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Original

Determinants of nutritional status in children under five living in a rural area of Mozambique: a population survey

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Abstract

Background: Malnutrition in sub-Saharan Africa contributes to high rates of childhood morbidity and mortality. Little information is available regarding moderate malnutrition prevalence in children under five in rural areas.

Methods: To assess nutritional status and the prevalence of malnutrition in children from Ibo Island, Mozambique, a nutritional population survey in children under 5 years was carried out. A structured questionnaire was administered from April 2009 to February 2010. Anthropometric measurements were recorded as z-scores and child nutritional status derived from the World Health Organization Child Growth Standards (WHO) reference population.

Results: 3313 people on Ibo were identified and interviewed and nutritional assessment was carried out in the 526 children under five. Most children had been fully vaccinated (90.5%), breastfed (100.0%), and some were also bottle fed (22.0%). The mean duration of the different feeding regimes were 20.3 ± 4.47 months for breastfeeding, 2.5 ± 0.8 months for exclusive breastfeeding and 3.2 ± 4.0 months for bottle feeding. The mean number of daily meals across the child age range was 2.3 ± 0.5. More stunted children had been exclusively breastfed than mixed fed (p = 0.058). Severe stunting was more likely in children in the ≤ 11 (26.3%) and 12-23 (21.2%) month age groups (p = 0.007). 13.5% of severely stunted children had not been fully vaccinated (p = 0.014), 72.7% ate unassisted (p = 0.013) and 64.8% had their own dish to eat from (p = 0.001) compared to the non-stunted group. More children from the 46-60 month age group (27.7%) were underweight compared to the other groups (p = 0.047).

Conclusions: moderate and severe malnutrition, especially stunting, in children under five in a rural setting in

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DETERMINANTES DEL ESTADO NUTRICIONAL EN NIÑOS MENORES DE CINCO AÑOS QUE VIVEN EN UNA ZONA RURAL DE MOZAMBIQUE: UNA ENCUESTA DE POBLACIÓN

Resumen

Fundamentos: La desnutrición en el África subsahariana contribuye a las elevadas tasas de morbilidad y mortalidad infantil, disponiéndose de poca información sobre la prevalencia moderada de la malnutrición en niños menores de cinco años de las zonas rurales.

Métodos: se realizó una encuesta nutricional de población en niños menores de 5 años, para evaluar el estado nutricional y la prevalencia de malnutrición en los niños de Ibo Island, Mozambique. Se administró un cuestionario estructurado de abril de 2009 a febrero de 2010. Las medidas antropométricas se registraron como puntuaciones z y el estado nutricional de los niños se obtuvo de acuerdo a las referencias de la Organización Mundial de la Salud (OMS) para el Crecimiento Infantil.

Resultados: 3313 personas en Ibo fueron identificadas y entrevistadas. Se realizó una evaluación nutricional en los 526 niños menores de cinco años. La mayoría de los niños habían sido totalmente vacunados (90,5%), amamantados (100,0%) y algunos también alimentados con biberón (22,0%). La duración media de los diferentes regímenes de alimentación fue de 20,3 ± 4,47 meses para la lactancia materna, 2,5 ± 0,8 meses para la lactancia materna exclusiva y 3,2 ± 4,0 meses para la alimentación con biberón. El número medio de comidas diarias en el rango de edad de los niños fue de 2,3±0,5. Los niños más atrofiados habían sido alimentados exclusivamente con leche materna que los alimentados con leche materna (p = 0,058). El retraso en el crecimiento fue más probable en los niños en los grupos ≤ 11 (26,3%) y 12-23 (21,2%) meses (p = 0,007). El 13,5% de los niños gravemente atrofiados no habían sido vacunados totalmente (p = 0,014), el 72,7% no asistió (p = 0,013) y el 64,8% tenía su propio plato para comer (p = 0,001) en comparación con el grupo no atrofiado. Más niños del grupo de edad de 46-60 meses (27,7%) tenían peso inferior al de los otros grupos (p = 0,047).

Conclusiones: la malnutrición moderada y severa, especialmente el retraso en el crecimiento, en niños menores de

Mozambique are still prevalent. Strategies to tackle this problem are required.

Key words: *Desnutrición. Trastornos del crecimiento. Síndrome debilitante. Mozambique.*

cinco años en un entorno rural en Mozambique siguen siendo frecuentes. Se requieren estrategias para abordar este problema.

Palabras clave: *Malnutrition. Growth disorders. Wasting syndrome. Mozambique.*

Introduction

Childhood malnutrition is still a public health challenge, particularly in low and middle-income countries, contributing to over a third of all deaths in children under five[1]. Worldwide, about 2.2 million children die annually, with poor nutritional status as an underlying cause[2]. According to the Global statistics of WHO in 2014 approximately 158.6 million children were stunted, 66.3 million were wasted and 95.5 million were underweight[3].

Nutritional status of children under five is an indicator of household well-being and a determinant of child survival[4]. Malnutrition is the most recognisable consequence of poverty and disease in children[5] that are especially vulnerable because they are affected during the critical growth process.

The three main indicators of malnutrition: wasting, stunting and underweight provide information on different aspects of a child's nutritional history. Low weight-for-height (wasting), an indicator of thinness, is generally associated with recent illness and loss of weight. In the first 2-3 years of life, linear growth retardation (stunting) is the result of poor energy and nutrient intakes, as well as infection, and is frequently associated with repeated exposure to poverty and poor sanitation. Low weight-for-age (underweight) indicates a history of poor health, including recurrent illness and/or starvation[6].

The Sixth Report on the World Nutrition Situation[7] showed that the global prevalence of malnutrition is still extremely high. Child malnutrition is a persistent problem in sub-Saharan Africa[8]. In 2015, The Millennium Development Goal 1 (MDG1) is still major concern in Africa and especially in Eastern region that remains the subregion with the biggest hunger problem where 124 million undernourished people being at home[9].

The burden of malnutrition in children under 5 in Mozambique, Southeast Africa increased between 2008 and 2011. Wasting, stunting, and underweight prevalences in children from the 2011 National Health Survey were 5.9%, 42.6%, and 15.9% respectively[10,11], and therefore seriously need to be tackled. Results from this survey are difficult to extrapolate to some specific areas such as rural islands.

Ibo is located in the Quirimba's islands, in Cabo Delgado province, in Northeastern Mozambique. Originally developed as a Muslim trading port, the island was a Portuguese colony from 1609 until 1975 when Mozambique became independent. During the colonialism period, Ibo was the main harbour of Northern Mozambique trading with India, Africa and Europe[12]. Current islanders are mainly from the Moaní ethnic group and Muslims. Subsistence agriculture (mainly maize, millet, cassava and some vegetables and fruits), animal farming (mainly chicken and goats) and fishing are their main sources of food and income. The characteristics, supplies and accessibility of the island are different to those of the mainland. Access is mainly by boat and depends on the weather and tides. Ibo is divided into four neighbourhoods: Cemento, Cumuamva, Rituto and Kirambo. Cemento is the main neighbourhood, close to the sea, with cement houses that remain from the Portuguese colonisation. Cumuamva and Rituto are the most crowded and Kirambo is at the other side of the mangrove swamps. Ibo has a primary health care centre (PHCC - Posto de Saúde) with a malnutrition prevention service that includes treatment with "plumpy nut" (a peanut-based paste) for severe but not for moderate malnutrition. The PHCC medication and supply stocks frequently run out due to transport difficulties from the mainland.

The aim of this study was to assess the nutritional status and the prevalence of malnutrition in the children under five from a rural insular area in Mozambique of poor access, and to identify family and household related determinants of malnutrition.

Material and methods

Ethical approval

The protocol was reviewed and approved by the Bioethics Committee Board of the Ministry of Health in Maputo (nº IRB00002657).

Population survey

This cross-sectional study was conducted in Ibo Island, between April 2009 and February 2010.

QuickBird satellite imagery was used to digitalise buildings and field maps were then produced, in which each of these was identified by a unique number. Fieldworkers visited each building and recorded what it was and whether it was inhabited. If so, all individuals living there were counted and assigned a unique personal identification number. This was used throughout the study to link information for each individual from the household surveys with that collected at the clinic. All of the 724 households that were counted were visited and interviewed. Birth dates (from national identity or health cards) were recorded.

A week-long intensive training period was held by 4 field workers to standardise the methods used for data collection, including anthropometric measurements.

They carried out home visits that were repeated until all household members had been interviewed. The household head gave informed consent for home-visits. Every child under five in Ibo was successfully included in the study. 526 children (230 boys and 296 girls) aged below 60 months were studied, 51 were under 6 months. Intra- and inter-observer coefficient of variability in anthropometric measurements no greater than 5% was ensured. No significant tendency towards biased measurements was identified in any of the field workers. The field worker was responsible for data verification and recording. Every day the principal investigator and study coordinator, a nutritionist, revised the anthropometric data. When an error was detected the nutritionist informed the field worker and ensured that the measurement was repeated. The following steps were taken during the training period and throughout the field work of the study to minimize errors in anthropometric data: the portable weighing scales were calibrated daily and insertion tape measurements were verified against a fixed measure, weekly.

A structured questionnaire on current household demographics, socioeconomic factors, food security, adolescent and child morbidity with a recall period of three months, household member characteristics and infant feeding regimes with a maximum recall period of five years, was administered to the head of the family (mother). It was designed to obtain information about social group composition (number of adults, adolescents and children), parental education and employment, household characteristics (type of home, construction materials, amenities such as toilet, protected water and electricity, size, farming activities), and pregnancy histories. The questionnaire consisted of 292 questions divided into the following sections: personal information, education, employment history, child clinical and vaccination history, child dietary habits, household meal frequency the previous day and home cultivation.

A trained nutritionist supervised the weight and height measurements of the children following WHO standard procedures[13]. Length (cm) was measured in children under 24 months using a recumbent length board (Crown, London, UK); and height (cm) was measured for older children without shoes to the nearest centimetre. Weight was measured in light clothing to the nearest 0.1 Kg using portable scales (Seca Model 881) that were checked and calibrated every morning with standard weights. Children who could not stand on the scales were weighed in their caretaker/respondent's arms, and their weight was obtained by subtracting the respondent's weight from the total weight.

Data analysis

Weight-for-height (WHZ), height-for-age (HAZ) and weight-for-age (WAZ) z-scores were calculated according to the WHO Child Growth Standards 2006 (14) and used as indicators of wasting, stunting and underweight respectively. Moderate and severe malnutrition were defined as WHZ, HAZ and WAZ and <-2 z-scores and <-3 z-scores respectively.

Breastfeeding regimes (exclusive breastfeeding or mixed feeding) as well as the duration of breastfeeding, exclusive breastfeeding or bottle feeding were recorded for all of the children that had finished any of the breastfeeding regimes.

Quantitative data are reported as means and standard deviation (SD) and qualitative data as percentages. A bivariate comparison of household and maternal variables between the different malnutrition groups were performed using the Chi-square test.

This test was also used to compare degrees of malnutrition between sexes within each age group. Variable categories were combined when necessary to fulfil the requirement (expected frequency ≥ 5 in each group) to apply this test. Logistic regression models were used to confirm the household and maternal risk factors for malnutrition with multivariate analysis. Six models were fitted: one for each of the three malnutrition criteria (HAZ, WAZ, and WHZ) and for each of the two degrees of malnutrition (moderate and severe). The independent variables included in the models were: age group, feeding regimes, unassisted eating, own dish, vaccination and the Household Economic Status Index (HESI). Due to some degree of colinearity between these variables, the forward inclusion criteria, based on the Wald statistic, was used to select those finally included in the models. ANOVA was used to compare means of quantitative variables between the three degrees of nutritional status. The Household Economic Status was assessed using an index derived from principal components analysis as previously described[15]. The variables included were: ownership of television, fridge, matrass, farm animals, mobile phone or bicycle. Other factors considered were home gardening, number of rooms/house, access to water, energy supplies, toilet, cooking fuel and household material. The scores from the first component were categorised into quintiles of household economic status index representing: very low, low, middle, high and very high[16].

The significance level was set at $p < 0.05$. Data was double entered by two independent researchers and analysed using SPSS 20 for Windows (SPSS Inc., Chicago, IL).

Results

The total population surveyed was 3313 (53.5% female, mean age of 22.6 ± 19.7 years). Most lived in the Rituto neighbourhood (49.0%) and nearly 60.0% of them had primary schooling. The main reported occupation was fishing (27%) and most were monogamists (87%).

Table I summarises the household characteristics by neighbourhood. A total of 724 households were identi-

Table I
Household characteristics by neighbourhood

	Total n (%)	*Cemento n (%)*	*Rituto n (%)*	*Cumuamwa n (%)*	*Kirambo n (%)*	*p-value*
Household						< 0.001
Economic Status Index	163 (22.6)	1 (1.1)	86 (23.6)	30 (14.8)	46 (74.2)	
Very low	145 (20.1)	13 (14.0)	70 (19.2)	52 (25.6)	10 (16.1)	
Low	147 (20.4)	15 (16.1)	84 (23.1)	44 (21.7)	4 (6.5)	
Middle	129 (17.9)	21 (22.6)	71 (19.5)	35 (17.2)	2 (3.2)	
High	138 (19.1)	43 (46.2)	53 (14.6)	42 (20.7)	0 (0.0)	
Very high						< 0.001
Meals/Day						
≤ 2	382 (69.1)	38 (51.4)	210 (75.8)	102 (64.6)	32 (72.7)	
≥ 3	171 (30.9)	36 (48.6)	67 (24.2)	56 (35.4)	12 (27.3)	
Number of family members						0.058
< 4	273 (37.7)	31 (33.3)	141 (38.7)	76 (37.1)	25 (40.3)	
4-7	368 (50.8)	50 (53.8)	190 (52.2)	94 (45.9)	34 (54.8)	
>7	83 (11.5)	12 (12.9)	33 (9.1)	35 (17.1)	3 (4.8)	

n: Number of participants (%); p-value from chi-square test for differences between neighbourhoods.

fied, within four neighbourhoods. There were significantly differences between neighbourhoods based on the Household Economic Status Index (HESI), 74.2% of the households in Kirambo were in the lowest quintile, nevertheless 46.2% in Cemento were in the higher quintile ($p < 0.001$). Meals per day were significantly different between neighbourhoods, 75.8% of the Rituto's households took ≤2 meals per day comparing to 51.4% in Cemento's. However, 24.2% in Rituto took ≥ 3 meals per day, comparing to Cemento with a 48.6% of the households ($p < 0.001$).

Child nutritional and health characteristics by age group are shown in table II. 526 children were under five years old and 56.3% were girls. The majority were up to date on their vaccinations (90.5%) and all of them had been breastfed. 22.0% had been bottle fed at some time and 11.6% exclusively breastfed (no water, tea or medication) for at least 4 months or more. 88.2%[45] of the children under 6 months were being exclusively breast fed and 11.8%[6] bottle fed. Significantly more were bottle fed in Cumuamba (32.4%) and Rituto (17.6%) ($p < 0.001$), (data not shown). The mean (± SD) length of breastfeeding was 20.3 ± 4.47 months, exclusive breastfeeding lasted 2.5 ± 0.8 months, bottle feeding 3.2 ± 4.0 months and the mean number of daily meals was 2.3 ± 0.5.

Approximately, 67.3% of the children had received food specially prepared for them after breastfeeding (weaning period), 80% fed themselves with no help and 53% had their own dish of food to eat from. 67.3% of the children that were ill in the previous 3 months had received primary health care assistance and the most prevalent sign of disease was fever of unknown origin (36.4%).

The prevalence of wasting, stunting and underweight by sex and age group is outlined in table III and did not differ overall between sexes or within the age groups. The overall prevalence of wasting, stunting and underweight (< -2 SD) was 13.4%, 49.8% and 22.7% respectively. The prevalence of moderate wasting (from WHZ < -2 SD to ≥ -3 SD) was 7.2% and 6.2% of the children had severe wasting (WHZ < -3 SD). The prevalence of moderate plus severe wasting increased with age, peaking in children aged 48-60 months (22.4%). As previously stated, there was no significant association between degree of wasting and sex in this age group ($p = 0.698$).

34.2% of the children were severely stunted and 15.6% moderately stunted. Stunting prevalence was highest in children aged 12-23 months though not significantly different between sexes in this age group ($p = 0.913$).

13.7% of the children were moderately underweight while 9% were severely underweight. The prevalence of moderate plus severe underweight was highest in children aged 36-47 months (29.4%) and there was no difference between sexes in this age group ($p = 0.673$). Boys were more malnourished than girls (wasting, stunting and underweight) though not significantly so.

Table IV shows the determinants of child, maternal and household characteristics associated with nutritional status (wasting, stunting, and underweight) in the children. Most mothers had a partner, had primary school education, worked at home and were financially dependent. The mean (± SD) maternal age was 24.9 ± 5.6 years, number of previous pregnancies 3.5 ± 2.1 and number of times married 1.6 ± 0.8, (data not shown).

Child (age group, feeding regimes, feeding themselves, feeding from their own dish, meals/day, vaccination), maternal (educational level, marital status, age, occupation, parity) and household (Economic Status Index) determinants, as well as paternal educational level, were not significantly associated with wasting categories in the children. Not all of the determinants were associated with stunting in the children. However, more

Table II
Child nutritional and health characteristics by age group (months)

Age (months)	*Total 526 (100)**	*< 6 51 (9.7)*	*6-11 46 (8.7)*	*12-23 102 (19.4)*	*24-35 100 (19.0)*	*36-47 110 (20.9)*	*48-60 117 (22.2)*	*p-value*
Sex: Female	296 (56.3)	30 (58.8)	27 (58.7)	60 (58.8)	50 (50.0)	66 (60.0)	63 (53.8)	0.698
Up to date vaccination	474 (90.5)	37(75.5)	38 (82.6)	92 (92.1)	92 (92.9)	103 (93.6)	112 (95.7)	< 0.001
Breastfed¨	315 (100)	–	–	–	94 (100.0)	109 (100.0)	112 (100.0)	–
Duration breastfeeding (months)**								0.512
1-12	19 (6.1)	–	–	–	9 (9.6)	4 (3.7)	6 (5.5)	
13-18	84 (26.8)	–	–	–	25 (26.6)	29 (26.6)	30 (27.3)	
> 18	210 (67.1)	–	–	–	60 (63.8)	76 (69.7)	74 (67.3)	
Bottle fed¨	69 (22.0)	–	–	–	18 (19.4)	26 (24.1)	25 (22.3)	0.721
Duration bottle feeding (months)**								0.173
1-2	52 (75.4)	–	–	–	14 (77.8)	16 (61.5)	22 (88.0)	
3-4	5 (7.2)	–	–	–	1 (5.6)	4 (15.4)	0 (0.0)	
5-6	0 (0.0)	–	–	–	0 (0.0)	0 (0.0)	0 (0.0)	
> 6	12 (17.4)	–	–	–	3 (16.7)	6 (23.1)	3 (12.0)	
Exclusively breastfed¨	299 (94.9)	–	–	–	89 (94.7)	103 (94.5)	107 (95.5)	0.932
Duration exclusive breastfeeding (months)¨								0.925
1	16 (5.3)	–	–	–	4 (4.4)	7 (6.7)	5 (4.6)	
2	95 (31.5)	–	–	–	31 (34.4)	32 (30.8)	32 (29.6)	
3	156 (51.7)	–	–	–	45 (50.0)	55 (52.9)	56 (51.9)	
≥ 4	35 (11.6)	–	–	–	10 (11.1)	10 (9.6)	15 (13.9)	
Special food after breastfeeding	330 (67.3)	11 (50.0)	20 (46.5)	65 (63.7)	73 (74.5)	77 (71.3)	84 (71.8)	0.006
≤2 Meals/day	330 (67.2)	15 (65.2)	23 (52.3)	63 (62.4)	74 (75.5)	65 (60.2)	90 (76.9)	0.007
Own dish to eat	260 (53.0)	9 (40.9)	23(52.3)	45 (44.1)	58 (59.2)	61 (56.5)	64 (54.7)	0.244
Eating unhelped	393 (80.0)	8 (36.4)	9 (20.5)	74 (72.5)	88 (89.8)	100 (92.6)	114 (97.4)	<0.001
Health care hospital attendance	76 (67.3)	5 (100.0)	12 (75.0)	21 (61.8)	9 (60.0)	14 (70.0)	15 (65.2)	0.578
Main diseases								0.240
Malaria	31 (29.0)	0 (0.0)	5 (31.2)	10 (31.2)	4 (25.0)	7 (38.9)	5 (25.0)	
Diarrhoea	24 (22.4)	2 (40.0)	7 (43.8)	9 (28.1)	0 (0.0)	1 (5.6)	5 (25.0)	
Measles	4 (3.7)	0 (0.0)	0 (0.0)	1 (3.1)	2 (12.5)	0 (0.0)	1 (5.0)	
Fever of unknown origin	39 (36.4)	2 (40.0)	4 (25.0)	11 (34.4)	8 (50.0)	7 (38.9)	7 (35.0)	
Others	9 (8.4)	1 (20.0)	0 (0.0)	1 (3.1)	2 (12.5)	3 (16.7)	2 (10.0)	
Number of disease episodes (last 3 months)¶								0.023
0	395 (75.8)	44 (88.0)	28 (62.2)	64 (63.4)	80 (80.8)	86 (78.9)	93 (79.5)	
1	107 (20.5)	5 (10.0)	15 (33.3)	29 (28.7)	19 (19.2)	18 (16.5)	21 (17.9)	
≥ 2	19 (3.7)	1 (2.0)	2 (4.4)	8 (7.9)	0 (0.0)	5 (4.6)	(2.6)	

*Number of subjects (%).
**information regarding only to those children that finished any type of breastfeeding and bottle feeding.
¶from those ill during the last three months; p-value from chi-square test for differences between age groups.

children in the ≤ 11 and 12-23 month age groups were severely stunted (26.3% and 21.2% respectively, p = 0.007). Also, more of these children were not up to date on their vaccinations (13.5%, p = 0.014) compared to the non-stunted group. Exclusive breastfeeding was most frequent in moderately and severely stunted children (83.0% and 84.3% respectively, p = 0.058). Bottle fed children under 6 months old were more likely to be stunted (83.4%) than those exclusively breastfed (61.4%), but there was no significant difference between these 2 groups. However, the sample size was very small (data not shown).

Similarly the studied child and maternal determinants were not significantly associated with the children being underweight. However, more children from the 46-60 month age group (27.7%, p = 0.047) were in the severely underweight category. Determinants (age group and own dish) for severe malnutrition, fitted better and obtained a greater percentage of correct classification (data not shown). Some of the bivariate associations were lost, possibly due to colinearity between the independent variables.

Discussion

The new results that we report are that 13.4% of the children under five were wasted, 49.8% stunted and 22.7% underweight in a rural insular area of Mozambique. We also observed that 7.2%, 15.6%, and 13.7% of the children had moderate malnutrition (wasting, stunt-

Table III
Weight-for-height (WHZ: wasting), height-for-age (HAZ: stunting), and weight-for-age (WAZ: underweight) z-scores by sex and age group

Weight for height / Age (months)	≥ 2 SD (normal nutrition)			< -2 SD-≥ 3 SD (moderate malnutrition)			< -3 SD (severe malnutrition)			p-value
	Total n (%)	Female n (%)	Male n (%)	Total n (%)	Female n (%)	Male n (%)	Total n (%)	Female n (%)	Male n (%)	
≤ 11	80 (90.9)	48 (92.3)	32 (88.9)		2 (3.8)	1 (2.8)		2 (3.8)	3 (8.3)	0.653
12-23	89 (87.3)	51 (85.0)	38 (90.5)		5 (8.3)	1 (2.4)		4 (6.7)	3 (7.1)	0.454
24-35	90 (90.0)	45 (90)	45 (90.0)		4 (8.0)	2 (4.0)		1 (2.0)	3 (6.0)	0.435
36-47	96 (88.9)	59 (90.8)	37 (86.0)		2 (3.1)	5 (11.6)		4 (6.2)	1 (2.3)	0.149
48-60	90 (77.6)	50 (80.6)	40 (74.1)		7 (11.3)	8 (14.8)		5 (8.1)	6 (11.1)	0.698
Total	445 (86.6)	253 (87.5)	192 (85.3)		20 (6.9)	17 (7.6)		16 (5.5)	16 (7.1)	0.724
Height for age / *Age (months)*										
≤ 11	35 (36.5)	20 (35.1)	15 (38.5)	14 (14.6)	8 (14.0)	6 (15.4)	47 (49.0)	29 (50.9)	18 (46.2)	0.902
12-23	45 (44.1)	26 (43.3)	19 (45.2)	19 (18.6)	12 (20.0)	7 (16.7)	38 (37.3)	22 (36.7)	16 (38.1)	0.913
24-35	51 (50.0)	30 (60.0)	21 (42.0)	17 (17.0)	8 (16.0)	9 (18.0)	32 (32.0)	12 (24.0)	20 (40.0)	0.161
36-47	58 (53.2)	32 (49.2)	26 (59.1)	15 (13.8)	10 (15.4)	5 (11.4)	36 (33.0)	23 (35.4)	13 (29.5)	0.589
48-60	74 (63.2)	43 (68.3)	31 (57.4)	17 (14.5)	9 (14.3)	8 (14.8)	26 (22.2)	11 (17.5)	15 (27.8)	0.379
Total	263 (50.2)	151 (51.2)	112 (48.9)	82 (15.6)	47 (15.9)	35 (15.3)	179 (34.2)	97 (32.9)	82 (35.8)	0.782
Weight for age / *Age (months)*										
≤ 11	85 (87.6)	49 (86)	36 (90.0)	4 (4.1)	4 (7.0)	0	8 (8.2)	4 (7.0)	4 (10.0)	0.212
12-23	83 (81.4)	50 (83.3)	33 (78.6)	11 (10.8)	7 (11.7)	4 (9.5)	8 (7.8)	3 (5.0)	5 (11.9)	0.433
24-35	78 (78.0)	42 (84.0)	36 (72.0)	14 (14.0)	4 (8.0)	10 (20.0)	8 (8.0)	4 (8.0)	4 (8.0)	0.219
36-47	77 (70.6)	44 (67.7)	33 (75.0)	22 (20.2)	14 (21.5)	8 (18.2)	10 (9.2)	7 (10.8)	3 (6.8)	0.673
48-60	83 (70.9)	46 (73.0)	37 (68.5)	21 (17.9)	11 (17.5)	10 (18.5)	13 (11.1)	6 (9.5)	7 (13.0)	0.814
Total	406 (77.3)	231 (78.3)	175 (76.1)	72 (13.7)	40 (13.6)	32 (13.9)	47 (9.0)	24 (8.1)	23 (10.0)	0.742

p-value from chi-square test for relationship between sex and nutritional status, overall and within each age group.

ing, and underweight, respectively) and 6.2%, 34.2%, and 9% were severely malnourished. These prevalences of malnutrition indicators in Ibo children under five were higher than published in the Sixth Report on the World Nutrition Situation for Mozambique 4.2% 43.7%, 18.3%; Africa 10.4%, 40.9%, 25.2% and Cabo Delgado province 5.6%, 52.8%, 20.6% respectively[7,11]. The observed differences between our and other studies may be for a number of reasons. Firstly we found differences in Ibo compared to the previous report from Cabo Delgado province. It is not clear from this report whether Ibo was included in it. It is based on 874 children out of the registered 899 hospital births. If births outside of the hospital were not included, the study was unlikely to be representative, especially of the poorer sector of the population. Cabo Delgado is one of the poorest provinces in Mozambique and Ibo is poorer than the mainland. This and the fact that our study included every child under 5 on the island of Ibo, thus completely representative of all children may explain why we detected the greatest prevalence of malnutrition. Some results (such as stunting) are in line with other studies from neighbouring areas such as Malawi, Zambia and Zimbabwe[17]. As in many other countries[18] we observed that stunting is the greatest problem followed by underweight and wasting. Our results agree with a previously reported trend for the highest prevalence of stunting in the UN sub-region of East Africa (42%) and the highest prevalence of severe wasting in Central Africa (5.6%)[19].

Previous studies in sub-Saharan Africa of children under five reported that males are more likely to become stunted than females[20-23]. However the authors of these studies have not been able to provide a clear mechanism for this observation and some have recognised that limitations to their study design could influence the results.

Our data included every child under five from Ibo and showed that both boys and girls are vulnerable to malnutrition with only a trend (non-significant) for slightly higher prevalences in wasting, stunting or underweight in boys than girls. Results of the multivariate analysis confirm the risk factors found with the bivariate analysis in the three types of malnutrition. Maternal education level was not included as a candidate in the multiple logistic regression models due to: 1) the large number of missing values; 2) the fact that the majority of mothers in Ibo had no schooling or elementary primary schooling; and 3) no significant effect in bivariate analysis.

The extent of breastfeeding (100%), exclusive breastfeeding (94.9%) and duration of exclusive breastfeeding (2.5 months) of the Ibo children were similar to a previous national survey in 2011[11]. Duration of exclusive breastfeeding in Cabo Delgado province is one of the highest among all provinces in Mozambique (2.7 months) and is

Table IV
Determinants associated with nutritional status

	≥ -2 SD WHZ n (%)	<-2 SD -≥-3 SD WHZ n (%)	<-3 SD WHZ n (%)	p-value	≥ -2 SD HAZ n (%)	<-2 SD-≥-3 SD HAZ n (%)	<-3 SD HAZ n (%)	p-value	≥ -2 SD WAZ n (%)	≤-2 SD-≥3 SD WAZ n (%)	≤-3 SD WAZ n (%)	p-value
Age group				0.135				0.007				0.047
≤11	80 (18.0)	3 (8.1)	5 (15.6)		35 (13.3)	14 (17.1)	47 (26.3)		85 (20.9)	4 (5.6)	8 (17.0)	
12-23	89 (20.0)	6 (16.2)	7 (21.9)		45 (17.1)	19 (23.2)	38 (21.2)		83 (20.4)	11 (15.3)	8 (17.0)	
24-35	90 (20.2)	6 (16.2)	4 (12.5)		51 (19.4)	17 (20.7)	32 (17.9)		78 (19.2)	14 (19.4)	8 (17.0)	
36-47	96 (21.6)	7 (18.9)	5 (15.6)		58 (22.1)	15 (18.3)	36 (20.1)		77 (19.0)	22 (30.6)	10 (21.3)	
48-60	90 (20.2)	15 (40.5)	11 (34.4)		74 (28.1)	17 (20.7)	26 (14.5)		83 (20.4)	21 (29.2)	13 (27.7)	
Feeding regimes				0.234				0.058				0.323
Exclusive breastfeeding	204 (77.9)	16 (64.0)	15 (83.3)		128 (72.3)	39 (83.0)	70 (84.3)		175 (77.8)	39 (70.9)	23 (85.2)	
Mixed feeding	58 (22.1)	9 (36.0)	3 (16.7)		49 (27.7)	8 (17.0)	13 (15.7)		50 (22.2)	16 (29.1)	4 (14.8)	
Eating unhelped	336 (79.4)	30 (83.3)	24 (82.8)	0.791	212 (84.5)	61 (81.3)	120 (72.7)	0.013	296 (78.5)	63 (90.0)	34 (77.3)	0.078
Own dish	225 (53.2)	18 (50.0)	15 (51.7)	0.927	115 (45.8)	38 (50.7)	107 (64.8)	0.001	199 (52.8)	34 (48.6)	27 (61.4)	0.408
Vaccination				0.330				0.014				0.386
Not up to date	42 (9.5)	1 (2.7)	2 (6.2)		22 (8.4)	2 (2.4)	24 (13.5)		34 (8.4)	9 (12.5)	6 (12.8)	
Maternal education level				0.903				0.562				0.837
No schooling	36 (28.8)	2 (22.2)	1 (33.3)		18 (26.9)	7 (29.2)	14 (28.6)		30 (27.0)	6 (35.3)	3 (25.0)	
Elementary primary school	66 (52.8)	4 (44.4)	2 (66.7)		37 (55.2)	14 (58.3)	23 (46.9)		57 (51.4)	10 (58.8)	7 (58.3)	
Advanced primary school	22 (17.6)	3 (33.3)	0 (0.0)		12 (17.9)	3 (12.5)	10 (20.4)		22 (19.8)	1 (5.9)	2 (16.7)	
Secondary school	1 (0.8)	0 (0.0)	0 (0.0)		0 (0.0)	0 (0.0)	2 (4.1)		2 (1.8)	0 (0.0)	0 (0.0)	
Household Economic Status Index				0.089				0.440				0.745
Very low	101 (22.7)	7 (18.9)	2 (6.2)		54 (20.5)	19 (23.2)	38 (21.2)		89 (21.9)	15 (20.8)	7 (14.9)	
Low	92 (20.7)	6 (16.2)	13 (40.6)		62 (23.6)	13 (15.9)	38 (21.2)		85 (20.9)	20 (27.8)	9 (19.1)	
Middle	86 (19.3)	10 (27.0)	5 (15.6)		53 (20.2)	16 (19.5)	33 (18.4)		79 (19.5)	12 (16.7)	11 (23.4)	
High	86 (19.3)	8 (21.6)	9 (28.1)		57 (21.7)	17 (20.7)	30 (16.8)		84 (20.7)	11 (15.3)	9 (19.1)	
Very high	80 (18.0)	6 (16.2)	3 (9.4)		37 (14.1)	17 (20.7)	40 (22.3)		69 (17.0)	14 (19.4)	11 (23.4)	

Nutritional status: ≥-2 SD = normal; <-2 SD -≥-3 SD = moderate malnutrition; <-3 SD = severe malnutrition. WHZ: weight for height (wasting); HAZ: height for age (stunting); WAZ: weight for age (underweight); p-value from chi-square test for the relationship between the different determinants and nutritional status.

associated with lower education level and household wealth[11]. The median breastfeeding duration in our study was 20.3 months (data not shown) slightly lower than the national health survey[11] in the same area (22.4 months) but that did not include Ibo. Although the government infant nutrition campaign clearly advocates the benefits of exclusive breastfeeding, the WHO recommendation of 6 months of exclusive breastfeeding[24] is far from fulfilled in Ibo, where it applied in only 1.7% of the children. The recommendation also includes complementary foods with continued breastfeeding up to two years of age. However, the relationship between exclusive breastfeeding and malnutrition (stunting) that we observed should be considered. The effect of exclusive breastfeeding on child nutritional status may be determined by maternal health and nutritional status. Maternal nutritional status and number of previous pregnancies affects milk quality. A limitation of our study is that we do not have this information, but our data show that exclusive breastfeeding does not have the same effect in all maternal environments. It suggests that exclusive breastfeeding by mothers from a poor rural area that are probably malnourished, does not provide the expected benefits from the WHO recommendation.

In 2011 Fewtrell *et al* suggested that the WHO recommendation should be monitored in different settings to assess compliance and to record and act on adverse events[25]. In our study we reported a borderline association between exclusive breastfeeding practice and a low height for age (stunting) (p = 0.058). Taking into account these results and the mean duration of exclusive breastfeeding of 2.5 months in Ibo, we suspected that this could be associated with the early cessation of exclusive breastfeeding and premature introduction of supplementary feeding. In line with these results, other reports from a study performed in Uganda (2008) reported a risk for stunting when exclusive breastfeeding stopped early[26] and reports regarding other studies in Kenya (2004)[27] and Vietnam (2008)[28] reported that early supplementation was associated with increased risk of wasting and stunting. However, more research should be done in this area.

22.0% of the children were bottle fed at some point and this form of feeding was significantly higher in the most crowded and deprived neighbourhoods (Cumuamba and Rituto) where the children may have been fed with artificial milk (probably obtained from external aid) due to maternal illness or malnutrition. We did not collect data regarding HIV infection that affects 11.5% of adults in Mozambique and is slightly more prevalent in women (13.1%) than in men (9.2%)[29].

Stunting was the most prevalent type of malnutrition and was related to age group, feeding regimes, immunization, eating unhelped and having an own dish to eat from. Stunting has been reported to be more critical during the first two years of life, after which it is difficult to recover normal growth[30]. During this period, poor infant and child nutrition and care practices increase under nutrition in the children[31]. Significantly more children aged 12-23 months were stunted (44.4%) than in the older age groups. These findings were similar to those reported by Senbanjo et al.[32] although they did not observe significant differences between age groups. With the exception of infants under 11 months, analysis by age group showed that stunting decreased significantly with age, in contrast to other studies in which it increases with age[22,33]. Our results also contrast with those from other studies conducted in Kenya, India and Ghana where stunting was most commonly found in the 36-47 month age group[21,34,35].

High number of previous pregnancies (mean 3.5), maternal malnutrition (not recorded) or a poor supplementary feeding period with the early introduction of complementary food might explain why children under two in our study were more likely to be stunted than other age groups.

On the other hand, we observed that underweight increased with age group. This trend was also reported in a study in Equatorial Guinea[36] but a Nigerian study observed a tendency for underweight to decrease with age group[32]. Unlike our study, the results in these studies were not significant.

The prevalence of wasting is below 5% in most impoverished settings in developing countries[21], which is far from our situation. The fact that our setting is an island with difficult access and roaming goats that eat the local crops makes the food in the area insecure and therefore the children are vulnerable to malnutrition.

We provide evidence for the necessity for intervention to improve nutrition and growth in children under five in this rural area in Mozambique. A recent study reported that optimum health care for HIV infected children is lacking in rural Mozambique due to low coverage of the National combination antiretroviral therapy programme and poor health care infrastructures. The importance of child health monitoring due to the high HIV prevalence in Mozambique is highlighted in this report[37]. Our data indicate that child nutritional status in rural Mozambique also requires urgent attention.

A possible limitation to the study was the lack of data regarding the effect of maternal malnutrition, health and maternal milk quality on child malnutrition. All of these factors may have contributed to the negative effect of exclusive breastfeeding on child growth.

Conclusions

Wasting, stunting, and underweight are a prevalent public health problem in children under five in a rural insular area of Mozambique. Stunting is the most important nutritional problem followed by underweight and wasting. It is clear that the on-going preventive activities related with nutrition at the community level are poor in rural Mozambique.

Breastfeeding is widely practised in Ibo. However, exclusive breastfeeding was a borderline significant determinant of malnutrition. This may be due to its short duration and premature introduction of complementary food. Specific nutritional and public health interventions that can be implemented at the primary health care level are needed to tackle the problem of malnutrition in this area.

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Author contributions

MEV-N planned, designed, coordinated and carried out the study, oversaw data collection, cleaned, analysed and interpreted the data and wrote the paper. FA and FX G-O participated in the design and coordination of the study, BC planned and coordinated the logistic techniques for the data collection. CI participated in the field work and logistical aspects of the study. JDFB oversaw data cleaning, designed the analytical strategy, analysed the data, interpreted it and participated in writing the paper. MMM participated in data analysis, interpretation and writing the paper.

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