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Research Article

Food Consumption Practices and Implications for Mycotoxin Exposure Risk: A Cross-sectional Study in Inhambane and Gaza Provinces, Mozambique

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Abstract

Diet is considered the main route of exposure to the risk of mycotoxin poisoning. Consequently, given the prevalence of mycotoxins in Mozambique, there is a need to develop studies on the population's consumption habits to implement control and mitigation strategies in a sustainable way. This quantitative and cross-sectional study aimed to report the dietary habits of the population in two provinces of Mozambique and to investigate whether province, place of residence, gender, and age were differentiating factors in dietary habits. Primary data were collected using a food frequency questionnaire adapted from a validated version for Portugal, which was modified to include foods commonly consumed in Mozambique. The data, collected by agricultural technicians between October and November 2022, refer to 300 individuals from 55 households. According to the results, 58.4% of the products consumed by families were of local origin, 40.2% were of national origin, and only 1.4% were imported. Foods such as milk, oil, fresh fish, eggs, rice, bread, sugar, onions, water, mango, and bananas are part of the daily diet of these households. In addition, it was found that the province, environment, and gender of the participants acted as differentiators of eating habits. That is, a greater quantity of foods from all food groups was consumed in the urban environment compared to the rural one. Considering the province, the consumption of fats, bread, and cereals is higher in Gaza, while, in Inhambane, dairy products, fats, fruits, and beverages are consumed in greater quantities. Finally, considering gender, it was found that women consume a greater quantity of dairy products. These results are crucial for the development of sampling strategies that assess fungal and mycotoxin contamination and estimate the risk of exposure to the studied population.

Keywords: Contaminated food; Mycotoxins, Eating habits, Mozambique.

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Introduction

Understanding dietary habits is essential for elucidating the relationship between nutrition and health outcomes at both individual and population levels (Volp et al., 2010). Food safety has emerged as a pressing public health concern, as consumers are increasingly exposed to diverse hazardous agents through food consumption (Malissiova et al., 2020). Among these, mycotoxins, secondary metabolites produced by specific filamentous fungi (Unicsovics et al., 2024), pose a particularly significant risk. These compounds can enter the human diet through contaminated plant products or residues in animal-derived foods (Unicsovics et al., 2024) and have been implicated in disorders affecting the gastrointestinal, urogenital, vascular, renal, and nervous systems. Importantly, mycotoxin exposure has been linked to the development of various cancers, including breast, lung, brain, skin, and colon malignancies (Malissiova et al., 2020; Demirel & Doğan, 2023).

In Mozambique, mycotoxins represent a substantial public health threat. Approximately 80% of the population relies primarily on agriculture for income, often as their sole livelihood. Key staple crops, including maize, cassava, and peanuts, are particularly susceptible to mycotoxin contamination (Tamele et al., 2022). The paucity of experimental research and the absence of systematic monitoring programs further exacerbate the population's risk of exposure (Van Rensburg et al., 1985).

Against this backdrop, the present study aimed to describe the dietary habits of populations in Gaza and Inhambane provinces and to assess potential differences in monthly consumption by province, residence, sex, and age group.

The manuscript is structured into five sections. Section 1 introduces the study and its rationale; Section 2 provides a review of the relevant literature; Section 3 details the methodology, including data collection and analysis procedures; Section 4 presents the results with accompanying tables and figures, followed by a critical discussion; and Section 5 concludes with key findings, recommendations, study limitations, and suggestions for future research.

Literature Review

Dietary exposure to contaminants is influenced by various factors, including eating habits, food types and quantities, contaminant concentrations, processing methods, seasonal variations, and geographic location (Malissiova et al., 2020). Mycotoxins are a diverse group of environmentally persistent compounds that can cause adverse health effects or death in humans and animals when ingested, inhaled, or absorbed (Stoev, 2013). The most common species belong to *Aspergillus, Penicillium*, and *Fusarium* (Unicsovics et al., 2024).

Marin et al. (1996) reported that trichothecenes, fumonisins, ochratoxins, and zearalenone contribute substantially to dietary exposure. Cereals, nuts, fruits, fats and oils, and alcoholic beverages are primary sources of human exposure.

Malissiova et al. (2020) studied 403 residents in Thessaly, Greece, finding adherence to a Mediterranean diet rich in fruits, vegetables, milk, and dairy products. Mycotoxins and pesticides were primarily detected in cereals, including rice, with women and older adults (aged 65 years and above) exhibiting higher exposure.

Unicsovics et al. (2024) conducted a cohort study of 52 women (44-86 years) with histologically confirmed endometrial cancer, divided into low-grade (grades 1-2) and high-grade (grade 3) groups. Higher aflatoxin and zearalenone levels correlated with greater cancer severity.

Frequent contamination of crops by mycotoxin-producing fungi is driven by climatic conditions, poor agricultural practices, poverty, limited producer knowledge, and weak regulation (Ezekiel et al., 2021). In humid tropical regions, high temperatures and rainfall favor fungal growth, while socioeconomic challenges exacerbate the risk of contamination (Ekwomadu & Mwanza, 2015).

Mozambique faces high food insecurity and malnutrition due to limited access to safe, nutritious foods (FAO, 2009). Droughts and irregular rainfall exacerbate vulnerability in Nampula, Tete, Manica, Gaza, Inhambane, and

Maputo, while floods affect Sofala, Manica, and Gaza (CNSAN, 2021).

Although research on mycotoxins in Mozambique is limited, aflatoxins, especially aflatoxin B1 (AFB1), have been most studied due to their toxicity, association with liver cancer (Van Rensburg et al., 1985), and export restrictions on peanuts and maize (Augusto et al., 2014). Warth et al. (2012) detected high aflatoxin levels in maize and peanuts from Nampula markets, while a review of 42 maize and soil samples confirmed predominance of *Aspergillus flavus* (Probst et al., 2014). Post-harvest practices further influence toxin levels in the diet. Hlashwayo (2018) found mean AFB1 concentrations in raw peanuts from Maputo markets of 2.71 µg/kg, exceeding the European Union limit of 8 µg/kg. Based on this context, the following null hypotheses were formulated:

H_{01}: Eating habits are similar in Gaza and Inhambane provinces.

H_{02}: Rural or urban environment does not influence eating habits.

H_{03}: Food consumption, by food groups, is independent of gender.

H_{04}: Food consumption, by food group, is not associated with age.

Methodology

A quantitative, cross-sectional study was conducted in Gaza and Inhambane provinces, southern Mozambique, between October and November 2022. Three districts per province were selected: Gaza (Chokwé, Chonguene, Mandjakaze) and Inhambane (Jangamo, Massinga, Inharrime). Selection criteria included high production of crops prone to fungal contamination and mycotoxin formation (such as maize, peanuts, and beans) (MADER, 2021), elevated household food insecurity (INE, 2020), a lack of local dietary studies, and limited research funding.

Data were collected using a food frequency questionnaire (FFQ) adapted from a validated Portuguese version to include Mozambican foods and categorized according to the Food Pyramid (Philippi et al., 1999). Portion sizes were recorded in grams or household measures. A pilot test with six households ensured clarity and comprehension of the questionnaire.

The final FFQ, administered by trained interviewers, comprised three sections: (1) socio-economic profile, including residence, gender, age, marital status, education, household size and income, ethnicity, religion, occupation, and housing type; (2) dietary habits, including food origin, presence of infants, meals outside the home, and frequency of eating out; and (3) average monthly consumption across nine food groups: Dairy; Oils and Fats; Eggs, Meat and Fish; Bread, Cereals and Similar; Sweets and Pastries; Vegetables; Fruits; Beverages; and Others.

A non-probabilistic convenience sample was used. Based on 2017 census data (Gaza: 1,465,802 inhabitants; Inhambane: 1,564,289 inhabitants) (INE, 2022) and the formula (1) presented by Yamane (1967) at a 90% confidence level, and 10% margin of error, a minimum of 100 participants per province was required.

$$n = \frac{N}{1+Ne^2} \quad (1)$$

Where:

n - sample size to be calculated.
N - relevant population.
e - standard error (dependent on the desired level of confidence).

Data were entered into Excel and analyzed descriptively. As the distributions were non-normal, the Mann–Whitney and Kruskal–Wallis tests were applied, with significance set at 0.05. Participants were fully informed of the study's aims, assured of anonymity, and provided written informed consent prior to participation.

Results and Discussion

In this section, the respondents' profiles are initially presented. This is followed by the weight of food consumed by food groups and by provinces. Finally, monthly consumption is compared by province, place of residence, gender, and age groups.

Considering the profile of the family head, Table 1 indicates that most family heads resided in urban areas (54.5%), were female (58.2%), relatively young (49.1%), married or in a marital union (70.9%), and had completed at least lower secondary education (65.5%). Ages of family heads ranged from 20 to 75 years, with a mean of 42.3 years (SD = 13.73). The median and mode were 43 and 21 years, respectively. Additionally, most households reported an income between 5,800 and 11,400 metical (63.6%), equivalent to 2 to 3 minimum wages in Mozambique. Most family heads were either self-employed (49.1%) or employed by others (40.0%), as shown in Figure 1

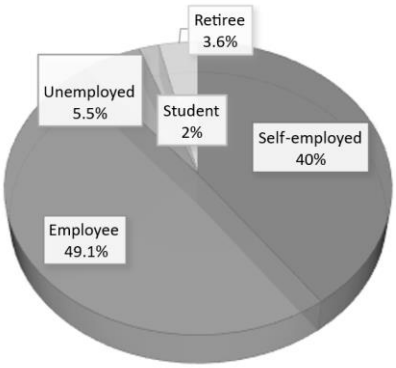

Fig 1. Professional status of the head of the family

The heads of 55 households were interviewed, 28 from Gaza Province (50.9%) and 27 from Inhambane Province (49.1%), as shown in Table 1.

Most households consisted of 2 to 5 members (54.5%), while the remaining households had between 6 and 11 members (45.5%).

Table 1: Respondents' profile

Variable	Categories	Frequencies	
		Absolute (n)	Relative (%)
Province	Gaza	28	50.9
	Inhambane	27	49.1
District	Chokwe	8	14.5
	Chongoene	10	18.2
	Mandjakaze	10	18.2
	Massinga	12	21.8
	Jangamo	9	16.4
	Inharrime	6	10.9

Gender	Female	32	58.2
	Male	23	41.8
Residence	Rural	25	45.5
	Urban	30	54.5
Age (years)	20-31	14	25.5
	32-42	13	23.6
	43-53	16	29.1
	54-64	10	18.2
	65-75	12	3.6
Marital status	Married	13	23.6
	Cohabitation	26	47.3
	Single	11	20
	Widowed	4	7.3
	Missing	1	1.0
Educational qualifications	No education	7	12.7
	Primary education	12	21.8
	Secondary school (1st cycle)	10	18.2
	Secondary school (2nd cycle)	20	36.4
	Higher education	6	10.9
Monthly household income level (metical)	3,000-5,800	10	18.2
	5,801-8,600	18	32.7
	8,601-11,400	17	30.9
	11,401-14,200	2	3.6
	14,201-17,000	8	14.5
Household size	2 – 6 members	30	54.5
	6 – 11 members	25	45.5

Considering all members of the 55 families (n = 300; Gaza: n = 151; Inhambane: n = 149), only 10 were infants (Gaza: n = 8; Inhambane: n = 2), although only 8 reported being breastfed (Gaza: n = 7; Inhambane: n = 1). In Gaza, of these, 3 were exclusively breastfed, 3 received mixed feeding (breast milk/formula, or porridge), and 1 was predominantly breastfed, with the introduction of water/tea. In Inhambane, there was only one infant, who was exclusively breastfed. In Mozambique, maize is the staple food. Most children consume maize flour porridge as their first food, with most mothers adding table sugar to enhance flavor and palatability (Dewey & Brown, 2003). In the northern regions of the country, sweet potatoes and cassava flour are commonly included in main meals. These foods are among the agricultural products that present varying levels of risk for mycotoxin contamination, ranging from moderate to high.

As shown in Figure 2, 58.4% of the products consumed by families were locally sourced, 40.2% were of national origin, and only 1.4% were imported.

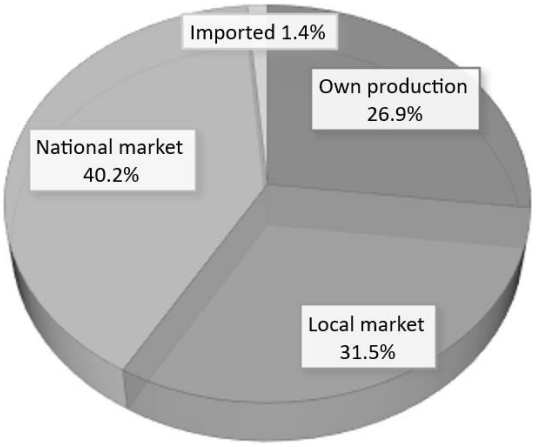

Fig 2. Origin of products consumed by families

To approach the dietary intake, the relative weight of each food item within its respective food group was first determined, followed by an analysis of the distribution of each food item by province. The relative frequency of consumers per food item and per food group was also calculated.

Within the "Dairy" group, Table 2 shows that the three foods with the highest weight were milk (51.4%), yoghurt (17.1%), and other dairy products (14.1%), with milk and yoghurt having a higher weight in Inhambane compared to Gaza.

Table 2: Weight of products consumed in the "Dairy" food group and number of consumers in total and by province

Dairy	Total of consumers		Gaza		Inhambane	
	n	Weight (%)	n	Weight (%)	n	Weight (%)
Milk	230	51.4	107	33.3	123	62.3
Other milks	107	14.1	61	18.9	46	11.2
Yogurts	154	17.1	78	16.6	76	17.4
Cheese	52	1.7	19	2.1	13	1.4
Milk desserts	49	4.4	37	7.7	12	2.4
Ice cream	139	11.4	91	21.6	48	5.3

Regarding "Oils and Fats," Table 3 shows that oils (54.2%), butter (18.9%), and olive oil are the products with the highest weight in the food group (over 10%). These are also the products with the highest weight by province.

Table 3: Weight of products consumed in the "Oils and Fats" food group and number of consumers in total and by province

Oils and Fats	Total of consumers		Gaza		Inhambane	
	n	Weight (%)	n	Weight (%)	n	Weight (%)
Olive Oil	141	15.5	83	16.6	58	14.2
Oils	296	54.2	148	51.6	148	57.4
Margarine	121	7.3	68	7.4	53	7.3
Butter	234	18.9	107	19.4	127	18.3
Mafura Oil	94	4.0	60	5.0	34	2.8

In the "Eggs, meat, and fish" food group, Table 4 shows that the three products with the highest weight are fresh fish (24.4%), eggs (22.2%), and chicken (14.0%). Furthermore, fresh fish, chicken, beef, pork, goat, and rabbit meat, as well as eggs and dried fish, are among the foods commonly consumed by most household members.

Table 4: Weight of products consumed in the "Eggs, meat, and fish" food group and number of consumers in total and by province

Eggs, meat, and fish	Total of consumers		Gaza		Inhambane	
	n	Weight (%)	n	Weight (%)	n	Weight (%)
Eggs	251	22.2	131	24.7	120	19.2
Chicken	294	14.0	147	14.1	147	13.9
Dried Meat	8	0.2	6	0.2	2	0.1
Meat	256	9.7	118	9.8	138	9.5
Liver	139	3.8	77	3.7	62	3.9
Kidneys/Heart/Tongue	24	0.5	18	0.7	6	0.2
Ham/Salpicon/Chorizo/Prosciutto	68	2.4	27	1.1	41	4.0
Bacon	8	0.2	8	0.4	0	0
Sausages	83	4.8	46	5.6	37	3.9
Dried Fish h	176	5.8	96	5.6	80	5.9
Fres Fish	294	24.4	147	26.2	147	22.3
Canned Tuna/Sardines	132	5.9	54	6.1	78	5.6
Squid/Octopus	26	0.5	6	0.2	20	1.2
Crab/Shrimp/Clams	131	4.4	34	1.2	97	8
Game	65	1.3	10	0.4	55	2.5

In the food group "Bread, cereals and similar", rice (31.7%), bread (20.7%), and xima (13.6%) are foods that account for more than 10% (Table 5) and are also the products sought by the largest number of consumers.

Table 5: Weight of products consumed in the "Bread, cereals and similar" food group and number of consumers in total and by province

Bread, cereals, and similar	Total of consumers		Gaza		Inhambane	
	n	Weight (%)	n	Weight (%)	n	Weight (%)
Bread	297	20.7	149	25.2	148	15.8
Cornbread	57	0.4	14	0.2	43	0.6
Sura dumplings	94	1.3	31	0.6	63	2.1
Xima (corn + cassava)	297	13.6	149	13.9	148	13.3
Cereal flakes	137	3.4	86	3.5	51	3.3
Rice	294	31.7	146	28.3	148	35.4
Pasta	278	3.9	137	3.3	141	4.6
French fries	245	4.6	117	5.2	128	3.9
Roasted potatoes	283	5.0	146	4.6	137	5.4
Roasted/cooked cassava	293	6.7	146	6.7	147	6.8
Rhale (tapioca/cassava seed)	293	6.7	146	6.7	147	6.8
Molina	269	1.9	135	1.7	134	2.0

Within the "Sweets and Pastries" group, the three products with the highest consumption weight were sugar (54.1%), biscuits (Maria, water & salt, or wholemeal) (15.1%), and fried cakes (12.8%) (Table 6). In Inhambane, biscuits were consumed by all family members, while fried cakes (14.1%) had a higher weight compared to Gaza (11.4%).

Table 6: Weight of products consumed in the "Sweets and Pastries" food group and number of consumers in total and by province

Sweets and Pastries	Total of consumers		Gaza		Inhambane	
	n	Weight (%)	n	Weight (%)	n	Weight (%)
Biscuits (Maria, water and salt, or whole grain)	286	15.1	137	17.8	149	12.5
Other cookies or crackers	205	11.3	112	13.8	93	9.0
Chocolate	78	2.7	64	3.7	14	1.7
Marmalade	0	0	0	0	0	0
Honey	150	4.1	68	4.8	82	3.4
Sugar	294	54.1	146	48.5	148	59.3
Fried	201	12.8	107	11.4	94	14.1

Within the "Vegetables and Legumes" group, onion (30.7%), lettuce/watercress (6.6%), and carrot (6.0%) were the three most representative products. Beans showed equal consumption across provinces, whereas onion consumption was higher in Inhambane. Overall, the three foods consumed by the vast majority of participants were Nhemba beans (100%), onion (98.0%), and other beans (96.3%) (Table 7).

Table 7: Weight of products consumed in the "Vegetables and Legumes" food group and number of consumers in total and by province

Vegetables and Legumes	Total of consumers		Gaza		Inhambane	
	n	Weight (%)	n	Weight (%)	n	Weight (%)
Kale	288	6.1	147	6.6	141	5.6
Green Beans	184	0	92	2.4	92	2.2
Lettuce/Watercress	290	6.6	143	6.8	147	6.4
Onion	294	30.7	147	26.7	147	34.8
Carrot	261	6.0	145	6.3	116	5.7
Pepper	245	6.3	123	6.3	122	6.3
Cucumber	242	4.1	118	3.9	124	4.4
Legumes	293	3.7	145	3.5	148	3.9
Cowpeas	300	1.4	151	1.4	149	1.4
Other Beans	289	3.7	143	3.7	146	3.7
Peas/Fava Beans	45	0.3	15	0.1	30	0.5
Cassava Leaf	280	2.9	132	2.7	148	3.1
Sweet Potato Leaf	236	3.2	124	4.1	112	2.4
Gimboa	101	1.0	84	1.8	17	0.2
Kiabos	101	1.0	84	1.8	17	0.2
Canana	245	2.6	118	2.9	127	2.4
Matapa	277	3.1	129	2.9	148	3.3
Nhangana	258	3.5	125	3.9	133	3.0
Tseque	215	2.1	127	2.1	88	2.0
Mboa	249	3.1	133	3.4	116	2.8
Djejele	147	2.7	37	3.3	110	2.1
Soybeans	63	0.5	30	0.3	33	0.6
Pumpkin Leaf	239	3.1	126	3.3	113	2.9

Within the "Beverages" group, water (67.1%), tea (14.6%), and soft drinks (6.0%) were the three products with the highest weight in the diet, as well as the most frequently consumed (Table 8). However, by province, consumers in Inhambane preferred fruit juices, whereas those in Gaza preferred soft drinks.

Table 8: Weight of products consumed in the "Beverages" food group and number of consumers in total and by provinces

Beverages	Total of consumers		Gaza		Inhambane	
	n	Weight (%)	n	Weight (%)	n	Weight (%)
Water	298	67.1	150	72.1	148	62.3
Beer	34	0.7	14	0.5	20	0.9
Soft Drinks	286	6.0	144	6.3	142	5.8
Fruit Juices	256	5.2	114	4.0	142	6.4
Coffee	114	3.0	50	2.1	64	3.9
Tea	293	14.6	147	11.9	146	17.2
Maheu	224	2.2	110	2.2	114	2.3
Malambe Juice	110	1.0	46	0.7	64	1.3
Wishs	6	0.1	4	0.2	2	0

Within the "Fruits" group, the most consumed items were mango (97.0%), fresh tomato (98.0%), and banana (94.0%). These products were also the most representative when considering average monthly consumption (Table 9).

Table 9: Weight of products consumed in the "Fruits" food group and number of consumers in total and by province

Fruits	Total of consumers		Gaza		Inhambane	
	n	Weight (%)	n	Weight (%)	n	Weight (%)
Apples and pears	347	2.7	119	2.5	128	3.0
Oranges and tangerines	274	6.4	126	7.0	148	5.8
Bananas	282	7.3	138	7.9	144	6.7
Strawberries	59	1.0	32	0.6	27	1.3
Peaches	58	0.6	28	0.3	30	1.0
Mango	291	23.5	144	24.2	147	22.9
Papaya and papaya	264	2.7	132	3.1	132	2.3
Avocado	238	3,5	114	4.6	124	2.5
Guava	118	1.0	46	0.4	72	1.5
Maboque	251	2.7	141	3.8	110	1.8
Pineapple	102	0.7	43	0.4	59	1.0
Passion fruit	116	0.9	29	0.3	87	1.5
Fresh grapes	116	0.9	29	0.3	87	1.5
Roasted peanuts	240	2.8	120	2.8	120	2.8
Fresh peanuts	254	4.7	116	4.2	138	5.2
Roasted cashews	254	2.3	140	2.9	114	1.8
Other nuts	137	0.8	62	0.9	75	0.6
Olives	16	0.1	0	0	16	0.1
Massala	158	1.0	64	1.0	94	1.0
Malambe	158	1.2	51	0.6	107	1.8
Ata	168	2.5	96	3.3	72	1.7

Mafphilwa	138	1.4	48	0.8	90	2.0
Tinysiva	103	1.2	38	0.8	65	1.5
Jambalau	192	3.5	82	2.0	110	4.7
Sweet cane	241	3.5	118	0.1	123	3.6
Melon	147	1.4	87	1.7	60	1.1
Watermelon	147	1.4	87	1.8	60	1.0
Fresh tomato	294	18.4	147	18.6	147	18.3

Within the "Others" food group, coconut curry (23.8%), peanut curry (23.6%), and mayonnaise (11.6%) had the highest consumption weight (Table 10). In Inhambane, the average consumption of coconut and peanut curry was higher than in Gaza. In Inhambane, vegetable soup ranked third among the highest-weighted products, while in Gaza it was mayonnaise.

Table 10: Weight of products consumed in the "Others" food group and number of consumers in total and by province

Others	Total of consumers		Gaza		Inhambane	
	n	Weight (%)	n	Weight (%)	n	Weight (%)
Croquettes and Rissoles	119	2.1	67	2.2	52	1.9
Mayonnaise	267	11.6	136	17.1	131	6.9
Sauces/Ketchup	122	3.8	69	6.3	53	1.7
Pizza	21	0.2	15	0.4	6	0.1
Vegetable Soup	242	8.3	120	6.1	122	10.3
Fish Soup	201	6.2	93	5.2	108	7.0
Peanut Curry	295	23.6	147	18.8	148	27.6
Coconut Curry	296	23.8	148	19.8	148	27.1
Canned Chili Peppers	55	4.1	36	4.5	19	3.7
Xiguinha	247	4.8	128	1.0	119	0.9
Tihove	79	1.5	38	5.1	41	4.6
Xibhehe	55	0.9	39	0.9	16	2.0
Badjia	201	7.6	114	10.9	87	0.7
Hamburger	47	0.6	24	0.7	23	0.6

To identify differences, monthly median food consumption was compared by province, place of residence, gender, and age group. The results are presented in Tables 11–16.

The comparison of consumption by province shows no statistically significant differences for "Eggs, meats and fish" (p-value = 0.744 > 0.05), "Sweets and pastries" (p-value = 0.119 > 0.05), "Vegetables and legumes" (p-value = 0.936 > 0.05), and "Others" (p-value = 0.193 > 0.05), indicating that monthly quantities were similar across provinces. However, Gaza showed higher consumption of "Oils and fats" and "Bread, cereals and similar products" (p-value < 0.05). In contrast, Inhambane showed higher consumption of "Dairy" (p-value = 0.001 < 0.05), "Fruits" (p-value = 0.049 < 0.05), and "Beverages" (p-value = 0.022 < 0.05), as shown in Table 11.

Table 11: Weight of Monthly quantity (portions) of food consumed by food group and by province

Food group	Province	n	Median	Mean ranks	p-value[a]
Dairy (n = 299)	Gaza	151	2.2	126.44	0.001*
	Inhambane	148	5.0	174.03	
Oils and fats (n = 300)	Gaza	151	11.4	161.69	0.024*
	Inhambane	149	9.8	139.16	
Eggs, meat, and fish (n = 300)	Gaza	151	3.2	152.12	0.744
	Inhambane	149	3.3	148.86	
Breads, cereals, and similar products (n = 300)	Gaza	151	15.2	161.17	0.032*
	Inhambane	149	13.5	139.68	
Sweets and pastries (n = 300)	Gaza	151	9.0	142.74	0.119
	Inhambane	149	9.7	158.36	
Vegetables and legumes (n = 300)	Gaza	151	11.8	150.90	0.936
	Inhambane	149	12.2	150.09	
Fruits (n = 300)	Gaza	151	5.8	140.72	0.049*
	Inhambane	149	6.7	160.42	
Beverages (n = 300)	Gaza	151	21.4	139.07	0.022*
	Inhambane	149	22.6	162.09	
Others (n = 300)	Gaza	151	6.4	144.03	0.193
	Inhambane	149	7.0	157.06	

**Statistically significant differences at the 5% significance level.*
[a] Obtained with the Mann-Whitney test.

In Table 12, the median consumption by food group according to place of residence is presented. The results indicate that food consumption differs statistically across all food groups (p-value < 0.05), except for the "Vegetables and legumes" group (p-value = 0.168 > 0.05), for which no statistically significant differences were observed. However, consumption of these products was slightly higher in urban areas compared to rural areas. A similar pattern was observed for the remaining food groups. Overall, median food consumption was generally higher in urban areas.

Table 12: Weight of Monthly quantity (portions) of food consumed by food group and by place of residence

Food group	Province	n	Median	Mean ranks	p-value[a]
Dairy (n = 299)	Rural	134	1.3	116.93	0.001*
	Urban	165	5.0	176.86	
Oils and fats (n = 300)	Rural	134	6.6	133.44	0.002*
	Urban	166	11.4	164.27	
Eggs, meat, and fish (n = 300)	Rural	134	2.3	106.81	0.001*
	Urban	166	3.9	185.77	
Breads, cereals, and similar products (n = 300)	Rural	134	13.6	133.94	0.003*
	Urban	166	14.4	163.86	
Sweets and pastries (n = 300)	Rural	134	9.5	136.12	0.010*
	Urban	166	9.8	162.11	
Vegetables and legumes (n = 300)	Rural	134	11.3	142.81	0.168
	Urban	166	12.0	156.71	
Fruits	Rural	134	6.8	139.03	0.040*

(n = 300)	Urban	166	6.6	159.76	
Beverages (n = 300)	Rural	134	21.1	135.38	0.007*
	Urban	166	22.4	162.71	
Others (n = 300)	Rural	134	5.7	128.84	0.001*
	Urban	166	7.1	167,98	

**Statistically significant differences at the 5% significance level.*
[a] *Obtained with the Mann-Whitney test.*

Only "Dairy" consumption differed significantly by gender, with females consuming more than males ($p = 0.045 < 0.05$). For other groups, consumption was similar across genders (p-value > 0.05) (Table 13).

Table 13: Weight of Monthly quantity (portions) of food consumed by food group and by gender

Food group	Province	n	Median	Mean ranks	p-value[a]
Dairy (n = 298)	Female	168	4.1	158.27	0.045*
	Male	130	3.6	138.17	
Oils and fats (n = 298)	Female	168	11.4	152.09	0.554
	Male	130	10.3	146.15	
Eggs, meat, and fish (n = 298)	Female	168	3.3	157.47	0.069
	Male	130	3.2	139.20	
Breads, cereals, and similar products (n = 298)	Female	168	14.4	155.31	0.185
	Male	130	13.5	141.99	
Sweets and pastries (n = 298)	Female	168	9.7	152.95	0.432
	Male	130	9.1	145.04	
Vegetables and legumes (n = 298)	Female	168	11.8	149.99	0.911
	Male	130	11.8	148.87	
Fruits (n = 298)	Female	168	6.7	148.47	0.815
	Male	130	6.8	150.83	
Beverages (n = 298)	Female	168	22.4	152.48	0.497
	Male	130	21.4	145.65	
Others (n = 300)	Female	168	7.0	153.28	0.389
	Male	130	6.4	144.61	

**Statistically significant differences at the 5% significance level.*
[a] *Obtained with the Mann-Whitney test.*

Regarding age groups, the "Beverages" food group was the only one to show statistically significant differences (p-value = 0.037 < 0.05). For the remaining food groups, although differences were not statistically significant (p-value > 0.05), some disparities were observed. For instance, elderly individuals consumed the least amounts of "Dairy," "Eggs, Meats and Fish," "Sweets and Pastries," and "Fruits." This age group, however, had the highest consumption of "Vegetables and Legumes," "Bread, Cereals and Similar," and "Other" food items. In contrast, children consumed higher amounts of "Oils and Fats" and "Sweets and Pastries," and lower quantities of "Vegetables and Legumes" and "Other" foods. Young adults consumed the most "Dairy" and, together with adults, were the highest consumers of "Eggs, Meats, and Fish." Additionally, adults consumed lower quantities of "Bread, Cereals and Similar" but higher amounts of "Fruits," along with adolescents. Adolescents, in turn, consumed the lowest amounts of "Oils and Fats" (Table 14).

Table 14: Weight of Monthly quantity (portions) of food consumed by food group and by age

Food group	Province	n	Median	Mean ranks	p-value[a]
Dairy (n = 298)	0-12 years (Children)	89	3.8	154.92	0.315
	13-17 years (Teenagers)	34	3.9	143.01	
	18-29 years (Young Adults)	81	4.7	160.85	
	30-59 years (Adults)	84	3.0	139.62	
	≥ 60 years (Seniors)	10	2.8	114.40	
Oils and fats (n = 298)	0-12 years (Children)	89	11.2	153.04	0.852
	13-17 years (Teenagers)	34	11.3	134.62	
	18-29 years (Young Adults)	81	11.4	150.62	
	30-59 years (Adults)	84	11.2	151.77	
	≥ 60 years (Seniors)	10	9.2	140.35	
Eggs, meat, and fish (n = 298)	0-12 years (Children)	89	3.2	143.17	0.380
	13-17 years (Teenagers)	34	3.2	140.37	
	18-29 years (Young Adults)	81	3.6	165.60	
	30-59 years (Adults)	84	3.2	146.42	
	≥ 60 years (Seniors)	10	3.0	132.35	
Breads, cereals, and similar products (n = 298)	0-12 years (Children)	89	14.1	145.35	0.586
	13-17 years (Teenagers)	34	13.8	149.06	
	18-29 years (Young Adults)	81	14.6	160.91	
	30-59 years (Adults)	84	14.1	141.04	
	≥ 60 years (Seniors)	10	13.5	166.55	
Sweets and pastries (n = 298)	0-12 years (Children)	89	10.3	166.31	0.084
	13-17 years (Teenagers)	34	9.7	161.59	
	18-29 years (Young Adults)	81	9.7	145.33	
	30-59 years (Adults)	84	8.4	134.84	
	≥ 60 years (Seniors)	10	6.8	115.70	
Vegetables and legumes (n = 298)	0-12 years (Children)	89	11.7	144.31	0.958
	13-17 years (Teenagers)	34	12.1	152.34	
	18-29 years (Young Adults)	81	11.8	152.54	
	30-59 years (Adults)	84	11.8	149.54	
	≥ 60 years (Seniors)	10	12.5	161.15	
Fruits (n = 298)	0-12 years (Children)	89	6.8	147.72	0.370
	13-17 years (Teenagers)	34	6.8	155.79	
	18-29 years (Young Adults)	81	6.7	149.27	
	30-59 years (Adults)	84	6.9	155.27	
	≥ 60 years (Seniors)	10	5.8	97.25	
Beverages (n = 298)	0-12 years (Children)	89	22.4	139.75 (I)	0.037*
	13-17 years (Teenagers)	34	20.2	119.06 (I)	
	18-29 years (Young Adults)	81	22.4	167.19 (II)	
	30-59 years (Adults)	84	22.4	157.67 (II)	
	≥ 60 years (Seniors)	10	20.7	127.95 (II)	
Others	0-12 years (Children)	89	6.4	136.02	0.236

(n = 300)	13-17 years (Teenagers)	34	6.9	139.50	
	18-29 years (Young Adults)	81	6.9	161.90	
	30-59 years (Adults)	84	6.9	152.42	
	≥ 60 years (Seniors)	10	8.1	178.50	

**Statistically significant differences at the 5% significance level.*
[a] Obtained with the Kruskal-Wallis test.

Statistically significant differences were observed in the "Beverages" food group across age categories, leading to the identification of two homogeneous groups (I and II). Group I included children and adolescents, whose consumption did not differ significantly from each other ($p > 0.05$) but was significantly lower (p-value < 0.05) than that of Group II, which comprised young adults, adults, and the elderly. In Group II, beverage consumption was both statistically higher and significantly different from that in Group I (Figure 3).

Group I	Group II
Children Teenagers	Young adults Adults Seniors

Fig 3. Homogeneous groups within the "Beverages" food group

Conclusion

This study provides a comprehensive analysis of the dietary habits of families residing in Gaza and Inhambane provinces, Mozambique. Their diets were dominated by vegetables and greens (notably onions, lettuce/watercress, and carrots), beverages (mainly water and tea), fruits (such as mangoes, fresh tomatoes, and bananas), and staple foods including rice, bread, and xima.

The comparative analysis of median monthly consumption revealed that the intake of eggs, meat, and fish, sweets and pastries, and other foods was largely consistent across both provinces. However, differences emerged across all food groups when considering the type of residence, most prominently in the vegetables and greens category. Demographic factors, including age and gender, influenced consumption patterns primarily in the dairy and beverages groups.

Importantly, these diets include substantial quantities of foods either produced domestically or sourced from local and national markets, which are highly vulnerable to contamination by fungi and mycotoxins. This represents a significant public health concern, emphasizing the need for systematic screening, monitoring, and control strategies, alongside preventive and proactive interventions at every stage of the food supply chain, from production and distribution to consumption.

Future work will focus on in situ sampling of foods across these categories to assess fungal and mycotoxin contamination and to quantify the associated risk of population exposure. Such data will be crucial for informing targeted public health strategies and mitigating dietary exposure to mycotoxins.

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