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Maternal and children nutrition in northern Mozambique: a mixed methods study.

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Abstract

Introduction: children malnutrition is a public health problem in Mozambique and we know that integrated agriculture and nutrition interventions can mitigate malnutrition adverse effects, especially during the first 1,000 days of life. For an agriculture intervention positively impact on nutrition, the implementation must be purposely designed to achieve this objective; this baseline survey was carried out to benchmark a project progress towards attaining its objectives as well as in guiding implementation process.

Methods: descriptive mixed methods research to evaluate the nutritional status of mother-child (aged from 6 to 24 months) pairs, food availability and consumption trends. Focal group discussions to prepare food demonstration tools, a structured questionnaire for 24h-recall and a food frequency questionnaire to collect data were used. We surveyed randomly selected households in Malema and Gurué districts, Northern Mozambique.

Results: 577 infant-mother pairs were surveyed and we found a high prevalence of children born underweight (18.8 %), a prevalence of chronic and acute undernutrition of 6.0 % and 15.4 %, respectively. A double burden of malnutrition (underweight and overweight) was found among mothers. Both Malema and Gurué districts produce various food crops. Legume crops are the main protein source for most households. The 24 h - recall indicated that the median protein consumption among infants was 25.3 g / day, threefold higher than the recommended protein intake from complementary foods, assuming a child is breastfeeding as is expected for children below two years.

Conclusion: this baseline survey highlighted the nutrition status of infant-mother pairs in Malema and Gurué districts, Mozambique, showing a children nutritional positive evolution since the 2011 Mozambican Demographic and Health Survey. Malnutrition double burden (under and overweight) attains mothers and possible underlying factors for the nutrition status were underscored. Potential intervention niches for an integrated agriculture and nutrition project were highlighted.

Key words: children, malnutrition, maternal, Mozambique, nutrition, overweight, underweight.

1. Introduction.

Maternal and children under nutrition in low and middle-income countries encompasses both under nutrition and a growing problem with overweight and obesity. [1] Annually, under nutrition accounts for 3.5 million deaths with over half of the global child mortality occurring in Africa. Under nourished children have an increased death rate from diarrhoea, pneumonia, measles, and other infectious diseases. [2] In Mozambique, the prevalence of stunting is 43 %, [3] and it is responsible for over a third of deaths among children aged less than five years. Undernutrition prevalence rates differ within the country, with the northern part (Nampula Province) having the highest prevalence (55 %). Undernutrition is not only a health but also an economic problem, being responsible for a 2 – 3 % loss of gross internal product. Chronic under nutrition is recognized as the best indicator of the quality of human capital. [4]

Maternal and child under nutrition including stunting, wasting and deficiency of essential vitamins and minerals has been a subject of discussion by various professional, who agree there is potential for reduction through equitable coverage of proven nutrition interventions. The need to focus on the crucial period from conception, through the first two years of life (the first 1,000 days), during which good nutrition and healthy growth have lasting benefits throughout life has been recommended. [5]

In Sub-Saharan Africa, millions of households depend on agriculture for income and food. In 2006 80 % of Mozambicans lived in rural areas depending on agriculture for their livelihood. Agricultural interventions have long been thought to influence nutrition. In the past 10 - 15 years, people have accepted that for agricultural intervention to have greater chance of affecting nutrition status, they must be implemented with that objective. [6] Northern Mozambique is considered the country's food basket as most food production happens there. [7] However, there is high prevalence of undernutrition in northern Mozambique compared to other parts of the country, an example that agriculture or high food production does not always translate into better nutritional outcomes.

During 2011 - 2015, the *International Institute of Tropical Agriculture (IITA)* has set out to implement a nutrition sensitive project, with the aim to increase soybean production and consumption for better nutrition. To effectively implement and measure project' progress, a baseline survey was performed, in cooperation with Lúrio University (LU) Health Sciences Faculty researchers, to assess the nutritional status of the key beneficiaries of the project (body mass index – BMI - of women and children aged from six months to two years), local

dietary characteristics (components and preparation techniques), food availability and consumption trends among this target population.

2. Methods.

Descriptive mixed methods study, using qualitative and quantitative tools to gather data from children of age between 6 and 24 months and their mothers, in Gurué (Zambézia Province) and Malema (Nampula Province) districts in Mozambique, during April and May 2013.

Initial interactions with key informants during focus group discussions (FGD) were used to appraise the type of foods that were commonly eaten in the community and their methods of preparation. FGD also aided to develop the food frequency questionnaire (FFQ) as foods available in the study area were documented. For quantitative data, we used a questionnaire that contained agriculture and nutrition related questions including a 24 h - recall.

FGD and development of a pictorial manual.

FGD were conducted in the study area to gather information on types of food typically eaten, with women of reproductive age group (n = 68). A structured questionnaire was used to guide the discussions.

Using information gathered through FGD, a pictorial manual showing illustrations of food combinations, that would normally be served for a normal meal, was developed. Three local women prepared various recipes described by FGD. The women served the various food combinations, as they would do normally. The weight of each food type on the plate was then recorded and photographed to guide interviewers while filling the 24 h - recall questionnaire.

Sample selection.

A total of 612 households participated in the study. Children aged from 6 to 24 months and their mothers qualified to participate. The number of children to be surveyed, was calculated per district, using Nampula and Zambézia Provincial Health Directorates (Ministry of Health) data about undernutrition prevalence, plus a 10 % chance of non-respondents. The respondents were randomly selected from a list of all qualifying households.

Data collection.

Ethical clearance was provided by the Institutional Bioethics for Health Committee of LU. Data were collected using a structured questionnaire, record of anthropometric measurements of infant - mother pair, 24 h - recall for children and FFQ. BMI was calculated and categorized following the guidelines of National Institute of Health,

1998. Software Antro® of World Health Organization (WHO) was used to determine the undernutrition indicators for children.

For the 24 h - recall of foods eaten, data were collected for all foods and drinks consumed during the last 24 hours before the interview. Details of commercial products were taken so as the detailed ingredients for the various recipes. At the end of the 24 h - recall, the respondent was asked whether food intake in the previous day was normal, whether any supplements or medication was consumed, and whether the infant or mother was sick or had low appetite for food.

Foods recorded in the 24 h - recall were tabulated into specific nutrients using Food Processor Plus® based on United States Department of Agriculture food composition tables. The LU Nutrition Department adapted these tables based on recipes that were typical to Mozambique. Food composition data from Brazil was also used in the absence of some foods in the Mozambican food composition table.

Nutrient consumption evaluation.

The following nutrients were selected to evaluate intake: total energy, carbohydrates, total fat, proteins, vitamin A, D, E, B1, B2, B6, B12, folate, iron, calcium, iodine, zinc, phosphorus and magnesium. Children and adults used the WHO recommendations to determine prevalence of inadequate caloric intake. A comparison was made to the recommended dietary intake of the various nutrients to determine adequate intake. Acceptable macronutrient distribution ranges from 20 – 35 % for protein, 45 – 65 % for carbohydrates and 10 – 35 % for total fat, were used to calculate the contribution of various nutrients to total energy. [8] To calculate inadequacy of micronutrient intake, estimated average requirement (EAR) was used as the cut-off point. [9]

Statistical analysis.

Data analyses used Statistical Package for the Social Sciences version 19.0®. Significance level was set at 5 %. Qualitative variables were represented as proportions and were compared using Chi-square and Fisher whenever applicable. To describe ingestion of various nutrients, median was used and percentile 25 (P25) and 75 (P75). To compare variations in ingestion of nutrients, T – Student test was used or Mann - Whitney test for non - parametric data.

3. Results and discussion.

Study population.

Study population and its characteristics can be seen on table I and II. We interviewed mainly pairs of infant and mother (95 %). The respondents were well distributed between the two districts with the households from Malema and Gurué being 317 and 295, respectively. Boys represented 47.7 %, 577

mothers participated in the study with 292 (50.6 %) and 285 (49.4 %) being from Malema and Gurué districts, respectively.

Over 70 % of both children parents had either never studied or did not complete primary school education, while less than 3 % had completed secondary education. The Mozambique Millennium Development Goals Report 2005 (MMDGR) cited low access to education among women as a challenge to improved child-wellbeing. [10] The 2008 - 2009 Kenya Demographic Health Survey found a direct correlation between mother education and compliance with minimum infant and young child feeding practices. The 2011 Mozambique Demographic and Health Survey (MDHS) found infant mortality to be highest among children born to mothers who have low level of education. Often, these deaths are due to under nutrition.

Families with more than one child aged less than 2 years were 21 %. Short child-birth interval increases chance of a child becoming undernourished. The Kenya National Bureau of Statistics in 2010 found an inverse relationship between the length of the preceding birth interval and the proportion of children who were stunted. Similar trends were reported in the MDHS.

Table I: study population.

Characteristics	Total n (%)	Malema n (%)	Gurué n (%)
Nº of children	612 (94.2)	317 (51.8)	295 (48.2)
Sample distribution			
Boys	291 (47.7)	154 (48.6)	137 (46.4)
Girls	321 (52.3)	163 (51.4)	158 (53.6)
Mothers	577 (88.8)	292 (50.6)	285 (49.4)
Missing / other care givers	35 (11.2)	-	-

Table II: parent's education level.

Parents education level	Malema			Gurué		
	Father n (%)	Mother n (%)	Total n (%)	Father n (%)	Mother n (%)	Total n (%)
Never studied	44 (15.1)	57 (19.5)	101 (17.3)	52 (18.2)	74 (26.0)	126 (21.6)
Primary (Incomplete)	152 (52.1)	175 (59.9)	327 (56.0)	163 (57.2)	183 (64.2)	346 (60.8)
Primary (Complete)	45 (15.4)	29 (9.9)	74 (12.7)	27 (9.5)	12 (4.2)	39 (6.9)
Secondary (Incomplete)	37 (12.7)	26 (8.9)	63 (10.8)	35 (12.3)	13 (4.6)	48 (8.7)

Nutritional evaluation.

Table III shows infants and mother's anthropometric data. Children born with low birth weight (< 2,500 g) were 115 (18.8 %); they face numerous challenges and may often not attain their full potential as adults. [11] A cohort of children born underweight followed by WHO for the first eight years of life concluded that these children had poor cognitive function, academic achievement,

and behaviours at eight years. The existence of a population born underweight is not only a health concern but also affects this population' social and economic achievements. [12]

About 30 % of children did not have child growth monitoring cards and did not provide the weight at birth. This is consistent with the findings of the MDHS reporting that 80 % of respondents had a child growth - monitoring card. Major reason for children not having a growth - monitoring card is that the child was born at home. While delivery care is critical for both mother and new-born, slow progress has been registered ensuring women get skilled health professionals delivery care. According to the MMDGR, skilled health personnel attended 48 % of deliveries in 2003 compared with 44 % in 1997. Reasons cited included lack of women's decision-making power, perceptions of risk, traditional beliefs and practices, long distances and poor transport to a maternity.

Children participating in the study were less than two years of age. Chronic undernutrition attained 6 % while 15.4 % presented acute undernutrition (≤ - 2 Z score). Prevalence of acute undernutrition registered in this study was slightly higher than that reported in the MDHS (6.4 -10.5 %). Trends in prevalence of chronic undernutrition observed in this study were lower than the rates reported in the same survey (27.6 - 48.1 %).

Most mothers (71.4 %) had a normal BMI, overweight was observed among 13.9 % and 12.3 % were underweight. The referred survey reported underweight levels of 9.8 %, overweight levels of 10.5 % and normal BMI among 79.7 % of rural women. Another study comparing data from 36 developing countries (Mozambique was not included) found that overweight exceeded underweight among women of reproductive age. [13] Underweight among women of reproductive age is a health concern as such women are at a high risk of having low birth weight children, [14] especially if adequate weight is not gained during pregnancy. [15] The MDHS found the mothers' BMI has an inverse relationship with stunting; mothers who are thin (BMI < 18.5) had children with the highest stunting level (45 %). No anthropometric measurements for both mother and child were significantly different for the two districts ($p < 0.05$).

Table III: children and mothers' anthropometric characteristics.

Anthropometric characteristics of children and mothers	Total n (%)	Malema n (%)	Gurué n (%)	*p*
Birth weight < 2,500g	115 (18.8)	57 (18.0)	58 (19.7)	0.084*
Birth weight > 2,500g	330(53.9)	184 (58.0)	146 (49.5)	
No response	167 (27.3)	76 (24.0)	91 (30.8)	
Weight/age				
< - 2 Z-score	22 (3.6)	15 (4.7)	7 (2.4)	0.274*
> - 2 Z-score	577 (94.3)	296 (93.4)	281 (95.3)	
Missing	13 (2.1)	6 (1.9)	7 (2.4)	
Chronic undernutrition (height/age)				
< - 2 Z-score	37 (6.0)	21 (6.6)	16 (5.4)	0.769*
> - 2 Z-score	558 (91.2)	288 (90.9)	270 (91.5)	
Missing	17 (2.8)	8 (2.5)	9 (3.1)	
Acute undernutrition (weight/height)				
< - 2 Z-score	94 (15.4)	47 (14.8)	47 (15.9)	0.849*
> - 2 Z-score	487 (79.6)	255 (80.4)	232 (78.6)	
Missing	31 (5.1)	15 (4.7)	16 (5.4)	
Mothers BMI				
Underweight	71 (12.3)	38 (13.0)	33 (11.6)	0.240**
Normal	412 (71.4)	212 (72.6)	200 (70.2)	
Overweight	80 (13.9)	33 (11.3)	47 (16.5)	
Obese	-	-	-	
Missing	14 (2.4)	9 (3.1)	5 (1.8)	

* Chi-square ** Fisher test

Most mothers (526 or 91.2 %) attended prenatal health care. Receipt of nutritional education during pregnancy was reported by 67.2 % and 65 % received it in health facilities (Table IV). A lower number of mothers (51.0 %) had received post-natal nutritional education. There was no significant difference between attendance of pre and post-natal health care services for the two districts. Nutritional support is crucial during ante and post-natal periods to ensure good pregnancy outcomes and a good start in life for the new-born. Possibly the low prevalence of child undernutrition among respondents can be attributed to high attendance to nutritional education. Along with our research, local health facilities were implementing community level integrated strategies to reduce undernutrition, especially child undernutrition, through forums held at the health facilities and at community level. A community children health intervention implemented in Chokwé district Mozambique (South), under typical resource constraints environment, demonstrated it can improve child-wellbeing. [16] Another randomized control trial in 2004 showed that nutritional education leads to better nutrition outcomes, even among very poor families in Mexico. [17]

Table IV: nutritional education during pre-and post-natal care.

Item/District	Malema		Gurué		Total		*p*
Attended pre-natal clinic	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	
	267 (91.4)	17 (5.8)	259 (90.9)	20 (7.0)	526 (91.2)	37 (6.4)	0.754*

Item/ District	Malema		Gurué		Total		*p*
Received nutritional education during pregnancy	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	
	204 (69.9)	84 (28.8)	184 (64.6)	94 (33.0)	388 (67.2)	178 (30.8)	0.312*

Where did you receive nutritional education during pregnancy	Malema n (%)	Gurué n (%)	Total n (%)	*P*
Health Centre	196 (67.1)	179 (62.8)	375 (65.0)	0.700**
Non-governmental organization	2 (0.6)	1 (0.3)	3 (0.4)	
Community workers (Ministry of Health)	1 (0.3)	1 (0.3)	2 (0.3)	
Private clinic	-	-	-	
Others	5 (1.2)	3 (0.6)	8 (1.0)	

Item/ District	Malema		Gurué		Total		*p*
	Yes n (%)	No n (%)	Yes n (%)	No n (%)	Yes n (%)	No n (%)	
Nutritional education during post-natal care	150 (51.4)	136 (46.6)	144 (50.5)	136 (47.7)	294 (51.0)	272 (47.1)	0.938 *

Where did you receive nutritional education during post-natal care	Malema n (%)	Gurué n (%)	Total n (%)	*P*
Health facility	143 (49.0)	136 (47.7)	279 (48.4)	0.774*
Non-governmental organization	0 (0.0)	0 (0.0)	0 (0.0)	
Community workers (Ministry of Health)	2 (0.7)	0 (0.0)	2 (0.3)	
Private clinic	-	-	-	
Others	5 (1.7)	0 (0.0)	5 (0.4)	

* Chi-square **Fisher-test

Table V shows trends in exclusive breast-feeding and introduction of solid foods. Mostly mothers are responsible for child feeding (80.4 %) and to make decisions on child feeding practices and age at which solid foods and complementary feeding is initiated (66.9 %). Most children receive exclusive breast-feeding for 5 - 6 months (46.6 %). There was a significant difference between Malema and Gurué districts regarding exclusive breast-feeding, with Malema children breastfed for a longer

period. Exclusive breast-feeding reduces infant morbidity and mortality through enhanced immunity and reduced incidence of disease, especially diarrhoea. [18]

Complementary period, the time when infants are introduced to other foods in addition to breast milk (6 - 23 months), is sensitive to stunting, with life-long and possibly irreversible consequences. [19]

Maize flour thin porridge was the common first food introduced to infants (96.4 %) mainly at the age of 5 - 6 months. Starchy staples such as maize have been reported as major complementary foods in Africa. [20, 21] Thin starchy porridges have been implicated in causing undernutrition in Sub-Saharan Africa countries. [22] Cereal based thin porridges do not meet the children nutrient needs due to their limited energy density. [23] In addition, due to small gastric capacity of about 250 g for children aged 6 months and 350 g for those aged 23 months, they cannot eat enough of the low energy density traditional complementary porridges to meet their energy needs. About 28 % of mothers reported to add oil or groundnut powder to the thin porridge, especially sunflower oil. Addition of oil to maize flour porridge may improve energy density of complementary porridges, due to the high caloric value of fat (9 kcal / g) as compared to carbohydrate (4 kcal / g); oil inclusion provides essential fatty acids indispensable for proper development of the nervous system.

Nutritional education messages must be well targeted to reach women, because mothers were responsible for decisions on child feeding for 80 % of respondents. The use of the health facilities to disseminate nutritional education seems a good approach, as most women reported to have received this education from health facilities, particularly during ante and post-natal consultations. Given the limited access to other channels of information, an integrated mother and child health project may need to strengthen nutritional education through health facilities.

Table V: introduction of solid foods/complementary feeding.

	Malema n (%)	Gurué n (%)	Total n (%)	*p*
Who is responsible for child feeding?				
Father	46 (15.8)	33 (11.6)	79 (13.7)	0.167**
Mother	226 (77.4)	238 (83.5)	464 (80.4)	
Others	4 (1.4)	0 (0.0)	4 (0.7)	
Grand - mother	3 (1.0)	3 (1.1)	6 (1.0)	
Until which age is exclusive breast-feeding done?				
2 - 3 Months	27 (9.2)	29 (10.2)	56 (9.7)	0.029*
3 - 4 Months	42 (14.4)	64 (22.5)	106 (18.4)	
4 - 5 Months	53 (18.2)	49 (17.2)	102 (17.7)	
5 - 6 Months	153 (52.4)	116 (40.7)	269 (46.6)	
More than 6 months	8 (2.7)	10 (3.5)	18 (3.1)	
No response	9 (3.1)	17 (6.0)	26 (4.5)	
Who decides when to introduce solid foods to a baby?				
Father	44 (15.1)	41 (14.4)	85 (14.7)	0.131*
Mother	202 (69.2)	184 (64.6)	386 (66.9)	
Grand father	3 (1.0)	8 (2.8)	11 (1.9)	
No response	10 (3.4)	21 (7.4)	31 (5.4)	
Others	33 (11.3)	31 (10.9)	64 (11.1)	
At what age are solid foods introduced?				
2 - 3 Months	14 (4.8)	20 (7.0)	34 (5.9)	0.051*
3 - 4 Months	27 (9.2)	46 (16.1)	73 (12.7)	
4 - 5 Months	43 (14.7)	38 (13.3)	81 (14.0)	
5 - 6 Months	148 (50.7)	117 (41.1)	265 (45.9)	
More than 6 months	55 (18.8)	55 (19.3)	110 (19.1)	
No response	5 (1.7)	9 (3.2)	14 (2.4)	
Which is the first solid food provided to babies?				
Maize flour thin porridge	285 (97.6)	271 (95.1)	556 (96.4)	0.436**
Cassava flour thick porridge	1 (0.2)	0 (0.0)	1 (0.1)	
Biscuit	3 (1.1)	0 (0.0)	3 (0.5)	
Maize flour thick porridge	3 (1.1)	14 (4.9)	17 (3.0)	
At what age do children eat family diet?				*p*
Less than 2 months	6 (2.1)	2 (0.7)	8 (1.4)	< 0.001*
2 - 4 Months	2 (0.7)	5 (1.8)	7 (1.2)	
4 - 6 Months	32 (11.0)	52 (18.2)	84 (14.6)	
More than 6 months	205 (70.2)	156 (54.7)	361 (62.6)	
No response	47 (16.1)	70 (24.6)	117 (20.3)	

* Chi-square ** Fisher test

Median energy intake among children under two years was 802 Kcal. There was no significant difference between boys and girls. This intake met the recommended dietary expected from complementary foods up to 23 months except for children aged 12 - 23 months receiving low energy from breast milk. This rate of rather sufficient intake of energy is consistent with the low prevalence of chronic undernutrition, which was reported at 6 %. Similarly, total energy consumption was 1,304 Kcal, within the recommended intake for non-pregnant

women. This may also explain why most of the women had a normal BMI.

Protein median consumption among children was 25.3 g. This rate is about threefold higher than the recommended protein intake from complementary foods, assuming a child is breast-feeding as is expected for children below two years. The high protein intake may explain the relatively low prevalence of undernutrition among respondents. Some authors suggested that a high protein intake stimulates insulin secretion, which in turn stimulates weight gain. [24, 25]

Protein median consumption among children was 13 % of total energy. Main sources of protein are legumes with limited contribution from animal foods (Figure1a). This trend may be of concern considering legumes do not have a balanced profile of essential amino acids. Higher than recommended intake of protein has been reported in studies that aimed to evaluate long-term effects of high protein intake during infancy. A study in France showed an average intake of protein of 16.3 % of total energy while in Italy was 20 %. Studies about high protein intake effects on children are inconsistent but a correlation with obesity later in life has been suggested. [26, 27]

Vitamin A median intake was 170.7 µg, lower than the recommended 350 µg, consistent with the trends reported using the FFQ, showing that a minority of respondents consumed vitamin A rich food, such as fruits and vegetables on daily basis (< 30 %) (Figure 1a). Further still, the frequency of consumption of animal source foods was also low in a daily basis. A randomized control trial among Mozambican children found 60 % had low serum retinol (< 0.70 µmol / L) and another author reported 71 % of vitamin A deficiency in children under five years. [28, 29]

Iron median intake was 5.8 mg, lower than the recommended (7 mg) for pre-schoolers. Prevalence of anaemia has been categorized as severe in Mozambique (≤ 40 %). Possibly these low intake of foods rich in iron, may in part explain the high prevalence of iron deficiency in Mozambique. Figure1 (a, b) shows that food rich in iron consumption is low (for animal and plant sources).

Evaluating nutrients inadequacy prevalence in children, the most deficient are phosphorus (78.5 %), calcium (80.1 %), zinc (60.1 %), iodine (98.6 %), vitamin B2 (76.4 %), vitamin B6 (65.4 %), B12 (87.2 %) and vitamin D (99.5 %). Considering micronutrients as vitamin A, vitamin B1, vitamin C, E, iron and folate, the prevalence of inadequacy is lower, showing individuals within or even above recommendations (Table VI).

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Children's mothers present a median energy intake of 1,029 Kcal. Evaluating inadequacy prevalence, most mothers have a nutrient intake lower than recommended. Micronutrients with the greatest deficiency are magnesium (93.6 %), zinc (90.6 %), iodine (99.5 %), vitamin B2 (95.1 %), vitamin B6 (91.0 %), vitamin B12 (91.1 %) and vitamin D (99.7 %).

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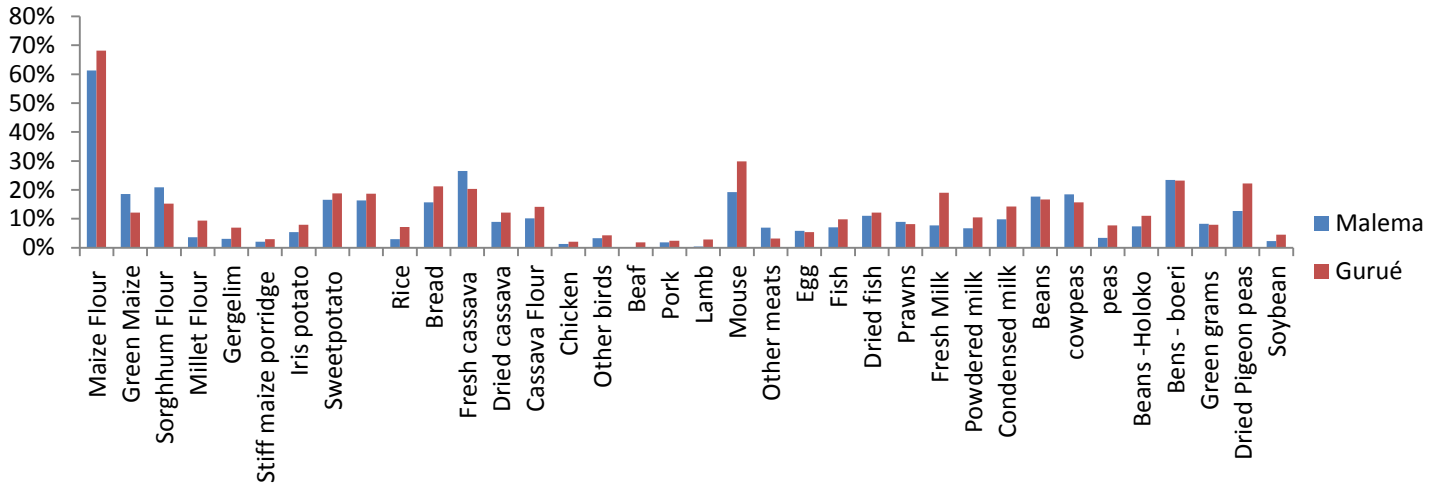

Figure 1a: daily frequency of household consumption in Malema and Gurué districts (%)

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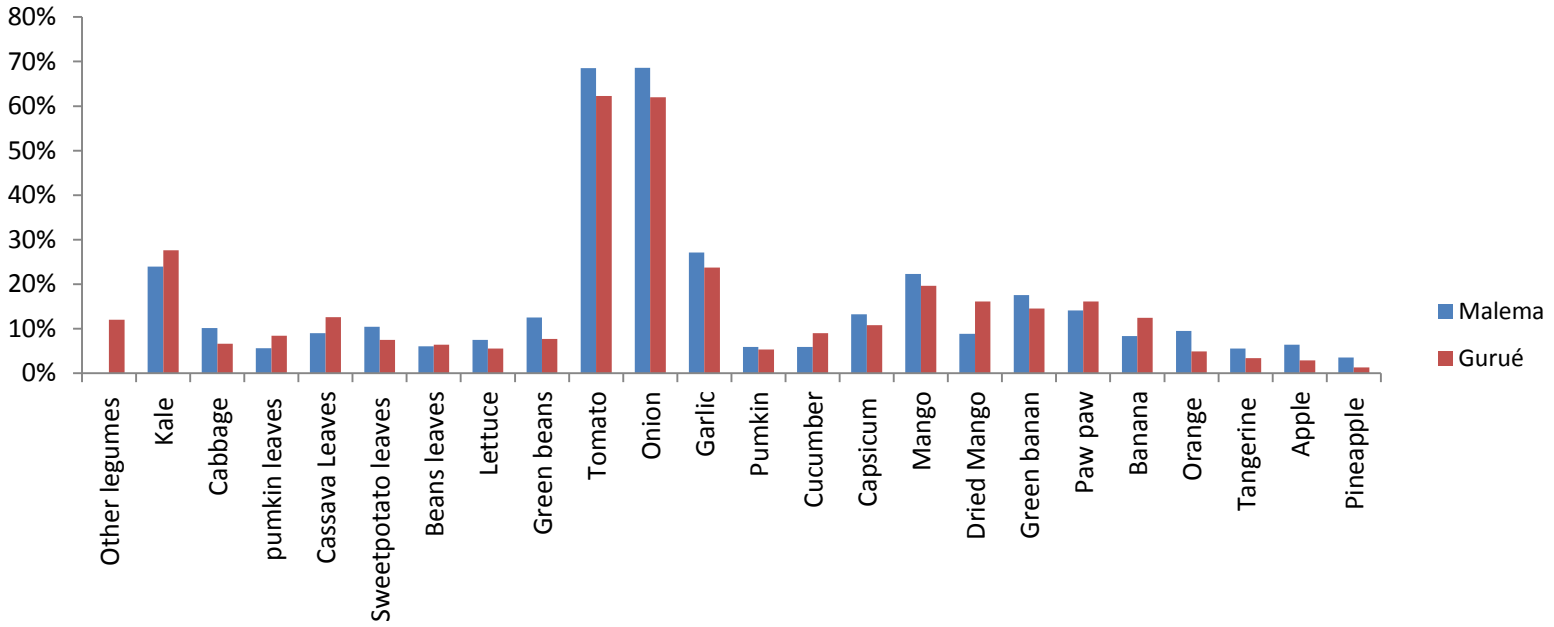

Figure 1b: daily frequency of household consumption in Malema and Gurué districts (%).

Table VI: prevalence of nutritional intake inadequacy in children under two years of age using EAR cut-off, AI and UL.

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	Boys			Girls			Total			*p*
	Below n (%)	Equal n (%)	Above n (%)	Below n (%)	Equal n (%)	Above n (%)	Below n (%)	Equal n (%)	Above n (%)	
Energy intake (Kcal)	69 (23,8)	-	221 (76,2)	60 (18,8)	-	259 (81,2)	129 (21,2)	-	480 (78,8)	0,133**
Protein (% TEV)	1 (0,3)	99 (34,1)	190 (65,5)	1 (0,3)	113 (35,4)	205 (64,3)	2 (0,3)	212 (34,8)	395 (64,9)	0,757*
Carbohydrates (% TEV)	15 (5,2)	37 (12,8)	238 (82,1)	17 (5,3)	37 (11,6)	265 (83,1)	32 (5,3)	74 (12,2)	503 (82,6)	0,844*
Total fat (% TEV)	137 (47,2)	71 (24,5)	82 (28,3)	152 (47,6)	68 (21,3)	99 (31,0)	289 (47,5)	139 (22,8)	181 (29,7)	0,737*
Phosphor (mg)	222 (76,6)	-	68 (23,4)	256 (80,3)	-	63 (19,7)	478 (78,5)	-	131 (21,5)	0,268**
Calcium (mg)	233 (80,3)	-	57 (19,7)	255 (79,9)	-	64 (20,1)	488 (80,1)	-	121 (19,9)	0,900*
Iron (mg)	45 (15,5)	1 (0,3)	244 (84,1)	54 (16,9)	1 (,3)	264 (82,8)	99 (16,3)	2 (0,3)	508 (83,4)	0,642*
Magnesium (mg)	132 (45,5)		158 (54,5)	154 (48,3)		165 (51,7)	286 (47,0)		323 (53,0)	0,497*
Zinc (mg)	170 (58,6)	1 (0,3)	119 (41,0)	196 (61,4)	-	123 (38,6)	366 (60,1)	1 (0,2)	242 (39,7)	0,505*
Iodine (mg)	178 (98,3)	-	3 (1,7)	179 (98,9)	-	2 (1,1)	357 (98,6)	-	5 (1,4)	0,654*
Vitamin A (µg)	48 (16,6)	-	242 (83,4)	39 (12,2)	-	280 (87,8)	87 (14,3)	-	522 (85,7)	0,128*
Vitamin B1 (mg)	129 (44,5)	1 (0,3)	160 (55,2)	144 (45,1)	3 (0,9)	172 (53,9)	273 (44,8)	4 (0,7)	332 (54,5)	0,813*
Vitamin B2 (mg)	218 (75,2)	3 (1,0)	69 (23,8)	247 (77,4)	1 (0,3)	71 (22,3)	465 (76,4)	4 (0,7)	140 (23,0)	0,579*
Vitamin B6 (mg)	188 (64,8)	6 (2,1)	96 (33,1)	210 (65,8)	6 (1,9)	103 (32,3)	398 (65,4)	12 (2,0)	199 (32,7)	0,811*
Vitamin B12 (µg)	246 (84,8)	1 (0,3)	43 (14,8)	285 (89,3)	0 (0,0)	34 (10,7)	531 (87,2)	1 (0,2)	77 (12,6)	0,099**
Vitamin C (mg)	47 (16,2)	-	243 (83,8)	32 (10,0)	-	287 (90,0)	79 (13,0)	-	530 (87,0)	0,024**
Vitamin D (µg)	289 (99,7)	-	1 (0,3)	317 (99,4)	-	2 (0,6)	606 (99,5)	-	3 (0,5)	0,620*
Vitamin E (mg)	125 (43,1)	-	165 (56,9)	141 (44,2)	-	178 (55,8)	266 (43,7)	-	343 (56,3)	0,786*
Folate (µg)	133 (45,9)	-	157 (54,1)	154 (48,3)	-	165 (51,7)	287 (47,1)	-	322 (52,9)	0,552*

	AI	UL	M ± sd
Fibre (g)	19		1,1 ± 0,5
Sodium (mg)		1,5	3,0 ± 0,1
Potassium (mg)	3		3,0 ± 0,3

TEV: Total Energetic Value *One-Way Anova test **Kruskal-Wallis test M – medium sd – standard deviation.

For nutrients without an established EAR, we used the AI value. We verified that the mean fibre intake in children was 1.1 g / day (recommended 19 g / day). For mothers, the average consumption was 1.3 g / day (recommended for adults 25 g / day). For potassium, the average consumption in children is equal to the recommended value (3 mg / day). In the case of mothers, the average consumption is higher than recommended (4.7 g / day). As for sodium, the average consumption of children and mothers (3 g / day) is higher than the value considered as limit with no harmful effects on health.

Analysing macronutrients average contribution to total energy value (TEV) in children (920 kcal / day), we verified that fat contributed on average to 14.3 % and carbohydrates and proteins respectively 55.4 % and 13.5 %. The same analysis for mothers showed an average contribution (macronutrients) to the TEV (1,304 kcal / day) of 14.6 %, 63.0 % and 22.3 % for protein, carbohydrate and fat, respectively.

4. Conclusions and recommendations.

We found a significantly low prevalence of chronic undernutrition (6 %) in children under two years of age, when compared to the 43 % among under five reported in 2011 in Mozambique, and a higher intake of protein than the recommended.

Malema and Gurué districts produce various crops that can be promoted for home consumption through integrated agriculture and nutrition projects. Such integrated projects have a potential to reduce undernutrition, particularly in regions typically considered as food baskets. Given the high agricultural productivity of Malema and Gurué districts, achieving good child and maternal nutrition through an integrated project is feasible. Such a project would contribute to reverse the high prevalence of children born underweight (18.8 %), the prevalence of underweight (12.3 %) and overweight (13.9 %) among mothers and the inadequacy of consumption of several nutrients in both children and mothers.

Thus, an integrated agricultural and nutrition project implemented with full detail of food production and malnutrition status, particularly focusing on the first 1,000 days, has a potential to reverse the emerging double burden malnutrition in Mozambique. This study guides on how nutritional education messaging would need to be packaged to improve malnutrition. A platform to disseminate these targeted messages to mothers is already provided by the high attendance of ante and post-natal clinics.

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