ORIGINAL RESEARCH

Dietary patterns and associated socio-economic factors in rural Mozambican adolescents

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Abstract

Background
Assessing food consumption in adolescents is essential for the determination of an appropriate nutritional status. This study intended to assess dietary patterns and its associated factors in rural Mozambican adolescents.

Methods
This was a cross-sectional study of 323 adolescents. A food frequency questionnaire was used and food was grouped into nine groups. An exploratory factorial analysis identified the food patterns. A principal component analysis provided food consumption scores in each factor, split into three groups. An adjustment of multinomial regression models was made.

Results
Two diet patterns were identified: pattern 1 (fats, beans, meats and eggs, cereals and sugars) and pattern 2 (vegetables, roots and tubers, fruits, chestnuts and walnuts). The proportional model for pattern 1 indicated highest consumption for adolescents with per capita family income equal to or greater than 78.13 meticais (Mozambique's currency) and for adolescents whose parents had a formal job. For pattern 2, consumption was lower for adolescents whose guardians had high school education or more. The consumption in the first three quartiles was lower for individuals with an income between 1 and 78.12 meticais.

Conclusions
For Mozambican adolescents, higher income, education and parents' jobs were predictive variables for consumption of fats, beans, meats and eggs, cereals, and sugars, while higher education and higher income implies lower consumption of vegetables, roots and tubers, fruits, chestnuts, and walnuts.

Keywords: adolescent, food consumption, education, low income country, nutrition transition, socio-economic factors.

Introduction

Hunger and malnutrition have been historically regarded as the main food consumption problems in Sub-Saharan African countries[1]. In recent times, however, these patterns have changed, and obesity and non-communicable diseases have started to play an important role in the distribution of health inadequacies in the population of these countries[1-2].

In Mozambique, 31% of families in rural communities experience inappropriate food consumption with a lack of a diversified diet[4]. Among Mozambique's provinces, Gaza, our chosen study setting, has one of the poorest diet quality as it does not meet the required nutrients, and increases the risk of chronic illnes[4].

Adolescence is universally considered to be a period of consolidation of appropriate food consumption habits for a healthy development. It is not unexpected, then, that adolescents are a group at risk for nutritional disturbances, especially due to inadequate patterns of food consumption[5-7]. As a consequence, this age group is typically marked by the onset of both nutritional deprivation and non-communicable chronic diseases[1,2].

Food consumption during school hours is a crucial factor for learning, as hunger may reduce academic performance[8]. An inadequate diet and a prolonged fasting period at school contribute to the risk of excessive eating after school hours, to compensate for the fasting period[8]. This problem may worsen academic performance[9]. This raises the question: What is the current food consumption and associated socio-economic factors of adolescent students of public institutions in their homes? This study is intended to provide some answers for students in the rural public schools in Manjacaze district, province of Gaza. We hope that this contribution to enhance knowledge about adolescence dietary patterns and associated socio-economic factors should provide input to professionals involved in planning actions to both offer high-quality food at school and promote healthy food consumption behavior at home.

Methods

This analytical cross-sectional study involved adolescents between 10-14 years of age in all five schools of the Main

Administration Unit of the Manjacaze district, in the province of Gaza, in the south region of Mozambique. To find a representative sample for each school, samples size calculations were used, considering a 95% confidence interval, a 5% error margin, and a 50% prevalence of inadequate consumption (as there are no dietary consumption data for this population), plus a loss of 20%, according the following formula:

$$n = \frac{z^2.p.q.N}{e^2(N-1) + z^2.p.q}$$

where z is the standard normal distribution score (1.96) at 5% significance (or 95% confidence), p refers to the proportion of students with adequate food consumption (as there is no adequate parameter of reference to estimate these data on the target population, 50% or 0.5 was considered), q is the complement of the probability of occurrence of p (q = 1-p), e is the margin of error (0.05) and N is the total of students in each school.

In a total population of 1625 school adolescents, the total sample size was 373 students. In each school, a randomized sample of size proportional to the number of students in the list of registered students at this age range was selected. After losses by refusal or lack of parenteral consent, 323 adolescents were interviewed.

Data collection was performed in the period from February to April 2015. This is a dry season in which the school period begins. The interviewer had been trained to use data collection instruments. Each adolescent was interviewed at school, along with their father, mother or guardian. In the first place, a socio-economic and demographic questionnaire was administered to the parents, containing questions about literacy, education, occupation and per capita family income. An assessment of the head of family's educational level was performed on the basis of their completed school grades. For this variable, four levels were chosen: no education, primary education I (1st to 5th class), primary education II (6th to 7th class), high school I (8th to 10th class), and high school II (11th to 12th class), and college. The guardian's information was used for a good number of adolescents who lived without a parent. The per capita family income was split into three categories: no income; from 1 to 78.12 meticais (the Mozambican currency; at the time of the questionnaire, the exchange rate was about 35 meticais per US dollar); 78.13 meticais or more. Finally, the parental or guardian's employment was categorized into formal jobs (e.g., miner, teacher, administrative technician) and informal jobs (e.g., salesperson, mason, angler).

Food consumption information was collected from the quanti-qualitative food frequency questionnaire (FFQ). This instrument initially contained previous information from 24-hour recall surveys of 30 students who had not been randomized for this study, aiming at using food and local preparations most consumed by the adolescents. The type of food and preparations were recorded along with the choices of their weekly and daily consumption, and their quantities in portions (small, medium, large) and in in-house measures (dish, spoon, glass, cup). An illustrated instrument was used containing drawings of food quantities and preparations to facilitate the responses of the interviewees.

Weekly consumption of each food item (food or food preparation) of the FFQ was determined by multiplying the size of the portion or in-house measure by the number of days in the week, by the number of times per day. Daily consumption was determined as the amount of each food and preparation consumed in a week (in grams or milliliters) divided by seven days.

After that, food preparations found in the FFQ were broken down into food items, according to the proportions normally used by the families: xiguinha (80% manioc and 20% peanuts); beans and their leaves (50% leaves, 20% green beans, 20% peanuts and 10% coconut milk); zucchini and its leaves (70% leaves, 15% zucchini and 15% peanuts); cacana (70% leaves of Mormodica balsamina), 20% peanuts and 10% coconut milk); matapa (70% manioc leaves, 20% peanuts and 10% coconut milk); and xima (100% corn flour).

Considering an analysis of the population's dietary composition, and that many food items presented very low consumption levels, the twenty-six food items consumed by more than 10% of the population were then classified. The information about the use of vegetable oils in food preparation was also entered, including oil in the preparations of fried bean dumplings and fried fish, and coconut milk. The sugar levels included sugar used in plain tea, coffee with milk, and soft drinks, according to information provided by the adolescents.

The following food groups were used: beans, cereals, roots and tubers, vegetables, fruits, meat and eggs, milk and cheese, chestnuts and walnuts, sugars (sugar, sweets and soft drinks) and oils and fats (oil, coconut milk, olive oil, butter, margarine and lard).

An exploratory factorial analysis[10] was used to identify dietary patterns from the food groups. The principal components method was used to estimate the factorial loads, commonalities and specificities. The varimax rotation method was used to obtain a structure that was easier to interpret. The number of factors (patterns) to be kept was determined based on a joint consideration of different criteria: a comparison of the eigenvalues obtained empirically with the eigenvalues obtained from correlation matrices associated to independent random variables; an evaluation of the variability explained by the set of factors and the coherence (practical justification) of the factors produced. The evaluation of the adjustment provided by the factorial analysis was based on the Kaiser-Meyer-Olkin criterion[11].

Provided the number of factors was determined, the factorial scores were calculated for each individual in each one of the factors by the weighted minimum squares method[12]. The scores calculated in each factor were split into three groups, according to their quartiles, as follows: Q1, Q2+Q3 and Q[4]. Based on this grouping, bivariate analyses were done based on the crossing of the grouped scores and the demographic and socioeconomic variables, by using the chi-square test of association to investigate a possible relationship between the variables.

Finally, all variables producing $p<0.10$ in the bivariate analysis were included in the adjustment of the multinomial

regression models[12] in which the categorized scores, produced by the factorial analysis, were taken as the response variable. Multinomial proportional odds models were adjusted, and the proportional odds assumption was verified by a likelihood ratio test. In case which the proportional odds assumption is not validated, partial multinomial proportional odds models was used. The results of the regression models are presented as estimated odds ratios and confidence intervals (95%).

The collected data were stored in Microsoft Office Excel, and analysed in R statistical software, version 3.2.2[13], using the ordinal package to fit multinomial models[14].

The research protocol was approved by the National Committee of Bioethics in Health of the Ministry of Health of Mozambique, protocol No.: 62/CNBS/[15], and an authorization was obtained from the District Services of Education, Youth and Technology for collecting data in the school.

Results

Of the total adolescents in the study, 169 were females and 154 were males. Most of them were in the age range of 10 to 12 years and had their mothers directly in charge of their education. Informal job was presented in 36% of the fathers, and a high number of the mothers did not work and/or practice livelihood farming. Approximately 20% of the adolescents did not have either a father or a mother. The families were usually large. More than 80% of them counted more than 4 individuals. No income was found in 36% of families and, of those who had an income, the monthly per capita income was 138.40 meticais (about 3.95 dollars) (Table 1).

Table 1: Distribution (%) of adolescents according to demographic and socioeconomic variables and scores of food consumption patterns. Manjacaze, Moçambique. 2015

Variables	Total	Pattern 1				Pattern 2			
	(%)	Q1	Q2,Q3	Q4	p	Q1	Q2,Q3	Q4	p
Sex									
Male	48.0	21	51	28	0.19	27	47	26	0.63
Female	52.0	29	49	22		23	53	24	
Age (years)									
10-12	68.0	24	48	27	0.55	27	45	28	<0.05
13-14	32.0	27	51	21		20	60	19	
Relationship to the adolescent´guardian									
Father	9.6	23	42	35		26	58	16	
Mother	57.3	23	51	26	0.12	25	49	25	<0.05
Grandfather/grandmother	12.7	41	46	12		22	32	46	
Others	20.4	21	53	26		26	59	15	
Job of the father/guardian									
Do not work/livelihood farming	20.0	32	59	9		24	46	30	
Informal job	36.0	28	45	28	<0.001	29	50	21	<0.05
Formal job	24.0	6	30	63		33	59	8	
Not applicable	21.0	28	59	13		15	49	37	
Job of the mother									
Do not work/livelihood farming	62.2	26	53	20		25	49	26	
Informal job	11.5	16	35	49	<0.001	27	54	19	0.17
Formal job	7.1	4	39	57		43	48	9	
Not applicable	19.2	34	52	15		18	50	32	
Individuals in the family									
Until 4	16.0	27	54	19		19	50	31	
5-7	52.0	26	48	26	0.80	27	51	21	0.52
8 or more	32.0	22	50	27		24	48	28	
Per capita income (meticais)									
No income	36.0	40	56	4		20	4	40	
1-78.12	31.0	28	56	16	<0.001	26	5	24	<0.001
78.13 or more	33.0	06	37	57		30	6	10	
Parental education									
No education	11.0	43	49	9		17	40	43	
Primary Education I	33.0	32	60	8		17	51	31	
Primary Education II	26.0	20	46	34	<0.001	26	49	25	<0.05
High school I	16.0	21	53	26		32	51	17	
High school II or more	14.0	9	31	60		40	53	7	

In the rotated factorial matrix presented in table 2, two diet patterns have been determined. Pattern 1 was characterized by the consumption of fats, beans, meats and eggs, cereals and sugars; and pattern 2 included vegetables, roots and tubers, fruits and chestnuts and walnuts. Jointly, the two factors explained more than half of the original data variation (51.5%). Additionally, the Kaiser-Meyer-Olkin value was 0.70 and the Bartlett 's test of sphericity produced $p < 0.001$, indicating that the correlations between food groups was not zero.

Table 2: Factor loadings and communities (h2) estimated for the two dietary patterns identified in adolescents. Manjacaze, Moçambique. 2015

Food groups	Fatorial loads		h_2
	Patterns identified		
	Pattern 1	Pattern 2	
Oils and fats	0.767	-0.233	0.782
Beans	0.732	-0.199	0.575
Meat and eggs	0.738	-0.211	0.776
Cereals	0.619	0.018	0.518
Sugars	0.619	0.016	0.396
Vegetables	-0.150	0.777	0.634
Chesnuts and walnuts	-0.271	0.790	0.715
Roots and tubers	-0.357	0.624	0.706
Fruits	0.155	0.458	0.576
Engeinvalues	3.320	1.314	
% of variance explained	29.7	21.8	
% cumulative variance explained	29.7	51.5	
Cronbach' alpha	0.750	0.610	

According to the results of a bivariate analysis, the quartiles of the dietary pattern scores showed the father's, guardian's or mother's job variable, per capita family income and educational level of the adolescents' parent as factors associated with pattern 1, while the adolescent's age, educational level of the person in charge, parental or guardian's job, per capita family income, and parents' educational level were factors associated with pattern 2 (Table 1).

The proportional odds model adjusted to the food consumption categories for the scores of pattern 1 indicated that consumption was higher for the adolescents with an income of 78.13 meticais or more and from 1 to 78.12 meticais when compared to the adolescents with no income; it was higher for the adolescents whose parents had a formal job, when compared to those who had informal jobs; it also indicated a moderate evidence that consumption for pattern 1 was higher for the adolescents whose guardians had an educational level equal to or greater than primary education II when compared to those who had no education (Table 3).

The proportional odds model adjusted to the categories of food consumption for consumption pattern 2 indicated that food consumption declined with the increase in the guardian's educational level, and it was lower for the adolescents whose guardians had high school level or more, when compared to those whose guardians had no schooling (Table 4).

Table 3 – Proportional odds model adjusted to the categories of food intake of adolescents to pattern[1]. Manjacaze, Moçambique. 2015

	Estimative	Odds ratio	CI(95%)	p
Intercept 1	0.384			
Intercept 2	3.367			
Per capita income (meticais)				
No income	0	1		
1-78.12	0.812	2.252	(1.208 ; 4.199)	0.011
78.13 or more	2.37	10.696	(4.75 ; 24.084)	<0.001
Job of the father/guardian				
Do not work/livelihood farming	0	1		
Informal job	0.31	1.364	(0.694 ; 2.679)	0.368
Formal job	1.012	2.750	(1.271 ; 5.954)	0.01
Not applicable	0.619	1.858	(0.869 ; 3.974)	0.11
Parental education				
No education	0	1		
Primary Education I	0.055	1.057	(0.495 ; 2.255)	0.887
Primary Education II	0.803	2.233	(0.985 ; 5.061)	0.054
High School I	0.593	1.809	(0.756 ; 4.327)	0.183
High School II or more	0.898	2.455	(0.895 ; 6.734)	0.081

Table 4: Proportional odds model adjusted to the categories of food intake of adolescents to pattern 2. Manjacaze, Moçambique. 2014

	Estimative	Odds ratio	CI(95%)	p
Intercept 1	-1.794			
Intercept 2	0.059			
Parental education				
No education	0	1		
Primary Education I	-0.247	0.781	0.372 ; 1.639	0.514
Primary Education II	-0.495	0.610	0.276 ; 1.346	0.221
High School I	-0.873	0.418	0.177 ; 0.981	0.045
High School II or more	-1.257	0.284	0.109 ; 0.751	0.011
Per capita income (meticais) (Q1 vs Q2+Q3 eQ4)				
No income	0	1		
1-78.12	-0.246	0.782	0.666 ; 2.457	0.460
78.13 or more	-0.161	0.751	0.589 ; 2.343	0.647
Per capita income (meticais) (Q1 and Q2+Q3 vs Q4)				
No income	0	1		
1-78.12	-0.667	0.513	0.066 ; 3.554	0.030
78.13 or more	-1.471	0.230	1.979 ; 9.596	0.011

In the case of the income variable, for the second pattern, the proportional odds assumption was not verified at the 5% significance level, rendering it necessary to estimate the effect of the income separately for each comparison of the consumption categories. An association was found, especially when comparing the first three quartiles to the 4th quartile. The consumption odds in the first three quartiles was lower for individuals with income between 1 and 78.12 meticais and higher than 78.13 meticais when compared to the individuals with no income.

Discusssion

Mozambique is a country with a population that is mainly poor and rural, and subsisting from farming activities. Frequently victimized by natural calamities, such as droughts, cyclones and water shortage, and without access to the consumption of appropriate food, a great portion of the family groups live in a situation of nutritional and food insecurity[4].

The usual diet of the adolescents in this study consists of little food diversity, which characterizes food monotony. There is a low consumption of fruits, vegetables, meats, eggs and dairy products, sources of vitamin and protein, and high consumption of cereals, sources of energy, especially rice and xima (a preparation based on corn flour), roots and tubers, and vegetable leaves. The highest consumption of products of plant origin reflects the dependence of the rural family groups in the province of Gaza on production based on livelihood farming and on the lack of physical and financial access to diversified food[4].

In addition to the abundant presence of cereals, roots and tubers in the diet, the group of chestnuts and walnuts–characterized by the presence of unsaturated fat contributing to high-energy intake–stands out in most of the preparations made by this rural community, especially cashew nuts and peanuts, ingredients widely used in local food preparations. The consumption of foods in this group is nutritionally positive, as in addition to having unsaturated fats, they are also rich in minerals, vitamins and fibers[15].

Changes in dietary patterns emerge when a population adopts a modern lifestyle in the course of its economic and social development. In developing countries, these changes have happened recently and very quickly, with an increasing impact in nutritional changes in rural and young populations. In spite of its nutritional value, the habit of consuming fruits and vegetables has gradually been lost over generations[1]. Acculturation and higher costs of fruits and vegetables in local markets are the reasons for lower consumption, although these foods are naturally available and appropriate for farming as they are resistant to local climate conditions[1,16]. An exception to this pattern is the frequent use of vegetable leaves alongside the base food in preparations. This observation corroborates studies indicating that in most African countries, vegetable leaves—especially those of manioc plants and leguminous plants such as zucchini—are commonly used as food by poor individuals in rural areas[1,16,17].

Among the least consumed foods in the region, the most important ones are eggs and milk. Red meat is practically absent in the diet, while fish is the most consumed animal product. In the rural areas, animal products such as meat and milk are consumed only in special dates, due to their high prices[18]. The absence of meat in the diet implies low availability of iron, generating the risk of anaemia, especially in adolescent girls[7]. It is worth highlighting that foods that are sources of iron have different levels of bioavailability, and the absorption iron in fish and poultry is roughly half of that in cattle beef. Although the adolescents' diet is rich in food that provides a certain amount of non-heme iron from vegetable products, this iron is not as bioavailable by the organism as the heme iron of animal origin[19].

The per capita family income found in this study is not enough for the acquisition of a basic food basket to feed a large family (average of 6.9 persons per family). It does not meet their basic needs and does not ensure a healthy diet, thus making the family members—including the adolescents—nutritionally vulnerable. In addition, frequent price variations of food products inevitably leads to changes in food consumption practices, as they buy low-cost basic food and, as a result, consume food of lower nutritional value and high-energy content. Sugary drinks and processed food are present in the local markets[2,4].

As per capita family income increases, there is an increase in the consumption of factor 1 food group (beans, meats and eggs, cereals, sugars and fats). A behavior similar to that of the income is found considering the type of job of the adolescent's father/mother or guardian, and this person's schooling level. The higher schooling level of the parents presumes more knowledge about healthy diets, predisposing them to higher income and, consequently, to more access to protein-rich food[16,20].

Despite the fact that better socio-economic conditions imply higher consumption of varied food, unhealthy food is also included, as it is rich in carbohydrates and lipids. This fact derives from the nutritional transition the country is experiencing. Families with guaranteed monthly income, and whose parents or guardians are educated, are higher consumers of industrialized products, such as polished grains, fried food, sugars, soda, among others, and lower consumers of vegetables and fruits, becoming more susceptible to problems such as overweight, obesity and non-communicable chronic diseases[1,2,16].

On the other hand, an income rise reduces the consumption of pattern 2 food groups (roots and tubers, vegetables, fruits and chestnuts and walnuts), which are products of plant origin and regarded healthier. Finding that there are less individuals with income in the fourth consumption quartile of pattern 2 is somewhat concerning, due to the vitamin and mineral content that the food groups of this pattern would supply to the organism[18].

The high consumption of pattern 2 by the poorest is one of the characteristics of the rural family groups at Gaza District, who depend on farming as a source of food production for their families. Women participate of this activity more often, probably because of their low educational level that prevents them from having a formal job[17,18].

The relationship between schooling and the consumption of pattern 1 groups is the opposite of pattern 2. For the healthier food groups, the higher the schooling level, in general, the lower the consumption of this type of food. This relationship is quite different from that observed in developed countries. But in these rural communities, fruits and vegetables are not seen as "actual food" such as the other types of foods like manioc and beans. The lack of knowledge about the importance of these types of food causes them to express lower social status, thus not being valued by the local communities[4,16].

The results herein presented should be seen with caution, as a limitation to be considered is that the production of certain types of food in this region is seasonal, depending on the rainy period, which could under or overestimate their consumption.

Conclusion

In short, two diet patterns were identified: pattern 1-fats, beans, meats and eggs, cereals and sugars; pattern 2- vegetables, roots and tubers, fruits, chestnuts and walnuts. Results show that the higher the income, formal jobs and schooling levels of the guardians, the higher the consumption of pattern 1 food groups; and the higher the income and schooling level of the guardian, the lower the consumption of pattern 2 food groups. This result indicates an urgent need of working towards integrated public policies and interventions aiming at food and nutritional education, in order to ensure appropriate and healthy food with economic sustainability for this population. In addition, it is also necessary to value the local culture and encourage the consumption of fruits and vegetables, as the factors that improve social life quality generally favour the consumption of unhealthy food.

Conflicts of interest

All authors declare that they have no competing interests related to this work.

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