as to decide on the extent of their coverage.[3] More importantly, using underweight as an aggregate indicator underestimates the seriousness of undernutrition because it is a product of stunting and wasting, and not their sum.[3]

Against the above background, in 2000, Peter Svedberg developed a model that classifies undernutrition into mutually exclusive groups, enabling the determination of aggregate prevalence of child undernutrition.[3] The model, known as the Composite Indicator of Anthropometric Failure (CIAF), identifies six groups used to classify undernutrition as follows: A (no anthropometric failure), B (wasting only), C (wasting and underweight), D (wasting, stunting and underweight), E (stunting and underweight) and F (stunting only).The seventh group (underweight only, Y) was added by Nandy in 2005. CIAF is calculated by aggregating CIAF subcategories from B through Y or subtracting group A from the summation of all the other groups. CIAF not only provides the burden of under-nutrition of a population as a single measure but also helps in detecting children with multiple anthropometric failures for targeted interventions.[4]

Opponents of CIAF have argued that its usefulness has to be carefully considered vis-à-vis the widely used conventional classifications before being adopted, claiming that it does not necessary address the limitations of the conventional classification such as being able to satisfy the long-felt need for a combined clinical and anthropometric classification that would be useful for clinical as well as community health work.[5] However, they observe that CIAF is welcome in view of the paucity of recent attempts to classify undernourished children satisfactorily.

Countries such as India, China and Bangladesh have adopted the CIAF model to redefine nutrition situations in their countries to better inform nutrition programming. In Malawi, where child undernutrition remains a significant public health problem, CIAF presents an opportunity to reinvestigate the prevalence and trends of child undernutrition from an aggregate perspective, in order to inform decisions of the national nutrition response. It is in light of the above that this study was conducted to assess the prevalence and trends of aggregate anthropometric failure in Malawi, using the CIAF model.

Method

The study used the Malawi Demographic and Health Survey (DHS) data sets of 1992 (*n* = 3 174), 2000 (*n* = 10 102), 2004 (*n* = 8 934) and 2010 (*n* = 4 586) employing the CIAF model[3] to determine the aggregate burden of anthropometric undernutrition. The DHS is a national socio-demographic survey that collects information based on a stratified two-stage cluster sampling design. Some of the information collected includes anthropometry, feeding practices, vaccination status, birth interval, childhood morbidity and mortality, use of maternal and child health services, and mother's background information on under-five children.

For all the Malawi demographic and health surveys (MDHS), districts from the northern region and urban areas were oversampled to take into account the smaller population size in these areas, and sample weights were applied to correct for oversampling.[6–9] In all four instances, the DHS data sets used were hierarchical in nature, and a list of households from selected clusters represented the sampling frame for the selection of households to participate in the survey. The clusters (groupings of households) at the top were the primary sampling units also known as communities or enumeration areas from which households were selected. Below the clusters were the households with children under the age of five. Below the households were the number of under-five children from each survey. At the lowest level were the number of children with weight for age, weight for height, and height for age z-scores. In 1992, 5 000 households were selected for interviews, while 13 220 were selected in 2000, and 15 091 and 27 307 were included in the 2004 and 2010 MDH surveys, respectively.

To standardise field work, NSO recruited and trained several people to serve as supervisors, field editors, female and male interviewers, reserve interviewers, and quality control interviewers.[6–9] The training course consisted of instructions regarding interviewing techniques and field procedures, a detailed review of items on the questionnaires, instruction and practice in weighing and measuring children, mock interviews between participants in the classroom, and practice interviews with real respondents. Senior staff members from NSO, ICF Macro resident advisers and consultants coordinated and supervised field-work activities.

In terms of anthropometry, DHS measured children's heights and weights in all sampled households regardless of whether their caregiver was interviewed or not. Data were collected to enable construction of conventional indices—height-for-age, weight-for-age, and weight-for height—to enable construction of three indicators: stunting, wasting and underweight. In pursuance of the objectives of this study, mean z-scores were calculated from the standard deviations of the aforementioned indices that were already available in the DHS files, using the WHO 2006 growth standards as a reference point. For all the data sets, weight measurements were obtained using a SECA mother–infant scale that has a digital screen, designed and manufactured under the guidance of UNICEF.[6–9] Further, height measurements were conducted using a measuring height/length board. Children younger than 24 months were measured lying down on the board (recumbent length), and standing height was used for older children.

The following calculations were done in Stata® version 12 (StataCorp, College Station, TX, USA) to obtain the z-scores: (1) weight-for-age = [(weight of subject) / (weight of a normal child of the same age)] * 100; (2) height-for-age = [(height of subject) / (height of a normal child of the same age)] * 100; and (3) weight-for-height = [(weight of subject)/ (weight of normal child of the same height)*100. The z-scores were then used to construct the conventional indicators of undernutrition (stunting, wasting and underweight), CIAF and its seven subcategories. CIAF was calculated by difference taking into account those children who did not reflect any form of undernutrition. Data were weighted due to probability proportion to size used during the respective surveys to come up with representative means and percentages.[10] After excluding outliers and children with incomplete and missing values (pooled total of 4 033), a pooled sample of anthropometric values for 26 796 under-fives was analysed.

Results

Table 1 summarises the demographic characteristics of the children. Across the surveys, there were notable differences in sample size and residence, while other variables were comparable.

In terms of specific anthropometric failure types, the percentage of children without any form of undernutrition increased slightly between 1992 and 2004 and sharply in 2010 (Table 2). Further, most of the children were in anthropometric failure due to stunting only (> 34% across all years), followed by those suffering from a combination of stunting and underweight (> 9% in all years). A few children (< 4%) were in anthropometric failure due to being concurrently stunted, wasted and underweight, while less than 1% were underweight only.

The CIAF analysis produced worryingly higher (> 50 % in all years) estimated values of undernutrition (Figure 1), which were

Table 1: Demographic characteristics of under-five children in the 1992, 2000, 2004 and 2010 Malawi Demographic and Health Surveys

Characteristic	1992 MDHS (***n*** = 3 174)	2000 MDHS (***n*** = 10 102)	2004 MDHS (***n*** = 8 934)	2010 MDHS (***n*** = 4 586)
Region (%)				
North	30.37	17.80	12.78	17.18
Central	34.69	38.30	37.46	37.13
South	34.94	43.90	49.75	45.68
Residence (%)				
Urban	24.95	18.40	10.43	9.94
Rural	75.05	81.60	89.57	90.06
Household head sex (%)				
Male	83.30	79.20	81.05	91.89
Female	16.70	20.80	18.95	8.11
Child sex (%)				
Male	49.97	49.90	50.82	49.56
Female	50.03	50.10	49.18	50.44
Age groups in months (%)				
0–6	15.15	14.90	13.86	9.81
7–12	13.07	12.20	12.54	10.31
13–23	19.41	19.30	21.34	20.98
24–35	18.37	19.70	17.36	20.21
36–59	33.99	33.80	34.90	38.68

Data sources: NSO (Malawi) and ORC Macro.[6–9]

Table 2: Categories of the Composite Indicator of Anthropometric Failure

CIAF category	1992 (*n* = 3 174)	2000 (*n* = 10 102)	2004 (*n* = 8 934)	2010 (*n* = 4 586)
No failure (%)	41.0	42.8	42.6	49.4
Wasting only (%)	1.1	1.8	2.4	1.7
Wasting and underweight (%)	2.0	1.9	1.9	1.1
Wasting, stunting and underweight (%)	3.3	2.1	1.6	1.3
Stunting and underweight (%)	17.6	13.9	12.6	9.6
Stunting only (%)	34.0	36.6	38.2	36.2
Underweight only (%)	0.7	0.7	0.7	0.7
CIAF, *n* (%)	1 873 (59.0)	5 758 (57.2)	5 092 (57.3)	2 293 (50.6)
Total (%)	100.0	100.0	100.0	100.0

Data sources: NSO (Malawi) and ORC Macro.[6–9]

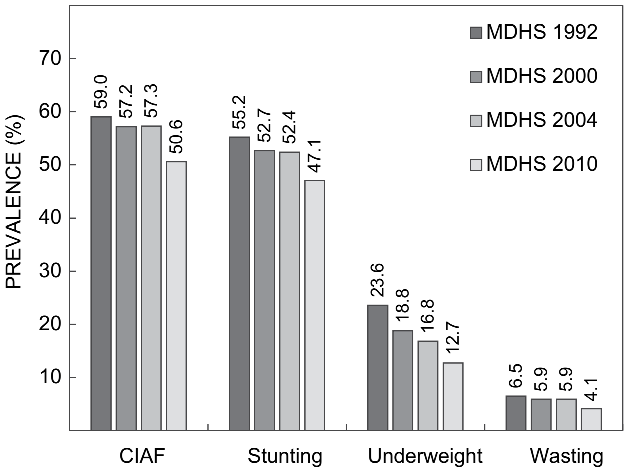

Figure 1: Trends of anthropometric failure in Malawi, 1992–2010.

largely stagnant across the DHS years of 1992, 2000 and 2004. However, there was a considerable decrease in anthropometric failure in 2010, representing an eight and six percentage point decrease in comparison with 1992 and 2004, respectively.

The estimate for levels of undernutrition based on conventional indicators (Figure 1) was similar to those reported by the NSO through its DHS series and other analysts,[11] using the 2006 WHO growth standards. Notably, stunting remained stagnant across the four time points, except that it decreased considerably between 2004 and 2010. Underweight decreased at a decreasing rate, while the prevalence of wasting decreased slightly with each additional MDHS year.

Discussion

The study employed CIAF as an alternative approach to describe malnutrition in four cohorts of Malawian children, in contrast to the more common evaluation of stunting, wasting and underweight. To the best of the researchers' knowledge, this is the first time that CIAF has been computed for Malawi, using large nationally representative datasets from as far back as 1992. Unlike others who also computed CIAF in various countries,[2,13,14,15,16] our retrospective approach gives a clear understanding of trends, hence enabling tracking of progress of changes in undernutrition in this context.

In this study, consistently high and worrying trends of anthropometric failure (> 50%) among under-five children in all years (59% in 1992, 57% in 2000 and 2004, and 51% in 2010) have been noted. Thus, unlike the use of conventional anthropometric indices, whose generally acceptable combined indicator of anthropometric failure, underweight, showed the highest prevalence of 24% in 1992, and was lower in other years, the CIAF gives estimates of more than 50% prevalence across all years.

In terms of different forms of anthropometric failure within CIAF, a majority of children were in anthropometric failure as a result of being stunted, which is in line with several other DHS studies[6–9,11,12] that also concluded that stunting remains the greatest form of undernutrition in the country. Therefore, current efforts to address malnutrition within the first 1000 days, with stunting as an entry point, have great potential to reduce undernutrition.

The observed CIAF values are marginally lower compared with other nationally representative surveys. An Indian study 3 used CIAF on a nationally representative sample of 24 396 children and found 60% of them to be in anthropometric failure. A study in Bangladesh[13] constructed and applied CIAF to 5 258 children (1 831 from urban and 3 427 from rural areas) in the 2007 BDHS (Bangladesh Demographic and Health Survey). The study established that 47% and 58% of children from urban and rural areas, respectively, were in anthropometric failure.

Though not comparable to the current one, studies that have applied CIAF at subnational levels in other countries have established a much higher prevalence of anthropometric failure. An Indian study[16] used a district representative sample of 1 012 children in West Bengal and found that 73.1% of children were in anthropometric failure according to CIAF, as opposed to 63.3 % that were underweight. In addition, another study also conducted in India used CIAF on 117 children from a slum location in Bankura, and found a prevalence as high as 80.3% among its study population.[14] As in the present study, the aforementioned studies also demonstrated that CIAF undoubtedly addresses the lack of an aggregate measure of undernutrition observed in the current conventional indicators. More importantly, it has been emphasised that the underweight indicator, mostly used to represent aggregate undernutrition, does indeed underestimate its seriousness. However, it must be noted that CIAF does not take into account children who are overweight and obese. This is a serious limitation given the increase in this category of malnutrition across developing countries like Malawi.

Conclusions

It is evident from this study that Malawi has had a serious problem of anthropometric failure as evidenced by CIAF. The study corroborates earlier studies, in which the authors argued that using underweight as the main criterion for assessing the magnitude of undernutrition underestimates the magnitude of the problem of undernutrition. Given the growing evidence on assessing anthropometric failure using CIAF as a more comprehensive indicator, there is a need to develop cut-offs to determine its public health significance, especially with regard to informing policy-makers about the actual magnitude of undernutrition. It is being recommended that the inclusion of

CIAF as a nutrition indicator be seriously considered in nutrition programming at national as well as other levels of implementation, as it truly addresses the long-felt need for an aggregate anthropometric indicator.

Conflict of interest – The authors have no conflict of interest to declare.

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