**Journal of Food and Nutrition Sciences**
2023; 11(3): 91-97
http://www.sciencepublishinggroup.com/j/jfns
doi: 10.11648/j.jfns.20231103.15
ISSN: 2330-7285 (Print); ISSN: 2330-7293 (Online)

# Level of Consumption of Some Cereal-Pulse Combinations and Extent of Metabolic Diseases in Four (4) Communes of Abidjan (Ivory Coast)

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## To cite this article:
Tan Koffi Cyrille, Gbakayoro Jean Brice, Akpro Lathro Anselme, Vanié Claver Stephane, Gbogouri Grodji Albarin. Level of Consumption of Some Cereal-Pulse Combinations and Extent of Metabolic Diseases in Four (4) Communes of Abidjan (Ivory Coast). *Journal of Food and Nutrition Sciences*. Vol. 11, No. 3, 2023, pp. 91-97. doi: 10.11648/j.jfns.20231103.15

**Received**: May 18, 2023; **Accepted**: June 10, 2023; **Published**: June 20, 2023

**Abstract:** Dietary behavior and habits are significant risk factors for the occurrence of metabolic diseases in populations. The objective of this study was to evaluate the level of consumption of cereal/legume combinations in the dietary habits of certain populations in the district of Abidjan and to measure the prevalence of metabolic diseases. Based on a descriptive and analytical cross-sectional food consumption survey, a cohort of 400 households was interviewed by reasoned choice in four (4) communes of Abidjan, with 200 Ivorian and 200 non-Ivorian households. The data obtained were processed using IBM SPSS Statistics 20.0 software. Most of the women interviewed were traders (52.25%), had a low socio-economic level (73.75%) and a primary education level (31.25%). Rice was the most consumed cereal (79.5%) with an average quantity of 200 to 250g per meal (30.75%), more at lunch and dinner (43.75%), 5 to 7 times per week (37.5%). Cowpea was the most consumed legume (92.25%) with an average quantity of 100 to 150g per meal (60.25%), more at breakfast (30.5%), 1 to 2 times per week (59.25%). Cowpea (97%) and cereal-cowpea combinations (90.5%) were consumed more by non-Ivorian households, by dietary habit. More non-Ivorian households (58.5%) had no one affected by metabolic diseases (obesity, T2D, hypertension) while 76% of Ivorian households had at least one. The non-Ivorian households consumed more cowpeas and cereal-cowpea combinations. This would make them safer from the occurrence of non-communicable diseases, compared to Ivorian households.

**Keywords:** Food Consumption, Cereals, Legumes, Metabolic Diseases, Abidjan

## 1. Introduction

Diet has a considerable impact on the increase in the prevalence of certain chronic diseases including diabetes [1] and is thus a crucial aspect in the overall management of diabetes.

Cereals and legumes contribute in a complementary way to the nutritional value of the diet of people in several regions of the world [2]. In West Africa, cereals and legumes constitute the basis of the diet in addition to being important bridging foods for the populations of the North and the populations of foreign origin emigrated from Sub-Saharan African countries.

In Ivory Coast, rice has become the main food of the population, both in urban and rural areas [3], and this is due to changes in the dietary habits of the population. This foodstuff is consumed every day, often with a frequency of consumption of more than three times a day, with two cooking methods that differ according to the amount of water. As for the interest in legumes, it is due to its interesting nutritional properties [4-6] and its beneficial phytochemical compounds for the elimination of free radicals [7, 8].

According to FID and OMS [9, 10], the number of diabetics in sub-Saharan Africa, estimated at 19.8 million in 2013, will reach 41.4 million in 2035, i. e. an increase of 109%. In Ivory Coast, deaths caused by non-communicable

diseases represent 31% of all recorded deaths. In decreasing order of importance of the causes of death by non-communicable diseases, we find cardiovascular diseases, cancer, chronic respiratory diseases and diabetes. The prevalence of diabetes mellitus in Ivory Coast is estimated at about 5% [11]. Different studies conducted in Ivory Coast have identified the main nutrition problems in the country and the obstacles to increasing nutrition actions.

The consumption of products rich in dietary fiber has an overall beneficial effect on many pathologies or nutrient-induced metabolic disorders such as obesity, diabetes, cardiovascular diseases, and certain cancer [12]. However, the combination of cereals and legumes is not always part of the main choices in the dietary habits of the populations, yet it could be beneficial for the consumers because it would guarantee a good fiber content of the food, useful to prevent these metabolic diseases. The main objective of this study was to evaluate the level of consumption of recipes formulated with cereals and legumes in the communes of Abidjan. To this end, a food consumption survey was conducted in four (4) communes of Abidjan and the extent of metabolic diseases in these surveyed populations was assessed.

# 2. Materials and Methods

### *2.1. Study Setting*

The survey took place in four (04) communes of Abidjan, namely Abobo, Adjamé, Marcory and Port-Bouët.

### *2.2. Type and Period of Study*

This is a descriptive and analytical cross-sectional study with a single questionnaire that took place from May 1 to July 5, 2022.

### *2.3. Study Population*

The study population consisted of women in households responsible for preparing family meals, aged 18 years and over. A total of 400 households were interviewed by reasoned choice in all four (4) communes, at a rate of 100 households per commune, consisting of 50 foreign households and 50 Ivorian households.

Inclusion criteria

Women from households that were present during the survey and agreed to answer the questions were included.

Non-inclusion criteria

Household women who were absent during the data collection period and households headed solely by men were excluded.

### *2.4. The Survey Process*

In each of the communes, the survey forms were filled out individually by a single woman, who was responsible for preparing the household's meals. In the multi-household concessions, a single household was selected by random draw. The questionnaire focused on the level of knowledge, consumption patterns, and importance of grain and pulse consumption in the household. They also focused on socio-demographic characteristics (age, level of education of the housewife) and the socio-economic status of the housewife.

### *2.5. Statistical Analysis*

Survey data were analyzed using IBM SPSS Statistics 20.0 software. Chi-2 was used to test for relationships between variables.

# 3. Results and Discussion

### *3.1. Socio-Economic and Demographic Characteristics of Women in the Households*

Table 1 presents the age range, level of education, monthly income and occupation of the respondents. Most of the respondents (85.5%) were between 19 and 70 years of age and had little or no education, with 47% not educated and 31.2% having a primary level of education. A very small proportion of the women (1.5%) had a high socioeconomic level. This rate is nevertheless lower than that found in a study conducted in Ouagadougou where the illiteracy rate was 67.7% [13]. This illiteracy among heads of households could be a limiting factor in achieving food security. According to Kouassi, B. et al. [14], in Abidjan, being a young, educated household head with sources of income and food stocks reduced the risk of food insecurity for the household.

Trade (52.2%) was the main income-generating activity for these women households. The chi-square test showed a significant difference between the rate of occupation observed in these communes. This could be justified by the fact that most of these women did not go to school and opted for trade to support themselves. Similarly, trade contributes, with experience, the most feasible alternative for these women of families, often alone in the management of multimember families. This finding was also observed in a study conducted in Burkina Faso, where women heads of household in rural areas are generally widows, inheriting very little of their deceased husband's property. They also have little access to productive resources (land, credit, etc.), which limits their ability to increase the household's food supply, and they decide to engage in small businesses [15, 16].

***Table 1.*** *Socio-Economic and Demographic Characteristics of Women Interviewed.*

| | Parameters Ivorian households (%) | Non ivorian households (%) | Total (%) |
|---|---|---|---|
| Age group (an) | | | |
| [10 à 18] | 9 | 10 | 9,5 |
| [19 à 70] | 90,5 | 80,5 | 85,5 |
| [70 and more] | 0,5 | 9,5 | 5 |

| | Parameters Ivorian households (%) | Non ivorian households (%) | Total (%) |
|---|---|---|---|
| Education level | | | |
| No | 17 | 16,5 | 16,75 |
| Primary | 29 | 33,5 | 31,25 |
| Secondary | 48 | 46 | 47 |
| Superior | 6 | 4 | 5 |
| Socio-économic level | | | |
| Low [50,000f/month] | 78,5 | 69 | 73,75 |
| Medium [50,000f200,000f/moth] | 20,5 | 29 | 24,75 |
| High [200,000f/monthand more] | 1 | 2 | 1,5 |
| Professions | | | |
| Student | 3 | 2 | 2,5 |
| Housewife | 12 | 4 | 8 |
| Merchant | 45,5 | 59 | 52,25 |
| Worker | 4,5 | 2,5 | 3,5 |
| Other | 35 | 32,5 | 33,75 |

### *3.2. Cereal Consumption by Surveyed Households*

Table 2 presents the consumption of cereals by the households surveyed. All of the households surveyed (100%) consumed at least one of the different cereals. Households that consumed rice, maize, and millet at the same time were the most numerous (42%). Of these grains, rice was the most consumed (18.75%). Cereals such as rice were consumed more (18.8%). This strong finding could be explained by the fact that these are cosmopolitan communes that have benefited from the migratory presence of peoples from the north of Ivory Coast. These peoples are culturally linked to cereal consumption. This was highlighted in the work of [17], who reported in their study the predominant presence of cereals in the diets of both rural and urban households.

Regarding the reason for cereal consumption, 61.8% responded that this consumption was linked to their dietary habits, with a high consumption (80%) by non-Ivorian households compared to 43.5% of Ivorian households. On the other hand, the work of [18], stating that the reason for consumption of cereals was due to their physical availability in addition to being relatively less expensive.

***Table 2.*** *Cereal Consumption by Surveyed Households.*

| | Parameters Ivorian households (%) | Non ivorian households (%) | Total (%) |
|---|---|---|---|
| Cereal consumption habit | | | |
| Yes | 100 | 100 | 100 |
| No | 0 | 0 | 0 |
| Types of cereals consumed | | | |
| Rice | 19 | 18,5 | 18,75 |
| Maize | 2 | 1 | 1,5 |
| Sorghum | 0,5 | 0 | 0,25 |
| Millet | 0 | 0 | 0 |
| Rice and Maize | 27,5 | 24 | 25,75 |
| Rice and Millet | 7 | 9,5 | 8,25 |
| Rice and Sorghum | 2 | 1 | 1,5 |
| Rice, Maize and Millet | 39 | 45 | 42 |
| Sorghum, Maize and Rice | 2,5 | 0,5 | 1,5 |
| Sorghum, Maize and Millet | 0,5 | 0,5 | 0,5 |
| Reason for consumption | | | |
| Less expensive | 13 | 0 | 6,5 |
| Food habits | 43,5 | 80 | 61,75 |
| Easy to access | 2 | 2,5 | 2,25 |
| Less expensive and eating habits | 22 | 4,5 | 13,25 |
| Less expensive and easy to access | 12,5 | 1,5 | 7 |
| Eating habits and easy access | 7 | 10,5 | 8,75 |
| Other | 0 | 1 | 0,5 |

### *3.3. Rice Consumption by Surveyed Households*

Table 3 presents rice consumption by Ivorian and non-Ivorian households surveyed. Rice was consumed regularly, with 46% of households consuming it 3 to 4 times/week and 37.5% consuming it 5 to 7 times/week. It was consumed at both lunch and dinner by 43.8% of households. The average quantity (g) consumed per meal and per person varied between 200 and 250 g (52.5%) and 250 g to 300 g (30.75%). Non-Ivorian households consumed rice much more frequently (50%, 5 to 7 times per week) than Ivorian households (25%, 5 to 7 times per week). In contrast, more Ivorian households consumed large amounts of rice (26%, 250-300 g/meal) than non-Ivorian households (35.5%, 250-300 g/meal). This rice craze may be justified by the fact that the majority of these women are very often away from home at lunchtime, and therefore buy rice in local restaurants.

Some authors have reported that in Ivory Coast, as in sub-Saharan Africa, rice is becoming increasingly important due to the strong growth of urban populations.

***Table 3.*** *Rice Consumption by Surveyed Households.*

| | Parameters Ivorian households (%) | Non ivorian households (%) | Total (%) |
|---|---|---|---|
| Consumption frequency | | | |
| K1 à 2 once/week | 21,5 | 11,5 | 16,5 |
| 3 à 4 once/week | 53,5 | 38,5 | 46 |
| 5 à once/week 7 | 25 | 50 | 37,5 |
| Moment of consumption | | | |
| Breakfast | 6 | 3,5 | 4,75 |
| Lunch | 12,5 | 33,5 | 23 |
| Dinner | 9,5 | 7 | 8,25 |
| Breakfast and lunch | 15 | 13 | 14 |
| Breakfast and dinner | 6,5 | 6 | 6,25 |
| Dinner and lunch | 50,5 | 37 | 43,75 |
| Average amount of rice consumed per meal and person in households (g) | | | |
| [100-150] | 3,5 | 2,5 | 3 |
| [150-200] | 19,5 | 6,5 | 13 |
| [200-250] | 50,5 | 54,5 | 52,5 |
| [250-300] | 26 | 35,5 | 30,75 |
| 300 and more | 0,5 | 1 | 0,75 |

### *3.4. Legume Consumption by Surveyed Households*

Table 4 presents the consumption of legumes by the surveyed households. Almost all of the households surveyed (99.75%) consumed the different types of legumes. Cowpea (red or white) was the most consumed legume (35.5%). The main reason for consuming legumes in both local and foreign communities was that they were part of the dietary habits of these respondents (51%). The metaphor "cowpea is the meat of the poor" reflects this accessibility of cowpea seeds to modest social strata.

***Table 4.*** *Legume Consumption by Surveyed Households.*

| | Parameters Ivorian households (%) | Non ivorian households (%) | Total (%) |
|---|---|---|---|
| Legume consumption habit | | | |
| Yes | 199 | 100 | 99,75 |
| No | 1 | 0 | 0,25 |
| Types of legumes consumed | | | |
| Small peas | 9 | 4 | 6,5 |
| Soybeans | 1 | 1 | 1 |
| Red or white bean | 27 | 44 | 35,5 |
| Red or white beans and soybeans | 5 | 10,5 | 7,75 |
| Red or white beans and peas | 49,5 | 33,5 | 41,5 |
| Lentils, peas and red or white beans | 8 | 7 | 7,5 |
| No | 0,5 | 0 | 0,25 |
| Reason of consumption | | | |
| Less expensive | 11,5 | 2 | 06,75 |
| Eating habits | 33 | 69 | 51 |
| Easy to access | 4 | 4,5 | 4,25 |
| Cheaper and better eating habits | 13 | 2 | 7,5 |
| Less expensive and easy to access | 11,5 | 2 | 6,75 |
| Eating habits and easy access | 12,5 | 7 | 9,75 |
| Other | 14,5 | 13,5 | 14 |

### *3.5. Cowpea Consumption by Surveyed Households*

More than half (63.25%) of the households surveyed consumed cowpeas between once and twice a week, while the rest consumed them more than twice a week (Table 5). The main reason for the low frequency (1-2 times/week) of cowpea consumption is thought to be related to discomfort due to bloating after eating the legumes. This discomfort, induced by oligosaccharides, reduces the consumption of legumes in some people. Oligosaccharides to almost are 50% of the main factors responsible for flatulence [19].

The majority (30.5%) of households consumed cowpea for breakfast. In 60.25% of households, the average amount of cowpea consumed per meal per person was between 100 and 150 g. More non-Ivorian households consumed cowpea more frequently (32.5%, 3 to 4 times per week) than Ivorian households (28.5%, 3 to 4 times per week). This study shows that in Ivory Coast, cowpea consumption at breakfast (30.5%) is similar to a study conducted in Burkina Faso (30.43%) [6]. However, the use of food depends on factors as diverse as

cultural habits and choices, culinary preparation, nutritional knowledge, synergies or antagonisms between nutrients, care and feeding practices. In addition, these foods are generally sold in the streets where the majority of people take breakfast to go about their business.

***Table 5.*** *Cowpea Consumption by Surveyed Households.*

| | Parameters Ivorian households (%) | Non ivorian households (%) | Total (%) |
|---|---|---|---|
| Consumption frequency | | | |
| 1 à 2 once/week | 60,5 | 66 | 63,25 |
| 3 à 4 once/week | 28,5 | 32,5 | 30,5 |
| 5 à 7 once/week | 4,5 | 1,5 | 3 |
| No | 6,5 | 0 | 3,25 |
| Moment of consumption | | | |
| Breakfast | 21,5 | 39,5 | 30,5 |
| Lunch | 17 | 23 | 20 |
| Dinner | 16,5 | 12,5 | 14,5 |
| Breakfast and lunch | 4 | 5 | 04,5 |
| Breakfast and dinner | 16 | 7 | 11,5 |
| Dinner and lunch | 24,5 | 13 | 18,75 |
| No | 0,5 | 0 | 0,25 |
| Average amount of beans consumed per meal and person in households (g) | | | |
| [100-150] | 60 | 60.5 | 60,25 |
| [150-200] | 17,5 | 21 | 19.25 |
| [200-250] | 15,5 | 10 | 12,75 |
| [250-300] | 6 | 7 | 06,5 |
| 300 and more | 1 | 1,5 | 1,25 |

### *3.6. Cereal/Legume Combinations Consumed by Surveyed Households*

In the Ivorian households surveyed, most cereal/legume combinations consumed were "Bread + cowpea or soybeans" (69%) followed by "Rice + cowpea or soybeans" (21%). These combinations were generally consumed 1 to 2 times/week (51.5%) or 3 to 4 times/week (27.5%) at breakfast (41.5%) or lunch (15.5%). In contrast, in non-Ivorian households, the most consumed cereal/legume combinations were "Rice + cowpea or soybean" (62%) followed by "Bread + cowpea or soybean" (25%). These combinations were generally consumed 5 to 7 times/week (53.7%) or 3 to 4 times/week (33.5%) at breakfast (38.5%) or dinner and lunch (24.5%). Our results are consistent with those of [20], indicating that the combination of cereals and legumes is found in the culinary traditions of many countries. For example, rice and soybeans in the Far East, couscous and chickpeas in North Africa, corn and dry cowpeas in America, millet and cowpeas in Black Africa.

***Table 6.*** *Cereal/legume Combinations Consumed by Surveyed Households.*

| Parameters Ivorian households (%) | Non ivorian households (%) | Total (%) | |
|---|---|---|---|
| Different types of combinations | | | |
| Rice + beans or soya | 21 | 62 | 41,5 |
| Bread + beans or soya | 69 | 28,5 | 48,75 |
| No | 10 | 09,5 | 9,75 |
| Consumption frequency | | | |
| 1 à 2 once/week | 51,5 | 03,5 | 27,5 |
| 3 à 4 once/week | 27,5 | 33,5 | 30,5 |
| 5 à 7 once/week | 10,5 | 53,5 | 32 |
| 0 once/week | 10,5 | 09,5 | 10 |
| Moment of consumption | | | |
| Breakfast | 41,5 | 38,5 | 40 |
| Lunch | 15,5 | 05,5 | 10,5 |
| Dinner | 6 | 2 | 4 |
| Breakfast and lunch | 27 | 27 | 27 |
| Breakfast and Dinner | 7 | 02,5 | 4,75 |
| Dinner and lunch | 3 | 24,5 | 13,75 |

### *3.7. Extent of Metabolic Diseases in These Surveyed Households*

Table 7 presents the extent of metabolic diseases. A high proportion of the Ivorian households surveyed (75.5%) had people affected by metabolic diseases. Also, 60% of these households had one (1) person affected by metabolic diseases while 13% had 2 to 3. Most of the metabolic diseases were, in descending order, hypertension (35.5%), type 2 diabetes (19%) and obesity (11%). On the other hand, less than half of the non-Ivorian households surveyed (42%) were home to people affected by metabolic diseases. In these households,

36.5% had one (1) person affected by metabolic diseases while 5% had 2 to 3 affected persons. Most of the metabolic diseases encountered were, in descending order, high blood pressure (28%), type 2 diabetes (5%) and the combination of high blood pressure and type 2 diabetes (5%). According to the women interviewed, the main cause of the occurrence of these diseases would be diet (42.25%), followed respectively by sedentary lifestyle (27.75%), heredity (16%) and 14% of people could not give a real explanation for the occurrence of diabetes in their family. The high occurrence of metabolic diseases (type 2 diabetes) in Ivorian households could be explained in part by the non-diversification of their diets but also by a lack of physical activity which are the main factors in the occurrence of these diseases. These excessive intakes are one of the causes of the accumulation of carbohydrate compounds (energy nutrients) that can lead to certain chronic diseases such as obesity, type 2 diabetes and hypertension, the incidence of which is constantly increasing in [21]. In other words, the consumption of cereal/vegetable combinations could increase the intake of dietary fiber and the presence of plant proteins in the dishes of this type of diet which could have an impact on the protection of metabolic diseases. Therefore, in the present study, non-Ivorian households that consume more of these types of cereal/legume combinations would be more protected against metabolic diseases.

***Table 7.*** *Extent metabolic diseases in households.*

| Parameters | Ivorian households (%) | Non Ivorianhouseholds (%) | Total (%) |
|---|---|---|---|
| Presence in the household of persons affected by metabolic diseases | | | |
| Yes | 75,5 | 42 | 58,75 |
| No | 24,5 | 58 | 41,25 |
| Number of people affected by metabolic diseases | | | |
| 1 | 60 | 36,5 | 48,25 |
| 2 à 3 | 13 | 5 | 9 |
| 4 and + | 02,5 | 0 | 1,25 |
| No | 24,5 | 58,5 | 41,5 |
| Cause of occurrence of metabolic diseases | | | |
| Heredity | 22,5 | 9,5 | 16 |
| Diet | 40,5 | 15 | 27,75 |
| Sedentary lifestyle | 12,5 | 15,5 | 14 |
| Other | 24,5 | 60 | 42,25 |
| Type of metabolic disease | | | |
| DT2 | 19 | 5 | 12 |
| HTA | 35,5 | 28 | 31,75 |
| Obesity | 11 | 1 | 5,75 |
| DT2 and HTA | 08,5 | 5 | 6,75 |
| DT2 and Obesity | 1 | 1 | 1 |
| HTA and Obesity | 1 | 01,5 | 1,25 |
| No | 24 | 58,5 | 41,25 |

### *3.8. Combination of Cereals and Legumes in the Dietary Prescriptions of the Households Surveyed*

Regarding dietary prescriptions, when asked whether the various patients receive assistance from nutrition and dietetics professional, 31.75% of them answered yes, compared to 68.25%. Among the 31.75%, only 24.5% had the combination of cereals and legumes in their prescription and 75.5% did not include this combination (Table 8). This analysis shows that more than half of the households surveyed do not have dietary prescriptions and do not combine cereals and legumes in the same meal. This observation would be due to dietary behaviors and habits, but mainly to the financial power of the head of the household, as these people are less frequent in nutritional care services. The first social difference in terms of diet would be financial in nature [22].

***Table 8.*** *Combination of Cereals and Legumes in the Dietary Prescriptions of the Households Surveyed.*

| Parameters | Ivorian households (%) | Non Ivorian households (%) | Total (%) |
|---|---|---|---|
| People with a dietary prescription | | | |
| Yes | 36,5 | 27 | 31,75 |
| No | 63,5 | 73 | 68,25 |
| Presence of cereal/legume combination in the dietary prescription | | | |
| Yes | 30 | 19 | 24,5 |
| No | 70 | 81 | 75,5 |

## 4. Conclusion

The objective of this study was to evaluate the level of consumption of cereals and legumes in four (04) communes in the district of Abidjan (Ivory Coast). Analysis of the results shows that rice is the most consumed cereal and cowpea the most consumed legume. The frequency of

consumption is 3 to 4 times per week for rice, with an estimated quantity consumed per meal per person of 200 to 250 g. Cowpea is consumed once or twice a week, with an estimated quantity of 100 to 150 g per meal. Also, half of the Ivorian households surveyed combine legumes (cowpea or soybeans) with bread, unlike non-Ivorian households, which consume more legumes with rice. The frequency of consumption of these combinations among Ivorian and non-Ivorian households was 3 to 4 times per week. Therefore, the combination of cowpea with rice could be an innovative solution to improve the diet of diabetic patients and undiagnosed cases.

## Abbreviations

IDF: International Diabetes Federation;
WHO: World Health Organization;
T2DM: Type 2 Diabetes;
Hypertension: High Blood Pressure.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the manuscript.

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