**Correlation between the food consumption of children aged 6 to 59 months and the socio-demographic characteristics of mothers-guardian and households: A comparative study of two areas with different horticultural characteristics in Niger.**

**Abstract**

Poor eating habits have a negative impact on the health of infants and young children.**Objective:** The objective of this study is to evaluate the dietary consumption patterns of children aged 6 to 59 months associated with the sociodemographic characteristics of mothers, guardians and households in two horticultural zones with different specificities. **Methodology: This cross-sectional study was conducted** across three municipalities, **involving** 214 households to **characterize** the socio-demographic profile and food consumption of children. **Data were analyzed** using Stata MP 16 and SPSS 25 **software.** **Résultats:** The findings **revealed** that the consumption of animal-based products **was generally low**, except **in** non-horticultural areas (Dosso **urban commune**), where a significant difference **was observed** (P = 0.05). **Furthermore,** 66.8% of children **achieved an Acceptable Food Consumption Score (AFCS).** Multivariate analysis **indicated** that children in the Tillabéri **horticultural area** and the Dosso **non-horticultural area swere** 5.33 and 4.34 times **more likely to have an acceptable food consumption score** compared to their counterparts in the Dosso **horticultural** area (adjusted OR = 5.33; P = 0.004), (adjusted OR = 4.34; P = 0.022). However, a **low level of maternal education was found to positively influence children's feeding practices** (adjusted OR = 4.61; P = 0.005). Conclusion: **While** the majority of children **have an acceptable food consumption score**, there is a need to **enhance** awareness among mothers **to promote** better feeding practices.

**Keywords:** food consumption score, sociodemographic characteristics, household, child, zone, market gardening, Niger

1. **INTRODUCTON**

According to the World Health Organization (WHO), malnutrition is defined as deficiencies, excesses, or imbalances in a person’s energy and/or nutritional intake [1]. Malnutrition primarily affects children under five years of age, particularly during the complementary feeding period, **worldwide and especially in developing countries,** and it is responsible for at least half of all child deaths [2,3]. **Globally,** nearly 149.2 million children under the age of five are stunted, 45.4 million **suffer from wasting,** and 38.9 million are overweight [1, 4]. The consequences of malnutrition during the first 1,000 days of life are severe, **leading to** high mortality and morbidity rates, as well as immune deficiencies among children in developing countries [4, 5]. **In Niger, according to the SMART 2022 survey, the prevalence of Global Acute Malnutrition (GAM) among children aged 6 to 59 months exceeds the WHO high threshold of 10.0%.** Children aged 6 to 23 months (17.6%) **are more affected** compared to their counterparts aged 24 to 59 months (9.4%). This significant difference was observed in four out of eight regions: Dosso, Maradi, and Tahoua. **Chronic malnutrition, or stunting,** is estimated at 47.0% among children aged 0 to 59 months, which is well above the WHO's very high threshold of 30%. This prevalence is higher than the 43.5% recorded in 2021. **The severe form of malnutrition** is estimated at 20.2% nationwide [6]. The **minimum acceptable diet** rate for children aged 6 to 23 months stands at 6.7% at the national level. This rate was 12.3% in 2020 and 19.5% in 2021, **indicating a significant decline compared to** 2021. The highest proportion is observed in Niamey (25.1%), while the lowest is in Diffa, at 1.9%.

In the Dosso region, Falmey has the lowest share (3.6%) of malnourished children, while Gaya has the highest (38.3%) [6].. The underlying causes of this **nutritional crisis** in developing countries, and particularly in Niger, include food insecurity, **socio-demographic**, and **sociocultural** factors [7,8]. Several studies have shown that inadequate infant and young child feeding methods are linked to the socio-demographic characteristics of mothers. The food consumption of children cannot therefore be analysed independently of all socio-demographic characteristics such as sex, age, marital status, wealth quintile and geographical location. A study on the feeding environment of young children is needed to better understand the problem of feeding practices. **Based on these considerations,** the present study was designed to assess the food consumption of children aged 6 to 59 months in relation to the socio-demographic characteristics of mothers, guardian**,** and households in both market garden and non-market garden areas in Niger. .

1. **MATERIAL AND METHODS**
	1. **Study area**

Three municipalities participated in this study. These include the commune of Liboré, located in the department of Kollo in the Tillabéri region, at Latitude 13.4047 and Longitude 2.19139. 13° 24 17 North, 2° 11 29 East, with an area of 110 km2; The municipality of N'Gonga, located 30 km south of the departmental capital of Birni N'Gaouré, and the urban municipality of Dosso, occupies the central part between latitude 13°05 north and longitude 1'30' and 30'20' east on the national road 1 (axis Niamey-N'Guigmi), 139 km east of Niamey, with an area of 592.6 km2. Figure 1 shows the map of Niger and the location of the different municipalities.The selection of regions was made on the basis of the high rate of children suffering from malnutrition observed, the presence of a water point, since the populations of the riparian villages consume more fish and produce vegetables almost in season, For other communities, market gardening is an off-season activity.The rural municipality of Liboré as a market gardening commune, N'Gonga as a market gardening commune and Dosso as a non-market gardening urban commune.

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**Figure 1:** Map of locations of study sites (source our study).

**1.2. Description of the study**

The study was conducted from February 20 to August 5, 2022 with mothers/caregivers of children aged 6-59 months. It is imperative that the children are healthy and have been living in the study area for at least 6 months, with an age of between 6 and 59 months prior to inclusion. Prior to inclusion of the mother/guardian and child in the study, parental consent is also required.

**1.3 Sampling**

The ASN SMART 2020 software, which is used in the national nutrition survey, was employed to determine the sample size by calculating the total number of mother-child pairs in the study. A cluster effect of 1.2 and a non-response rate of 0 were applied. The formula used is as follows:

$N=\frac{\left(1+NR\right)\left⌊D×Z^{2}p(1-p)\right⌋}{m^{2}}$ (1)

N = (1+NR) (D\*Z2\*p (1- P)) / m2. The formula parameters are: N is the sample size

* The cluster effect is equal to D=1.2;
* The No Answer is equal to NR=0 ;
* The normal-law quantile is equal to Z=1.96;
* P=0.664 is the prevalence of vitamin A supplementation (% of children aged 6-59 months), SMART 2020;
* Chronic food insecurity situation is equal to 0.325 ;
* m: Sampling error selected is equal to 0.12.

Mother-child couples were selected randomly in the three municipalities, namely the municipality of Liboré, N'Gonga and the urban municipality of Dosso. The study covered a total of 214 mother-child couples.

**1.4. Tools for collecting data**

Data collection from mothers was performed using oral questionnaires. The questionnaire is divided into three parts: socio-demographic characteristics, feeding practices and a list of all foods consumed by children on the day before the survey.

**1.5. Variable**

The variables for the socio-demographic characteristics of mothers include age, educational attainment, marital status, household background, and income-generating activity. For household characteristics, the variables are the practice of agriculture, livestock farming, and gardening. Regarding feeding practices, the key variable is the Food Consumption Score (FCS), which is a method used to assess children's food security. The FCS allows for the classification of children into three groups:

* Children with a Low Food Consumption score (LFC), where FCS ≤ 21, indicating food insecurity.
* Children with a Limited Food Consumption score (LFC), where 21.5 ≤ FCS ≤ 35, indicating children at risk of food insecurity.
* Children with an Acceptable Food Intake score (AFI), where FCS > 35, indicating food security.

**1.6. Statistical analysis**

Study data were collected using the KoboCollect software and processed on STATA MP 16 and SPSS 25. Children’s AFI were cross-referenced with sociodemographic variables to determine their association. Some variables (sociodemographic characteristics of mothers/ guardian of children 6-59 months and households) were expressed in terms of frequencies and percentages. The bivariate analysis was performed to examine the association between SCAA and dependent categorical variables to be included in the multinomial logistic regression analysis at a p-value < 0.05 for more precise information on their degrees of influence. This method was used to model a relationship between predictive variables and dietary diversity in children aged 6-59 months. The result was presented with an odds ratio (OR) and a 95% confidence interval (CI). A p-value < 0.05 was considered statistically significant.

1. **Results**
	1. **Descriptive findings**

The socio-demographic characteristics of mothers/ guardian of children 6-59 months and households are summarized in Table 1.

**Table I: Socio-demographic characteristics of mothers or guardian of children 6-59 months**

|  |  |  |
| --- | --- | --- |
| variable  | Number | % |
| Mother's age |
|  Under 20 years | 11 | 5,1 |
| 20 - 29 years | 103 | 48,1 |
| 30 -3 9 years | 72 | 33,6 |
| 40 years to more | 28 | 13,1 |
| Marital status |
| Married | 208 | 97,2 |
| Divorced | 2 |  0,9 |
| Widow  | 4 |  1,9 |
| Level of education |
| Higher education | 7 |  3,3 |
| Secondary education | 41 | 19,2 |
| Primary education  | 49 | 22,9 |
| Quranic School | 23 | 10,7 |
| No formal education | 94 | 43,9 |
| Source of income |
| Employee  | 13 | 6,1 |
| Farming  | 32 | 15,0 |
| Trader | 65 | 30,4 |
| No income | 104 | 48,6 |
| Number of persons in household |
| 1 to 4 | 211 | 98,5 |
| 5 to 7 | 2 | 1 |
| 8 to more | 1 | 0,5 |
| Practice of agriculture |  |  |
| Yes  | 162 | 75,70 |
| No  | 51 | 24,30 |
| Practice of gardening |  |  |
| Yes  | 84 | 39,25 |
| No  | 130 | 60,75 |
| Pratice of husbandry |  |  |
| Yes  | 123 | 57,5 |
| No  | 91 | 42,5 |

The analysis in table 1 shows that the 20-29 age group is most represented with a frequency (percentage) of 48.1%, followed by the 30-39 age group with 33.6%. About 97.20% of mothers/ guardian are married and 45.33% are not in school. Mothers/ guardian without income and traders represent 47.7% and 30.4% respectively. The most representative household size is [1-4] persons. There is 75.70% who practices agriculture, 39.25% practices gardening as for livestock it is only 57.5% practical.

* 1. **Analytical results**
		1. **Dietary profile of children aged 6-59 months according to the Food Intake Score (FIS)**

Figure 1 shows the rate of consumption of food groups by area for children aged 6-59 months. In all areas, starches (cereals, root, and tuber) and fruits and vegetables rich in vitamin A are the most consumed. Legumes and nuts, dairy products (milk, yogurt, and cheese), meat products (meat, fish, poultry, and liver/offal) and eggs are the least consumed. At the level of areas, consumption varies according to potential and availability of food. The children of the market gardener of Dosso (N'Gonga) and the non-market gardener (Dosso, urban commune), consume not only 100% of starches but also fruits and vegetables rich in vitamin A. The difference is not significant between zones. Other fruits and vegetables were more consumed (94.4%) in the market gardening area of the municipality of Liboré (region of Tillabéri), a significant difference was observed between the zones (p **˂** 0.001). In addition, pulses and nuts, dairy products (milk, yoghurt, cheese) and meat products (meat, fish, poultry, liver/offal) are more consumed in the non-market area of the urban commune of Dosso, respectively 50.0%; 100.0% and 50.0%. The proportions were statistically significant for this area (p **˂** 0.001). However, no difference was observed between the areas for legume and nut consumption (HASSANE S.Z et al., 2024).

***Figure 2: The proportions of food groups consumed by area. Dairy products (milk, yogurt, cheese): P< 0.001; meat products (meat, fish, poultry, liver/offal):*** P< 0,001 ; other fruit and vegetables: P< 0,001**.**

* 1. **Food consumption score by areas**

**Table 2 summarizes the food consumption scores by area of children aged 6-59 months.**

**Table II: Food consumption score by area**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|   | **Market gardener truck farmer Dosso** | **Market gardener Tillabéri**  | **non- market gardening Dosso** | **Ensemble** | *p* |
|   | n% | n% | n% | n% |
| **Food consumption groups - thresholds 28/42** |
| Poor  | 6(8,1) | 3(4,3) | 6(8,6) | 15(7,0) | **˂ 10-3** |
| Limite | 42(56,8) | 8(11,4) | 6(8,6) | 56(26,2) |
| Acceptable | 26(35,1) | 59(84,3) | 58(82,9) | 143(66,8) |
| Total | 74(100,0) | 70(100,0) | 70(100,0) | 214(100,0) |
| **Food consumption score class** |
| Poor + Limit | 48(64,9) | 11(15,7) | 12(17,1) | 71(33,2) | **˂ 10-3** |
| Acceptable | 26(35,1) | 59(84,3) | 58(82,9) | 143(66,8) |
| Total | 74(100,0) | 70(100,0) | 70(100,0) | 214(100,0) |

This analysis shows that food consumption is acceptable for 66.8% and this was statistically significant (P= 0.000).

* 1. **Correlation between the food consumption score of children aged 6 to 59 months and the socio-demographic characteristics of mothers and households according to the multivariate analysis**

To study the characteristics influencing children’s food consumption, the explanatory variables were introduced in a logistic model to obtain more refined information on the degree of influence they have on food consumption (Table 3). The multinomial logistic regression analysis led to conclusive models for predicting the probability of having an acceptable food consumption level.The analysis of the logistic model shows the p-values of the different explanatory variables identified. The estimated model identifies three (3) relevant variables explaining food consumption in children aged 6 to 59 months: This is the non-horticulturee area "Urban Dosso ˮ (P=0.022), the Tillabéri market gardening commune of Liboré ˮ (P=0.004) and primary schooling level (P=0.005) (Table 3).

**Table III: Bi-variate and multivariate analysis of the variables associated with food consumption of children from 6 to 59**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Variable  | OR brute **[**IC95% **]** | P | OR adjusted **[**IC95% **]** | p |
| Area  |  |  |  |  |
| Market gardener Dosso | 1 | - | 1 | - |
| Market gardener Tillabéri | 35,68[3,91-25,05] | 0.0000 | 5.33[1.69-16.83] | **0.004** |
| No Market gardening Dosso | 33,47[3,63-21,92] | 0.0000 | 4.34[1.24-15.18] | **0.022** |
| Level of education |  |  | 1 | . |
| Not any | 1 |  | 1 | . |
| Koranic | 5.93[2.98-11.78] | 0.000 | 1.26[0.40-3.93] | 0.692 |
| Primary  |  |  | 4.61[1.58-13.45] | **0.005** |
| Secondary and higher |  |  | 1.96[0.65-5.88] | 0.232 |
| Main source of income |  |  |  |  |
| Employee  | .60[0.32-1.13] |  | 1 |  |
| Farmer | .46[0.20-1.07] | 0.03 | 1.76[0.619-5.01] | 0.289 |
| Trader  |  |  | 0 .63[0.28-1.43] | 0.272 |
| Revenus without income | 1 | - | 1 | - |
| Agricultura practice |  |  |  |  |
| No  | 1 |  | 1 | . |
| Yes  | 034[0.15-0.75] | 0.053 | 1.22[0.46-3.26] | 0.694 |
| Practice of gardening |  |  |  |  |
| No | 1 |  | 1 | . |
| Yes  | .22[0.11-0.41] | 0.000 | 0.91[0.307-2.70] | 0.865 |
| Practice of raising |  |  |  |  |
| No  | 1 |  | 1 | . |
| Yes  | .24[0.12-0.47] | 0.0000 | 0.56[0.23-1.35] | 0.196 |
| Number of children under 5 |  |  |  | - |
| 1 child under 5 years | 1 | - | 1 |  |
| At least 2 children | 2.19[1.038-4.63] | 0.03 | 1.43[0.59-3.50] | 0.43 |

***Significance level at P 0.05; IC = confidence interval; OR = odds ratio.***

***Areas****:* is a very important feature in the analysis of food consumption. Children aged 6 to 59 months in the non-market gardening area of "Dosso commune urbaine ˮ and the vegetable- growing Tillabéri “commune de Liboré ˮ are less likely to have poor nutrition relative to their Dosso Market gardening Area counterpart (adjusted OR [95%CI] = 4.34 [1.24-15.18]; P= 0.022) (adjusted OR [IC95%] =5.33[1.69-16.83]; P= 0.004)

***Educational attainment: plays a key role in analysing food consumption. According to the results of the logistic regression, children born from mothers who have a primary level are less likely to be food insecure***. They have a higher probability of having acceptable food intake (adjusted OR [95%CI] = 4.61 [1.58-13.45]; P= 0.005) compared to mothers who are literate or have completed secondary or higher education.

1. **DISCUSSION**

**4.1. The socio-demographic characteristics of mothers/** **guardian of children aged 6-59 months and of the household**

This study was conducted to link the food consumption of children aged 6-59 months with socio-demographic characteristics of **mothers/ guardian** and households. The results show that the age group [20-29 years] is most represented with 48.1%. Approximately 43.93% of **mothers/ guardian** are uneducated, 47.66% have no income. This is comparable to studies in 23 sub-Saharan African countries where 43.8% have no formal education and 34.5% are without income [9]. However, they are superior to the results of the study conducted in southern Benin by Konton et al. (2017), which found 43.66% of mothers without income-generating activity and 30% illiterate [2]. A study conducted in north-central Burkina Faso reported that 56.9% of mothers were housewives, 75.6 uneducated, with an age range between [20-29 years] [4]. Another study conducted in Abidjan-Cote D'ivoire reported a proportion of 14.19% of mothers are housewives and 77.77% uneducated [10].

***4.2. Food consumption of children 6-59 months***

The main food groups consumed by children 6-59 months are cereals, fruits and vegetables rich in vitamin A in both areas. These results are consistent with the national documentation [11,16]. They are also comparable to the results reported by other authors in other African countries [2,4]. Other food groups are very little consumed, like animal products. These results are different from those of Boula et al., (2016) who reported a high consumption of meat products (meat, fish), followed by vegetables [7]. Indeed, studies carried out in rural communities of southern Benin, northern central Burkina and Madagascar have reported low consumption rates of animal products and a preponderant consumption of cereals [2,4,18]. Consumption of cereals, roots and tubers, meat products (meat, fish), fruits and vegetables, dairy products (milk, yoghurt, cheese), eggs and legumes-nuts are associated with the urban environment the vegetable garden Dosso commune urbainˮ and the rural environment of the vegetable garden area Tillabéri commune de Liboré ˮ as for the vegetable garden area Dosso, it is associated with starches and vegetables rich in vitamin A. These results are similar to those of Kouton et al. (2017) [2]. This very precarious and inadequate practice of mothers/ guardian on feeding their children could be due to ignorance, lack of information on good feeding practices and low household income. The risk of such a diet is micronutrient deficiency and, as a result, malnutrition and poor health [3].

Regarding the food consumption score, the results showed an acceptable score for the majority of children (66.8%) and a significant difference between children living in market garden and non-market areas. Only 35.1% of children living in the Dosso horticulture area have an acceptable food intake score. This could be due not only to the character of the area which is a very rural commune, but also to the non-presence and difficult accessibility to different food groups. The INS (2015) found the same results, where 18% of children living in rural areas are poorly nourished, 25% are on a low-limit diet and 57% have an acceptable diet [11]. However, this score is lower than that found by Dramé et al. (2019). who found 78.8% and 69.4% of households with acceptable consumption scores, respectively [19]. This is higher than the results of Hien et al. (2023) in Bobo-Dioulasso, Burkina Faso, who showed 16.1% of children with a minimum acceptable diet [20].

* 1. ***Association between children’s food consumption and the socio-demographic characteristics of mothers/guardian and the household. Bivariate and multivariate analysis.***

The bivariate analysis shows that the food consumption was inadequate among children living in the horticulture area of Dosso (rural commune of N'Gonga) compared to horticulture areas of Tillabéri "commune de Liboré" and non-horticulture area "Dosso commune urbaine" (P = 0.0000)**.** This may be due to the inaccessibility and non-availability of food, but also to the non-consumption of household produce. These results are identical to those of other studies on infant and young child food consumption (Jeannoda et al., 2006; Ouedraogo et al., 2019; Hien et al., 2023) [21,22,20]. Inadequate food consumption among children living in low-income households compared to those in the wealthy class (P= 0.03)**.** This may be attributed to the fact that the poor are primarily concerned with the quantity of food, not its quality. These results are in agreement with those of Kouton et al. (2017), Ouologuem et al. (2017) and Ouedraogo et al. (2019) which showed an association between food consumption and sources of income [2,22,23]. Children from educated mothers were more likely to have adequate food intake compared to uneducated (P = 0.03). This relationship could be attributed to the level of knowledge of mothers/guardian about the importance of good nutrition on children’s health. These results are similar to those of Rhashid et al. (2006); Jeannoda et al. (2006); Joshi et al. (2006); Kouton et al. (2017), Ouologuem et al. (2017) [2,21,23,25]. Inadequate food intake was found for children living in households with large numbers of children aged 6-59 months (P = 0.03) compared to households with small numbers**.** Children living in households where agriculture, livestock farming or gardening is practised were more likely to have adequate food intake (P 0.001). These results are corroborated by those of Bougma et al., (2022) concerning the number of children [4].

After adjustment, the logistic regression results showed a significant association between mother/guardian and household sociodemographic characteristics and children’s food consumption. Children living in the Dosso vegetable area are at risk of inadequate food intake compared to children in the Tillabéri horticulture area, "commune de Liboré" (adjusted OR [CI 95%] = 5.33 [1.69-16.83]; P = 0.004). This may be due to the availability and accessibility of food for children due to the proximity of the municipality with the capital, Niamey, the geographical location of the area, but also it is a riverside municipality of the Niger River. Food consumption was acceptable for children living in the non-market gardener zone " Urban Dosso " (adjusted OR [95%CI] = 4.34 [1.24-15.18]; P= 0.022) compared to those in the rural Dosso ". This is in agreement with those of Bougma et al. (2022) in their study in the north centre of Burkina Faso (OR = 2.8 and IC = 1.28-3.85), where they found a minimum acceptable diet for children living in urban areas compared to rural areas [4]. This is different from the finding of Kouton et al. (2017), where they found an inadequate complementary feeding practice in urban versus rural settings [2]. Children from mothers with primary education are more likely to have acceptable food intake (adjusted OR [95%CI] = 4.61 [1.58-13.45]; P = 0.005). This is in agreement with that of Ouologuem et al. (2017) who found that educated people have adequate food intake compared to uneducated (OR = 0.916 and IC = 0.886-0.946) [23]. This finding is in disagreement with that of Jeannoda et al. (2006) who found that children benefiting from better feeding practices are those born to mothers who have a secondary or higher education level [21; 26;27].

1. **CONCLUSION**

The analysis shows that cereals are generally the staple food for all children. Most children have an acceptable ACS (Acceptable Consumption Score). Socio-demographic factors of the mother/guardian and household, such as geographical location, the mother's low level of education, source of income, and the practice of agriculture, livestock farming, or gardening, positively influence children's food consumption. The nature of the area and the level of education are strongly correlated with adequate food intake. There is a need to strengthen awareness activities for behavior change among mothers and guardian regarding good feeding practices to improve children's nutrition.

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**CONSENT**

Participation was voluntary and each mother or guardian signed a declaration of informed consent. Data collection and processing were conducted in a confidential manner during the analysis and reporting of the data. .

**ETHICAL APPROVAL**

This study was authorized by the health authorities of the region and approved by the National Ethics Committee for Health Research under reference number 075/2021/CNERS, dated December 09, 2021. The content of the survey was explained in detail to the participants.

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**COMPETING INTERESTS**

The authors stated that there were no competing interests.

**COMPETING INTERESTS DISCLAIMER:**

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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