



Food consumption and diet typology in urban Niger

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Abstract

Introduction: Diets must meet energy needs and provide a diversified diet that can be consumed without risk. The objective of this work is to carry out a typology of urban household diets. It is a cross-sectional analytical study.

Methods: The methodology consists of a food survey of 220 households. The data analysis was carried out on SPSS, R and Minitab software. Pearson's chi-square, PCA and CHA tests were performed.

Results: The result revealed that the food products most stored by households are cereals (95.7%) and oils (75.2%). The average food diversity score of the surveyed households is high and based on the six food groups: cereals, vegetables, meat, oils/fatty products, sugar/sweet products and spices. The food consumption score shows that 85.7% of urban households have an acceptable food consumption and that the food groups that influence this score the most are vegetables, fruits, animal proteins, milk/dairy products, oils/fats and sugars/sweet products. Thus, the study resulted in four types of diets, based on their level of diversity and energy density. The first is a simple diet composed of foods that constitute the basis of the traditional diet in Niamey and the other three are modern mixed diets composed of processed and traditional foods (fat and sugar) heralding the nutritional transition at the household level.

Conclusion: the study shows an association of diets with diversity and household food consumption.

Keywords: food consumption, typology, diet, urban household, Niger

Introduction

Humans consume food to meet the multiple needs of the body ^[1]. Over the generations, human beings have changed their eating behavior and the current generation is composed of consumers who want to eat better ^[2]. Indeed, in recent decades, the food system has changed, with the daily supply of food predominating in households. Also, the food availability per capita has increased at the global level, and for a large part of the population of Developing Countries (DC) ^[3]. This modification of the food system is one of the consequences of urbanization accompanying changes in food consumption patterns. However, at the level of African cities, large or small, millions of consumers are supplied with fresh or processed products close to their homes every day. Also, these consumers are subject to multiple out-of-home catering options, which are very popular for mid-day meals ^[4].

This has resulted in a nutritional transition, characterized by changing food consumption habits and reduced physical activity ^[5].

In Niger, food and nutrition problems persist, with consequences for the population's lifestyle. On the one hand, many Nigerien families are not able to cover their basic food needs. They do not grow enough food and are too poor to supplement their diet by buying food at the market ^[6]. On the other hand, the nutritional situation is serious at the national level, with the prevalence of undernutrition generally higher in rural areas than in urban areas. Over-nutrition (i.e. overweight and obesity) is becoming as important an issue as undernutrition, especially in urban areas. The double burden of undernutrition and overnutrition weighs heavily on the country's health systems ^[7].

It is therefore important to characterize household food consumption in order to develop a typology of diets in urban areas.

Materials and Methods

Study materials

Data collection tool

The study material consisted of a questionnaire. The questionnaire focused on the food consumption situation at the household level and on the nutritional status of women of childbearing age.

Study methods

Location of the study

The study was conducted in all the neighborhoods (localities) sampled in the study area (Niamey). Niamey is the capital of Niger and has a diverse population, hence its choice for the study (urban environment).

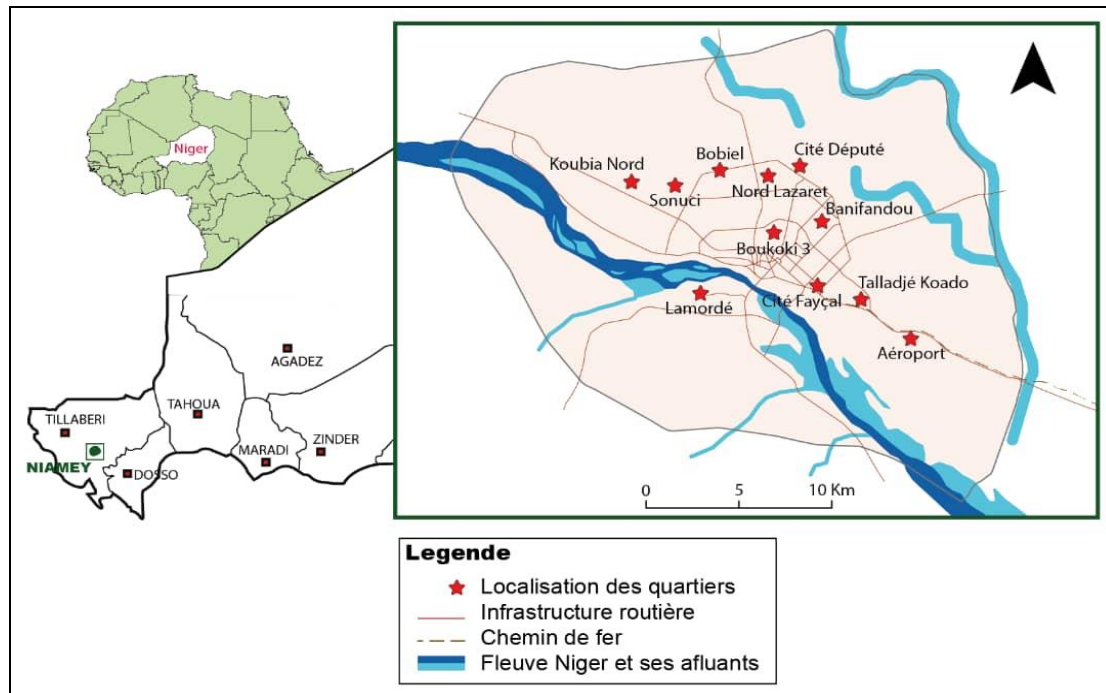


Fig 1: Location map of the study area

Target population

The statistical unit of interest was the household. The person surveyed was the person in charge of food management in the household (women in charge of the kitchen were interviewed and/or heads of households).

Sampling

The 2-stage probability cluster sampling method was used to select localities and households. The survey covered 220 households in Niamey, i.e. 20 households in each target locality (11 localities sampled). The statistical method used is the SMART formula (Daniel Schwartz formula); with a confidence level of 95%, an estimated prevalence of risk factors of 50%, a margin of error of 5% and a cluster effect of 2. Thus, the sampling step was used for the selection of households. The most recent 2012 general population census was considered in selecting locations by region. This cross-sectional study with an analytical purpose involved all localities, and households were informed of the objectives and content of the evaluation. The questionnaire was administered only after their consent was obtained.

Data analysis

Household Dietary Diversity Score HHDS

Dietary diversity refers to the foods and food groups consumed in a given reference period ^[8, 9] (Sanou *et al.*, 2018), (Ruel, 2002). The AMDS was determined from the food groups proposed by FANTA. There is no international consensus on which food groups should be included in the scores, and it is conceivable, in the light of new studies, to revert to the groups usually suggested ^[10] (UE et FAO, 2013). For this study, a 24-hour period preceding the survey was used as the reference period. Thus, the DMDS was determined according to the methodology of the FAO and the FANTA project (in 2010). The values of the dietary diversity variable are thus calculated by adding up all the food groups consumed by at least one member of the household in the 24 hours preceding the survey. After the determination of the AMDS, households were grouped according to the level of AMDS according to the FAO and FANTA classification ^[11] (Kennedy *et al.*, 2010). Thus, three groups of households were recorded: the group that consumes at most three (3) food groups (low AMDS); the group consuming between 4 and 5 food groups (medium AMDS); and finally, the group that consumes at least six (6) of the food groups (high AMDS). $SDAM = \sum_{i=1}^{12} x_i$ with: $x_i \in \{0: \text{Food } i \text{ not consumed}, 1: \text{Food } i \text{ consumed}\}$

Food Consumption Score FCS

The ACS is a composite score that assesses the frequency and diversity of household food consumption. The higher a household's score, the more frequent and diverse their diet ^[12] (WFP, 2013). The SCA is defined on the basis of the last seven (7) days recall. Taking into account the type of food and the frequency of consumption which are then weighted according to the relative nutritional value (i.e. 2 for cereals and tubers, 3 for

legumes/oilseeds, 1 for vegetable vegetables, 1 for fruits, 4 for animal protein, 4 for milk and milk products, 0.5 for oil and fat and 0.5 for sugar/sweetened products) of the food groups consumed

The SCA is calculated according to the following formula: $(SCA = \sum x_i \cdot p_i \cdot 9_i = 1)$. With

- $x_i \in \{\text{Frequency of consumption of each food group 'i'}\}$,
- $p_i \in \{\text{Food Group Weights}\}$.

It was chosen the thresholds set by the World Food Program (WFP): acceptable (>42), borderline (28-42), and low (<28) ^[23, 14] (Hugo *et al*, 2021), (Tingu et Mathunabo, 2019).

Diet typologies

A list of dishes, sauces and drinks was drawn up before the survey and completed at the time of the interview. During the interview, households stated what they had eaten in the past week and how often. The variable frequency of consumption of dishes, sauces and beverages was used to create the diet typology. Thus, the food subgroups were considered for interpretation, as they synthesize all types of consumption and provide information on the nutritional values of foods ^[15] (Danel,2005). From the initial list of foods consumed by the households, a principal component analysis (PCA) and a classification of these households into 4 groups were performed to determine the different diets. Then, the analysis of the ascending hierarchical classification (AMC) was used to actually specify the different diets at the level of these groups of households.

Results

Food Stock at The Level of The Target Households

Table 1: Distribution of households by food stock management

Type of food stored	n	%
Cereals	201	95,7
Roots/Tubercles	37	17,6
Pulses	67	31,9
Fruits and vegetables	12	5,7
Meat/fish/egg	28	13,3
Oils and Greases	84	40
Milk and dairy products	63	30
Sugar and salt	97	46,2
Condiments/Spices	156	75,2

Table 1 shows that among the food products stored by households, cereals and condiments/spices are the most frequently cited, with 95.7% and 75.2% respectively. On the other hand, the products least cited in the food reserve are fruits and vegetables with 5.7%.

Analysis of Food Consumption in Urban Areas

Household dietary diversity

Food groups consumed by households

Figure 2 presents the food groups consumed by households. The figure below shows that cereals, spices/condiments, vegetables, oils and meats are the food groups most often cited in the last 24 hours of food consumption by surveyed households, with 99.50%, 98.10%, 97.10%, 96.70% and 76.70% respectively. Nevertheless, the food group least cited by households is root/tubers with 15.7%.

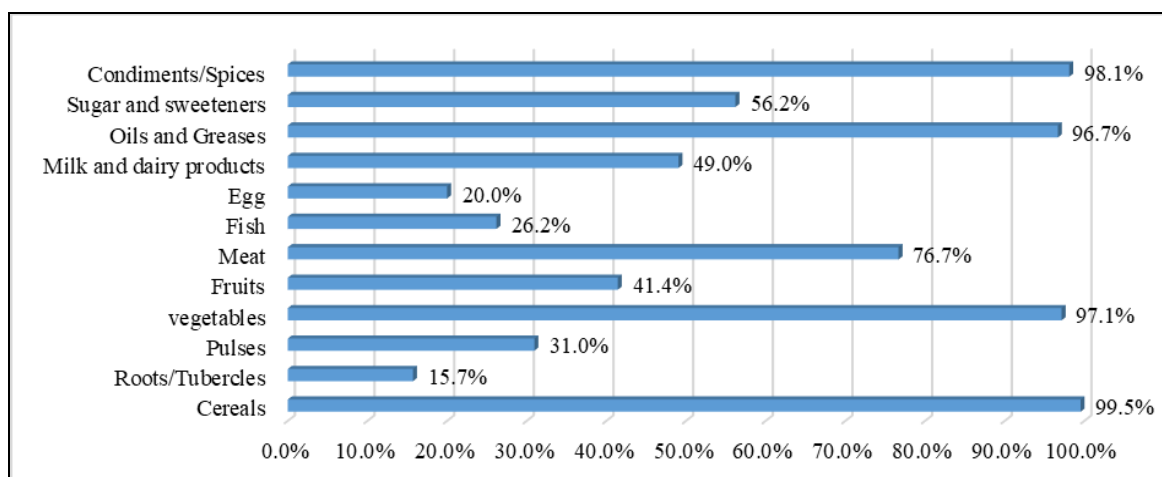


Fig 2: Distribution of households by food groups consumed in the 24 hours prior to the survey

Household Dietary Diversity Score

Figure 3 presents the dietary diversity score of households. Analysis of the figure below shows that 69,5% of households surveyed had high dietary diversity, 29% consumed between four and five food groups, and 1.5% had low dietary diversity.

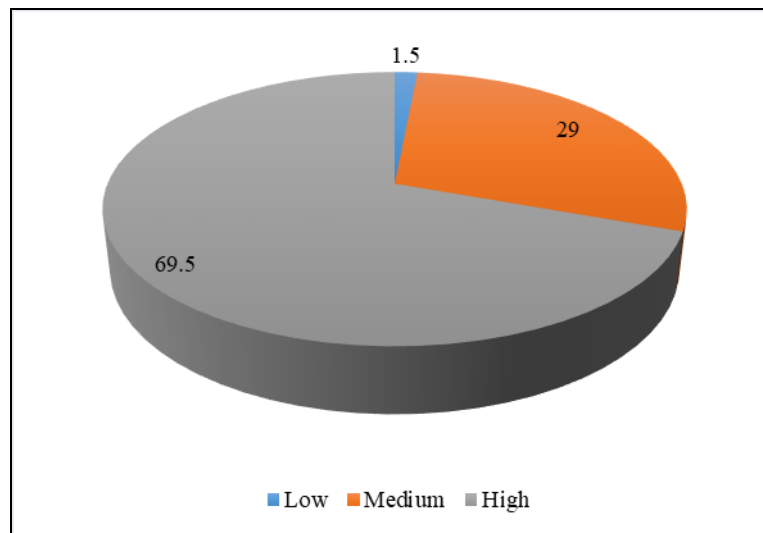


Fig 3: Distribution of households by Food Diversity Score

Household food consumption score

Figure 4 presents the household food consumption score. The analysis of the figure below shows that 85.7% of households have acceptable consumption, 12.9% have limited consumption. Only 1.4% of households have poor food consumption.

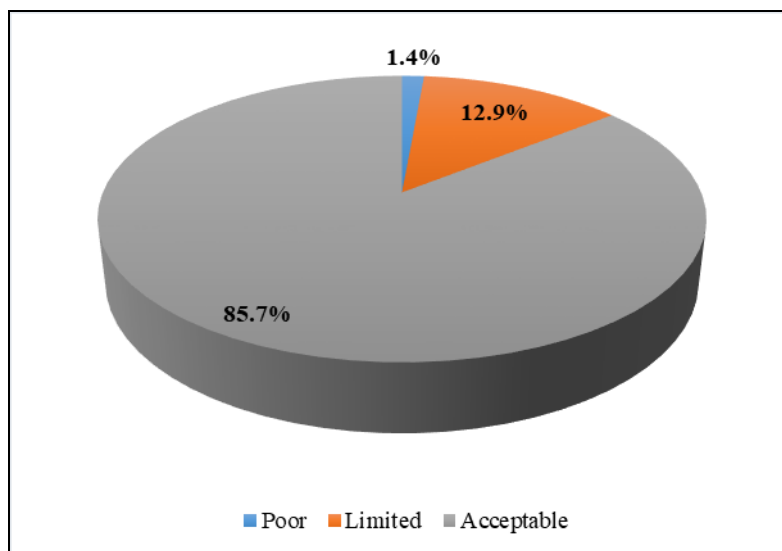


Fig 4: Distribution of households by Food Consumption Score.

Household food consumption profile

Table 2: Historical pattern of food group consumption over a 7-day period

Food groups	Urbain (Mean and standard deviation)
Cereals and Tubercles	6,82 [2 - 7] \pm 0,761
Pulses and Oleaginous	1,40 [0 - 7] \pm 1,313
Vegetables	6,39 [0 - 7] \pm 1,460
Fruits	2,59 [0 - 7] \pm 3,736
Animal Proteins	5,22 [0 - 7] \pm 2,161
Sugar and sweeteners	4,28 [0 - 7] \pm 3,109
Milk and Dairy Products	3,43 [0 - 7] \pm 3,031
Oils and Greases	6,91 [2 - 7] \pm 0,541

According to the analysis of the above table, the average frequency of consumption of food groups during the last seven (7) days shows that oils, cereals, vegetable vegetables and animal proteins are the most consumed with an average of 6.91, 6.82, 6.39 and 5.22 respectively. Thus, the dispersion of the frequency of consumption of different food groups is more or less homogeneous at the level of the households surveyed.

Table 3: Food group consumption by food consumption score

Food groups	SCA			P-value
	Poor	Limited	Acceptable	
Cereals and tubers	7	7	7	0,921
Pulses/Oleaginous	0	1	1	0,101
Vegetables	1	6	7	0,000
Fruits	1	1	3	0,007
Animal proteins	1	3	6	0,000
Milk/dairy products	0	0	4	0,000
Oils and Greases	4	7	7	0,000
Sugar/sweeteners	2	3	4	0,000

Table 3 shows that the consumption of the nine food groups varies significantly between the three food consumption thresholds, except for cereals and legumes, whose consumption is almost identical in the different consumption thresholds.

The average frequency of consumption of cereals is 7 by different categories of households, the difference is much greater for vegetables and milk/dairy products. Households with an acceptable and limited food profile have a frequency of consumption of vegetables of 7 and 6 respectively, while households with a poor food consumption have an average frequency of 1 consumption of vegetables. Milk/dairy products are consumed on average 4 times during the last seven days in households with an acceptable food profile and no consumption on average during the same period in households with a poor and limited food consumption.

Frequency of Dishes, Sauces and Drinks In Urban Eating Habits

Table 4: Distribution of households by frequency of consumption of dishes per week.

Parametres	Maen [mini-maxi] Standard deviation
Dishes	
Millet paste	0,17 [0-3] ±0,60
Corn paste	2,91 [0-7] ±2,179
Sorghum paste	0,02 [0-4] ±0,276
Bread with a side dish	5,11 [1-7] ±1,614
White rice	5,31 [0-7] ±1,676
Slurry	3,06 [0-7] ±2,699
Couscous	1,72 [0-7] ±1,461
Food paste	2,47 [0-7] ±1,349
Potato Ragout	0,47 [0-3] ±1,700
Ragout Yam	0,44 [0-3] ±0,691
Bean	1,43 [0-7] ±1,530
Fried yam	0,78 [0-4] ±1,021
French Fries Potato	1,07 [0-7] ±1,338
Cassava flour (Gari)	1,20 [0-7] ±1,602
Tapioca	0,70 [0-7] ±1,619
Meat	2,28 [0-7] ±2,265
Chicken	0,61 [0-6] ±1,071
Fish	0,62 [0-6] ±1,101
Salad	0,18 [0-5] ±0,658
Omelet	1,22 [0-7] ±1,947
Cowpea with rice	2,05 [0-7] ±1,379
Fatty (Rice and food paste)	2,41 [0-6] ±1,329
Sauces	
Red	3,00[0-7] ±1,537
Peanut	1,37 [0-7] ±1,392
Leafy vegetables	1,57 [0-5] ±1,189
White	1,48 [0-5] ±1,191
Okra	1,78 [0-7] ±1,227
Green leaves	2,14 [0-7] ±1,350

Vinaigrette	0,62 [0-7] \pm 1,066
Drinks	
Sugar factory (soft drinks)	0,84 [0-7] \pm 1,384
Bissap	1,64 [0-7] \pm 2,105
Tea	2,58 [0-7] \pm 3,079
Coffee	0,55 [0-7] \pm 1,744
Fresh fruit juice	1,32 [0-7] \pm 1,853

Table 4 shows that white rice and bread are the most important dishes in the diet, consumed with an average weekly frequency of 5.31 and 5.11 respectively. These dishes are followed by corn paste and porridge, consumed on average three times a week. Tomato sauce is the next most popular, consumed three times a week on average, followed by leafy vegetable sauce (cabbage, onion, amaranth, etc.), fresh and/or dried okra sauce, and green leaf sauce (baobab, corchorus, yoddo, etc.), consumed on average two days a week. Nevertheless, the most consumed beverages in the food habits are milk and tea with an average weekly frequency of 3.31 and 2.58 respectively.

Urban food model

The results of the PCA on the 36 variables are presented in Table 5. According to the axes the food patterns are described.

Table 5: Significance of variables used for PCA and contribution to axes 1 and 2.

Variables	Axe 1	Axe 2
Food paste	0,679	-0,022
White sauce	0,650	-0,082
Leafy Vegetable Sauce	0,592	-0,079
Cereals with Fatty	0,588	-0,041
Rice with cowpeas	0,556	-0,238
Bean	0,495	-0,152
Tomato sauce	0,494	0,203
Potato Fries	0,487	0,423
Chicken	0,338	0,176
Omelet	0,335	0,309
White rice	0,316	-0,225
Okra Sauce	0,281	-0,217
Fish	0,242	0,125
Couscous cereals	0,233	0,032
Slurry/Bullet	0,160	-0,107
Tapioca	0,154	0,131
Fruits	-0,305	0,566
Potato Ragout	0,014	0,539
Fried yam	0,335	0,515
Ragout Yam	0,045	0,505
Sugar factory	0,019	0,498
Fresh Fruit Juices	0,196	0,472
Tea	-0,296	0,438
Corn paste	0,134	-0,401
Meat	0,263	0,377
Bissap	-0,089	0,372
Milk	0,082	0,371
Salad	-0,156	0,357
Millet paste	0,028	-0,318
Green Leaf Sauce	0,099	-0,304
Vinaigrette Sauce	0,085	0,294
Peanut sauce	-0,141	-0,249
Gari (cassava flour)	0,181	-0,209
Drink Coffee	-0,108	0,189
Sorghum paste	-0,037	0,155
Bread with a side dish	0,025	0,058

Table 5 shows that, the variables that participate most in the construction of first axis are foods belonging to groups such as: cereals (pasta 0.679 and rice 0.316), vegetables (white sauce 0.650, tomato sauce 0.494, leafy

vegetable sauce 0.592 and in cereals with fat 0.588), legumes (beans 0, 495 as soups and in rice plus cowpea 0.556), tubers (potato French fries 0.487 and yam French fries 0.335), animal protein (chicken 0.338 and omelet 0.335), and oils/condiments.

The main positive components of axis 2 are foods that constitute the fruit (Fruit 0.566; Fresh Fruit Juice 0.472 and Bissap 0.372), tuber (Potato Fry 0.423; Potato Stew 0.539; Yam Fry 0.515 and Yam Stew 0.505), sweet products (Sugar 0.498; Tea 0.438 and Bissap 0.372), animal protein (Omelet 0.309 and Meat 0.377), milk 0.371 and vegetables (Salad 0.357).

Type of diet

The figure 5 shows a clear distinction between group 1 (47 households), group 3 (67 households) and group 4 (32 households). On the other hand, group 2 (64 households) presents a similarity of consumption in terms of products and frequencies with group 1 but especially with group 4

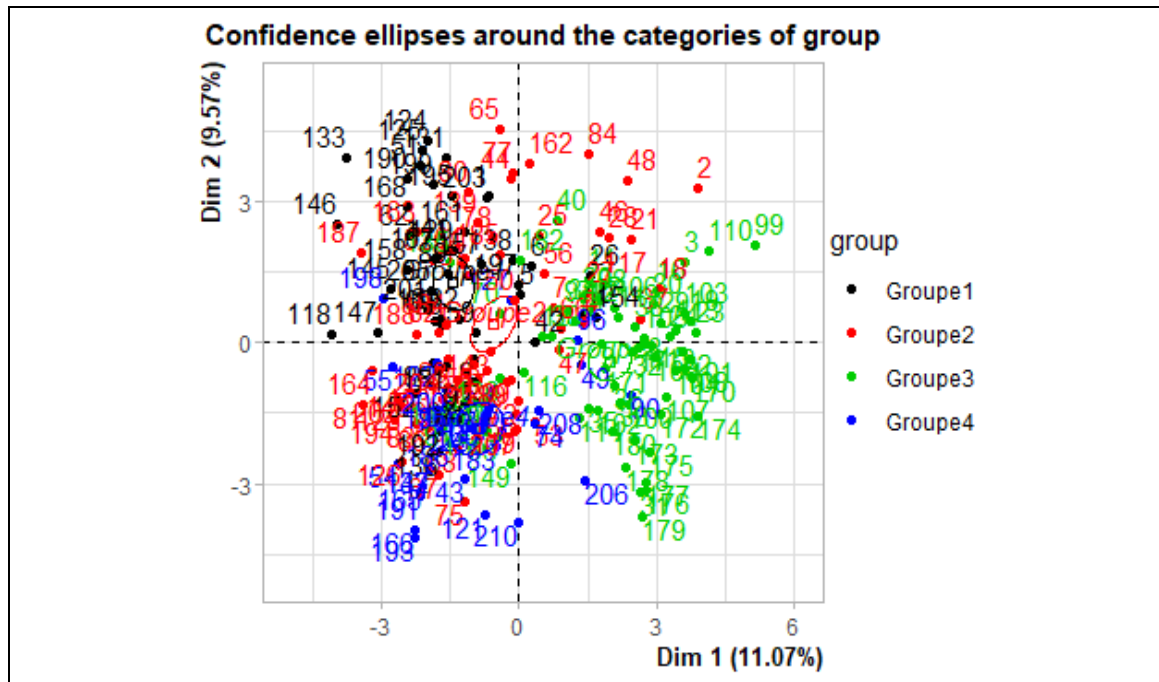


Fig 5: Distribution of households according to their similarities in food consumption

Characterization of diets in urban Niger

Table 6 presents the variables that participate in the characterization of each diet

Table 6: Distribution of foods according to different diets.

Variables	Diet 1	Diet 2	Diet 3	Diet 4	Centroid
Fruits	2,551	2,000	7,000	7,000	2,590
Millet paste	0,169	0,000	0,000	0,000	0,167
Corn paste	2,908	3,000	3,000	4,000	2,914
Sorghum paste	0,019	0,000	0,000	0,000	0,019
Bread with a side dish	5,082	7,000	7,000	7,000	5,110
White rice	5,338	4,000	4,000	3,000	5,314
Slurry/Bullet	3,029	2,000	7,000	7,000	3,062
Couscous cereals	1,691	3,000	7,000	2,000	1,724
Food paste	2,459	4,000	2,000	3,000	2,467
Potato stew	0,469	1,000	1,000	0,000	0,471
Yam ragout	0,435	1,000	1,000	0,000	0,438
Bean	1,406	3,000	7,000	0,000	1,433
Fried yam	0,754	4,000	3,000	1,000	0,781
Potato Fries	1,058	2,000	3,000	1,000	1,071
Gari (cassava flour)	1,188	5,000	2,000	0,000	1,205
Tapioca	0,633	4,000	5,000	7,000	0,700
Meat	2,285	3,000	2,000	0,000	2,276
Poultry	0,633	3,000	2,000	0,000	0,648
Fish	0,609	4,000	0,000	0,000	0,619
Salad	0,174	0,000	0,000	1,000	0,176

Omelet	1,174	2,000	5,000	7,000	1,224
Rice with cowpea	2,039	4,000	3,000	1,000	2,048
Rice and/or pasta with fat	2,415	3,000	4,000	0,000	2,414
Tomato sauce	2,976	4,000	3,000	7,000	3,000
Peanut sauce	1,372	2,000	1,000	0,000	1,367
Leafy Vegetable Sauce	1,580	1,000	1,000	0,000	1,567
White sauce	1,493	1,000	1,000	0,000	1,481
Okra sauce	1,768	3,000	1,000	3,000	1,776
Green leaf sauce	2,130	4,000	4,000	0,000	2,138
Vinaigrette Sauce	0,623	0,000	1,000	0,000	0,619
Sweets	0,826	3,000	0,000	2,000	0,838
Bissap	1,618	4,000	6,000	0,000	1,643
Green tea	2,512	7,000	7,000	7,000	2,576
Coffee	0,493	7,000	0,000	7,000	0,552
Fresh fruit juice	1,285	4,000	5,000	3,000	1,324
Milk	3,295	0,000	7,000	7,000	3,314

The table above shows that the diets of the households surveyed are divided into four categories. The foods are detailed as follows:

Diet 1: millet paste; sorghum paste; white rice; pasta; meat; cereals with fat; peanut sauce; leafy vegetable sauce; white sauce.

Diet 2: corn pasta; bread with cereals; couscous; pasta; potato stew; yam stew; bean soup; fried yam; fried potato; cassava flour; tapioca; meat; chicken; fish; omelet; rice plus cowpea; cereals with fat; tomato sauce; peanut sauce; okra sauce; sweets; bissap; tea; coffee; fresh fruit juice

Diet 3: fruits; corn paste; accompanied bread; cereal porridge; cereal couscous; potato stew; yam stew; bean; yam fry; potato fry; cassava flour; tapioca; chicken; omelet; rice plus cowpea; fat cereals; tomato sauce; green leaf sauce; salad dressings; bissap; tea; fresh fruit juice and milk

Diet 4: fruits; corn paste; bread with accompaniment; cereal porridge; cereal couscous; yam fry; potato fry; tapioca; salad; omelet; tomato sauce; okra sauce; sweets; tea; coffee; fresh fruit juice and milk.

Factors Associated With Different Diets

Table 7: Comparison of plan typology by HHDS and FCS.

		Diet 1	Diet 2	Diet 3	Diet 4	Test	P-value
HHDS	Low	0	0,5	1,0	0	Chi ² =36,370 ^a (6)	0,000***
	Medium	1,9	5,7	17,1	4,3		
	High	20,5	24,3	13,8	11		
FCS	Poor	0	0	1	0	Chi ² =13,791 ^a (6)	0,032*
	Limited	0	1,4	0,5	1,9		
	Acceptable	22,4	29	30,5	13,3		

Ns: not significant; * significant; ***very highly significant.

The analysis of the results in Table 7 concludes that dietary diversity and consumption have a significant influence on household diets with P-value 0,000 and 0.032 respectively.

Discussion

Availability of food stock at the household level

The presence of a food stock in the household provides a relative measure of the level of food security in the household ^[14].

The analysis of this study shows that almost all 93.4% of households buy their consumer products in bulk to stock and guarantee their availability at the household level. Of these food stocks, cereals (5, 79%) and condiments/spices (75.2%) are the most available products. This practice can be explained by the fact that cereals are the staple food in Niger and condiments/spices are used in all sorts of preparations in households. The availability of products such as (sugars and salt 46.2%, oils 40%, legumes 31.9%, and milk/products 30%) is not to be overlooked. However, only 5.7% of households store fruits and vegetables, which are perishable and require relatively large amounts of resources to store. This result is higher than that found in the DRC where 52.1% of households had a food stock ^[14].

Household Dietary Diversity Score

Regarding the analysis of diversity, the study shows that the most consumed food groups 24 hours before the survey are cereals (99.50%), spices/condiments (98.10%), vegetables (97.10%), oils (96.70%), meats (76.70%) and sugars/sweet products (56.20%). The least consumed group remains the one composed of roots and or tubers

in a proportion of 15.70%. However, the average dietary diversity score of the households surveyed is high, with consumption of at least 6 food groups. These 6 groups are composed of cereals, spices/condiments, vegetables, oils, meats and sugars/sweet products. However, it should be noted that these 6 groups make up the bulk of the foods in the urban food model. In addition, each of these six groups plays an important role in the dietary diversification of these urban households. Thus, cereals are the staple food; vegetables (especially leafy greens and other vegetables) are a source of vitamins and minerals; meats and oils are a source of protein and lipids, respectively; and finally, spices are essentially foods used to season meals. Thus, dietary diversity revealed that, 69,5% of households surveyed have a high dietary diversity, i.e., they consumed at least six food groups, while 29% consumed between four and five, and 1.5% between one and three. These results corroborate those found in 2019 in Bamako with a high dietary diversity score (DDS) of 77.8% [16]. But these results are different from those of (Diarra in 2018; Ouologuem in 2018 and Sogoba *et al* in 2019) [17, 18, 19]. The latter noted that the poor are much more exposed to an inadequate diet than the rich on the other hand the poor are more likely to have a diversified diet than the rich [19].

Household food consumption score.

Households in urban areas have an acceptable food consumption score with a rate of 85, 7%. This result is lower than that of 2018 obtained in Sikasso and Mopti in Mali which was 88.4% [17]. But higher than those obtained in 2018 in Mopti (67%) and Kayes (49.6), in 2019 in Bamako (78.8%) and in Kibumba (50.7%) in DRC [18, 19, 16, 20]. These differences can be explained, on one hand, by the availability and accessibility of certain consumer products by the target households in certain localities of the study area. On the other hand, the dietary pattern may influence the SCA from one area to another. However, the daily diet of households was mainly composed of cereals (with an average weekly frequency of 6.82), oils/fats (6.91), vegetables (6.39), proteins (5.22), and sugars (4.28). Milk/dairy products consumed an average of 3.43 per week, fruits (2.59), and legumes (1.40) were the least consumed. Thus, all these food groups present a very highly significant relationship with food consumption except for cereals and legumes.

Food consumption habit

In urban areas of Niger, rice and bread are the main staples of the diet, consumed on average five times a week, followed by corn paste and porridge, consumed on average three times a week. However, foods such as cereal couscous, pasta, meat and cowpea rice are also consumed on average twice a week (Table 4). These results are similar to those found in Burkina Faso in 2005, where rice and tô are the most common dishes followed by cereal porridge [15]. In urban areas, rice is served with tomato sauce (3 times per week on average) or peanut sauce with an average consumption frequency of lonce per week. Corn pasta is mainly served with green leafy vegetable and dry okra sauces, each with an average frequency of 2 times per week. Pasta is usually served with white or fat sauce with an average frequency of 1 and 2 times per week respectively. On the other hand, in households, beverages such as milk and bissap tea, sweets and fresh fruit juice (Table 4) occupy an important place. (Table 4) occupy a significant place in eating habits. Sweetened drinks are generally consumed after meals or to raise blood sugar levels.

Urban food model

The consumption of different foods by households reveals some nutritional and social specificities of the diet. The variables that participate most in the construction of the first dietary model are foods belonging to groups such as: Cereals (pasta 0.679 and rice 0.316), vegetables (white sauce 0.650, tomato sauce 0.494, leafy vegetable sauce 0.592 and in cereals with fat 0.588), legumes (beans 0.495 as soups and in rice plus cowpea 0.556), tubers (fried potato 0.487 and fried yam 0.335), animal protein (chicken 0.338 and omelet 0.335), and oils/condiments (in all sauces consumed). These different foods a priori indicate diversity in the protein and carbohydrate rich diet. These variables are positively correlated with each other. Indeed, all households that consume pasta also consume white sauce; leafy vegetable sauce; cereals with fat; rice plus cowpea; beans (cowpea-based foods); red sauce; fried potatoes; chicken; omelets; white rice and fried yams. This diet is at the limit of diversity, including food groups such as cereals, tubers, legumes, vegetables, animal products and, of course, the oils and spices that are used in daily meal preparation. This result could be explained by the fact that households are adapting to the situation of a simple food mode in urban areas. Nevertheless, fruit consumption (-0.305) changes negatively with households in this group. This means that fruit is not part of the eating habits of this group. The main positive components of the second food model are energetic and sometimes constructive foods, which constitute a modern urban diet. The food groups that make up these groups are: Fruits (Fruit 0.566; Fresh Fruit Juice 0.472 and Bissap 0.372), Tubers (Potato Fry 0.423; Potato Ragout 0.539; fried Yam 0.515 and Yam Ragout 0.505), sweet products (Sugar 0.498; Tea 0.438 and Bissap 0.372), animal protein (Omelet 0.309 and Meat 0.377), milks 0.371 and vegetables (Salad 0.357). The foods that were positively correlated with each other suggests a modern diet with too much fat and sugar. These are foods such as: fruit, potato French fries, omelet, potato stew, yam French fries, yam stew, sugar, fresh fruit juice, tea, meat, bissap, milk and salad. This result could be due to the fact that most urban households do not spend much time preparing food. This habit results in chronic (nutritional) diseases in the population. Indeed, food, especially when it is too sweet or too fatty, is a major determinant of chronic non-communicable diseases [21].

The variables (foods) that are negatively correlated with this second food model are Cornmeal (-0.401); Millet Paste (-0.318) and Green Leaf Sauce (-0.304). These foods are not part of the dietary pattern of this second food model.

Characterization of diets

For this study, households were divided into four groups representing similarities in their diets (foods consumed and frequency of consumption). Thus, in the characterization of diets, the first group (diet 1) of households had a simple diet found in urban areas based on cereals, legumes, animal proteins and vegetables. This diet includes foods such as: millet paste; sorghum paste; white rice; pasta; meat; cereals with fat; peanut sauce; leafy vegetable sauce; and white sauce. The other household groups consisting of diet2, diet3 and diet4 each form a mixed and modern diet based on all food groups. These diets include both basic and processed foods. Each of these diets contains foods with higher energy and protein values in terms of nutrition, whether the types of foods or preparations are traditional or westernized; and these are diets from a social point of view belonging to the middle and affluent class.

Relationship between diet and diversity and food consumption

Finally, the study shows a significant association between diets and diversity and food consumption. Indeed, households with a high dietary diversity have a mixed modern diet (D2, D3 and D4) with 49.1%, 22.4% of these households had a simple diet. This result explains that households with a modern diet had more opportunity to diversify their diet (source of good nutritional quality and covering the energy needs of consumers) [22]. The AUC was weakly significant (0.032) with diet. Indeed, households with acceptable food consumption frequency had modern mixed diets (D2, D3 and D4) with 72.8%. These results reveal that in this urban area, the modern diet is the most widespread because of its characteristics appreciated by households.

Conclusion

The diet is characterized by normal consumption frequency and acceptable diversification in most target households. In addition, households have a high dietary diversity based on cereals, vegetables, meats, oils, sugars/sweeteners and spices/condiments. Households have an acceptable frequency of consumption with an average minimum of 3 times for the different food groups except for legumes which are consumed on average 1 time. However, the staple foods for all households generally consist of cereals and or derivatives such as: white rice, accompanied bread, pasta and thick dough prepared from corn flour. The sauces that accompany these dishes are based on vegetables (namely: tomato, leafy vegetables, dried green leaves and okra). At the same time, the results of the study show two main types of diet (modern diet and mixed diet) to which four categories of households belong. A simple diet with accessible foods available almost all year round. And the other three diets are modern with fatty and sugary foods likely to be the source of chronic diseases in the population. However, the study found a significant association between the diets and the dietary diversification of the households.

Conflicts of interest

All authors have no conflicts of interest.

Contributions of the authors

Rabiou Abdou AbdoulRachid designed and conducted the study. Rabiou Abdou Abdoul Rachid participated in the collection, analysis, and interpretation of the data. Rabiou Abdou Abdoul Rachid wrote the manuscript. Oumarou Diadié Halima made critical revisions to the manuscript. The final manuscript was approved by Balla Abdourahamane. All authors have read and approved the final manuscript.

Acknowledgements

The authors thank the residents of Niamey for their voluntary participation in the study.

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