# Correlation between determining factors and dietary diversity in children aged 6 to 59 months in market gardening and non-market gardening areas of Niger.


## Summary

An unbalanced diet has been identified as a major cause of morbidity and mortality in children. The general objective is to identify the factors determining the food diversification of children aged 6 to 59 months in two areas of different horticultural specificity. This is a cross-sectional study, conducted in three municipalities, with 214 mothers and or caregivers. A questionnaire evaluating the food diversity was used, followed by statistical analysis of the results. The group of cereals and fruits and vegetables rich in vitamin A is the most consumed. Those of animal origin were low. A significant link between Minimum Food Diversity and certain characteristics such as area, income, mother education, agriculture, gardening and breeding (p 0.01). According to the logistic regression, residence of the child in non-market gardening zone (Dosso commune urbains) (ORa [IC95%] =44.60 [5.90-152.50]; P<0.001) and in market gardening zone of Tillabéri (ORa [IC95%] =30 [7.67-259.40], p <0.001) Increases their chances of having a diversified diet by 44 and 30 times respectively compared to a child in the Dosso market zone. Efforts to improve food security, especially in vulnerable households, were needed to ensure a balanced diet for children.



**Keywords:** diversification of food, mothers, children from 6 to 59 months, horticultural specificity.


## INTRODUCTON

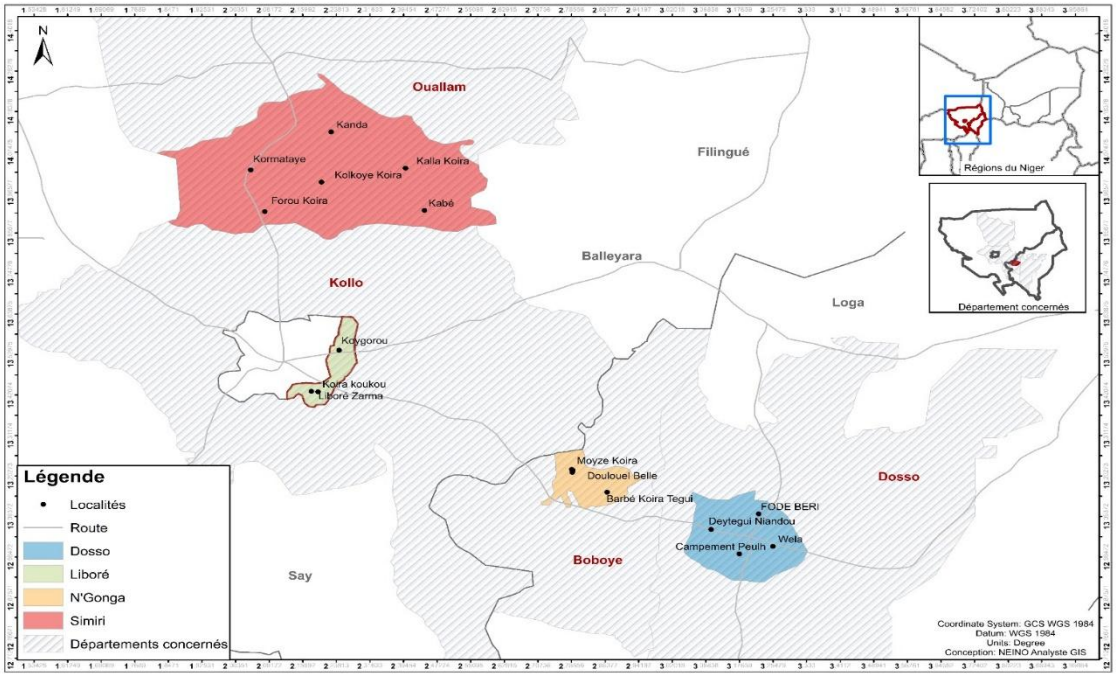
Food diversity is the basis of good nutrition, and an individual's nutritional status has important implications for labour productivity, lifetime incomes and economic development across the country (Shively and Evans, 2021). Undiversified diet leads to malnutrition in the image of marasmus and kwashiorkor (Houndji et al., 2013; Lourme Ruiz et al., 2016; Sanou et al., 2018). Malnutrition compromises the physical and intellectual growth of young children (Kayodé et al., 2012). In Niger, children suffering from acute malnutrition have a rate above the WHO 10% alert threshold and sometimes even above the emergency threshold (15%) (World Health Organization, 2009). This malnutrition is directly linked to inadequate nutrition. However, for a good balance of food, a diversified diet is necessary. It provides the body with most of the nutrients it needs to function properly (Sanou et al., 2018). Adherence to a minimum acceptable diet is also essential for reducing macronutrient and micronutrient deficiencies (Jones et al., 2014a; Bougma et al., 2022). According to the SMART 2019 survey, the majority of Nigerian children have a low food diversification with 42.1% consuming at least 4 groups of foods per day and only 31.8% having an acceptable minimum diet (INS, 2019). This situation varies greatly from one region to another. The lowest

proportions are in Maradi (3%), Tahoua (8.7%), Tillabéri (9.2%) and refugee camps (4.1%) (INS, 2018). Indeed, several studies have shown that inappropriate infant and young child feeding practices are linked to the socio-demographic characteristics of mothers, but little information is available on the dietary diversity of children for better understand the causes of this malnutrition. This study was initiated to identify the key determinants that influence children's dietary diversity.

## MATERIALS AND METHODS

### Study area

The present study concerned three municipalities. This is the commune of Liboré located in the department of Kollo region of Tillabéri, between 13° 24 17 latitude north and 2° 11 29 longitude east, with an area of 110 km. The commune of N'Gonga located 30 km south of the chief departmental place Birni N'Gaouré located between latitude 13°1799 and 2.826 13°10'48' north longitude and 2°49'34' east longitude with 211m of altitude. The urban commune of Dosso occupies the central part between 13°05 latitudes North, and 1'30 and 30'20 longitudes East on national road 1 (axis Niamey-N'Guigmi) 139 km to the East of Niamey (the capital) with an area of 592.6 km2. In Figure 1, you can see the map of Niger and the locations of the various communes (HASSANE et al., 2024).




**Carte 1: Location map of the study areas** (HASSANE et al., 2024).

**Description of the study:**

The study was conducted from February 20 to August 5, 2022, and involved mothers/caregivers of children aged 6-59 months. Children should be physically healthy and have resided in the study area for at least 6 months. Parental consent is also obtained prior to the inclusion of the mother/guardian and child in the study.

**Sampling**

The total number of mother-child couples in the study was determined using ASN SMART 2020 software used in the national nutrition survey to calculate sample size. The formula is N= (1+NR) (D*Z2*p (1-p)) / m2.

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

**tools for collecting data**

Data collection, processing and analysis were aligned with WHO guidelines on indicators for assessing infant and young child feeding practices (World Health Organization, 2010) and FAO to measure Food Diversity at household and individual level (Gina et al., 2013). A questionnaire was developed and focused on the collection of demographic and economic information. The Food Diversity questionnaire was developed according to WHO and FAO guidelines in accordance with the study objectives and country.

**Data collection tools**

Data collection, processing and analysis were adapted to the WHO guidelines on indicators to assess infant and young child feeding practices (World Health Organization, 2010) and FAO guidelines to measure Dietary Diversity at household and individual levels. A questionnaire was developed and focused on collecting demographic information (age, sex and education level of mothers or caregivers), socio-economic information (income-generating activities), food consumption (different food groups consumed) and production systems (crops, livestock and gardening). The Dietary Diversity questionnaire was developed according to WHO and FAO guidelines in accordance with the study objectives and the country. Face-to-face interviews with the mothers of the children were conducted in the households. Based on the open recall, it was checked which food groups were consumed using a predefined list of food groups. A list of 42 food items was used. One point was awarded for each food or food group consumed, and zero was awarded if none were consumed.

**Variables**

Variables that include demographic, socioeconomic characteristics, food consumption and production systems. The dependent variable was Minimum Food Diversity with these two

subgroups (low and acceptable). The choice of explanatory variables was based on a prior knowledge of the variables likely to influence the level of dietary diversity. The variables examined as determinants of food diversity were the place of residence, sex of the child; the level of education of the mother/guardian, the practice of breeding; the practice of gardening; farmer; and sources of income. In relation to the children's food diversity score (FDSE), it was equal to the number of food groups consumed by children. Based on WHO recommendations, the FDSE selected 7 groups according to WHO and FAO (Gina et al., 2013; World Health Organization, 2010; Ouédraogo et al., 2019; World Health Organization, 2010). Children who consumed daily foods from at least 4 out of 7 food groups defined during the previous day reach the Minimum Dietary Diversity (MDD). Minimum Dietary Diversity (MDD) and the frequency of eating group are dependent variables and were examined according to the areas and characteristics of households, mothers and children. The DAM is divided into two classes, low food diversity score (LFDS), when MDD<4 and Minimum Food Diversity acceptable (MFDA) when FDS >4. The children's dietary diversity was crossed with the household characteristics to determine their association.

**Statistical analysis**

Study data were collected using the KoboCollect software and processed on STATA MP 16 and SPSS 25. Chi-two association analyses were performed to describe the characteristics of mothers, children and households, the minimum food diversity and types of food groups consumed in relation to residential areas, the p-value of 0.05 was considered statistically significant. A multi-variate logistic regression analysis was performed to predict the probability that a child would belong to an adequate or low level of dietary diversity. The dependent variable was the Minimum Food Diversity with these two subgroups (low and acceptable). The choice of explanatory variables was based on a prior knowledge of the variables likely to influence the level of acceptable Dietary Diversity. Those with a p-value of 0.05 are associated with the variable to be explained in other words dependent. The Odds ratios (OR) column indicates how often it influences, positively or negatively, the food diversity and a confidence interval (CI) at 95%. The predictive power of the logistic model, the identification of determinants of children's food diversification was determined to create assumptions and predictions about children's food diversification in the future

**Ethical considerations**

This study was granted by the health authorities of the region and approved by the National Ethics Committee for Health Research (CNERS) under number 075/2021/CNERS of December 09, 2021. The survey content was explained in detail to participants. Participation was voluntary and each mother or caregiver signed a declaration of informed consent. Data collection and Processing was carried out in a confidential manner during the analysis and reporting of the data.

## Results

Distribution of children by age group according to zones.

The distribution of children by age group and area is shown in Table 1.

**Table 1:** Distribution of children 6 to 59 months according to age group according to market gardening and non-market gardening areas.

| | Areas | | | | |
|---|---|---|---|---|---|
| **age groups** | **market gardener Dosso** | **market gardener Tillabéri** | **non- market gardening Dosso** | **Total** | **p** |
| | N (%) | N (%) | N (%) | N (%) | **$<10^{-3}$** |
| 6 to 23 months | 35 (47.3) | 34 (48.6) | 68 (97.1) | 137 (64.0) | |
| 24 to 59 months | 39 (52.7) | 36 (51.4) | 2 (2.9) | 77 (36.0) | |
| Sample size | 74 (100.0) | 70 (100.0) | 70 (100.0) | 214 (100.0) | |

Table 1 shows that overall, children aged 6 to 23 months are most represented (64%). Specifically, children aged 6 to 23 months or more dominant (97.1%) in the non-market gardening area (Dosso) compared with (52.7%) and (51.4%) children aged 24 to 59 months respectively in the market gardening areas of Dosso and Tillabéri. There is a statistically significant relationship between the zones and age groups ($p<0.001$).

Table 2 presents an analysis of the sociodemographic and economic characteristics of mothers or caregivers who care for children aged 6 to 59 months (HASSANE S.Z et al., 2024).

**Table 2:** Relationship between the socio-demographic and economic characteristics of mothers or caregivers of children aged 6 to 59 months according to the areas

| Variables | Areas | | | Total | p |
|---|---|---|---|---|---|
| | Market gardener | Market gardener | Non-market | | |

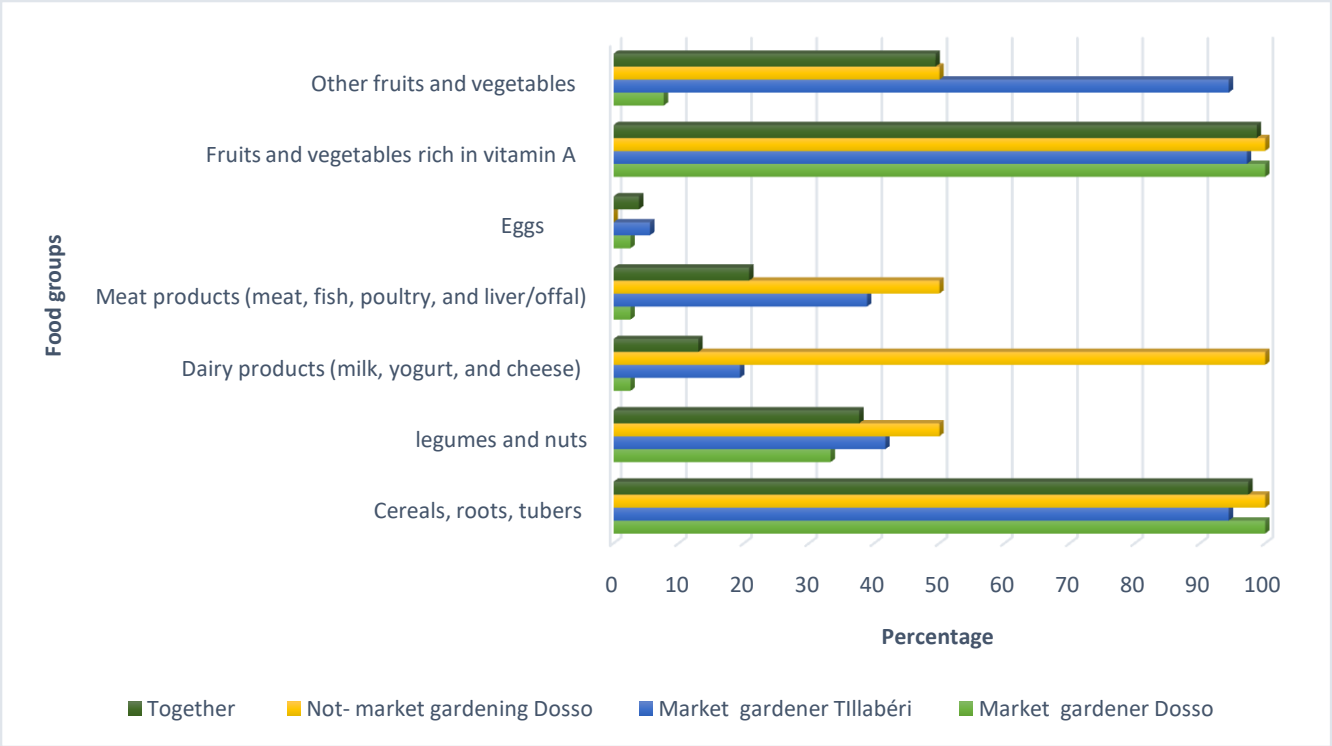
| | | Dosso N (%) | Dosso N (%) | gardening Dosso N (%) | | |
|---|---|---|---|---|---|---|
| Level of education | schooled | 8 (10.9) | 40 (57.14) | 49 (70) | 97 (45.33) | **< $10^{-3}$** |
| | Out of school | 60 (81.08) | 17 (24.29) | 17 (24.29) | 94 (43.93) | |
| | Koranic School | 6 (8,11) | 13 (18,57) | 4 (5,71) | 23 (10,75) | |
| Total | | 74 (100) | 70 (100) | 70 (100) | 214 (100) | |
| Civil status | Bride | 70 (94.59) | 68 (97.14) | 70 (100) | 208 (97.2) | **0.02** |
| | Divorced | 0 | 2 (2.86) | | 2 (0.93) | |
| | Widow | 4 (5.41) | 0 | 0 | 4 (1.87) | |
| Total | | 74 (100) | 70 (100) | 70 (100) | 214 (100) | |
| Source of income | Employees | 0 (0.0) | 3 (4.29) | 10 (14.29) | 15 (6.19) | **< $10^{-3}$** |
| | Farmers | 25 (33.78) | 5 (7.14) | 2 (286) | 32 (14.95) | |
| | traders | 29 (39.19) | 17 (24.29) | 21 (29.9) | 65 (31.2) | |
| | Without income | 20 (27.03) | 45 (64.29) | 37 (52.86) | 102 (47.66) | |
| Total | | 74 (100) | 70 (100) | 70 (100) | 214 (100.0) | |
| Gardening practice | Yes | 64 (86.49) | 17 (24.29) | 3 (4.29) | 84 (39.25) | **< $10^{-3}$** |
| | No | 10 (13.51) | 53 (75.71) | 67 (95.71) | 130 (60.75) | |
| Total | | 74 (100.0) | 70 (100.0) | 70 (100.0) | 214 (100.0) | |

This analysis shows that the majority of mothers were married and there is a strong link between zones and marital status (p 0.05). The rate of no income was 47.66%, the difference was also significant ($p < 0.001$). The rate of non-income was particularly high (52.86%) in the non-horticultural area of the urban municipality of Dosso and in the horticultural area of Tillabéri (64.29%). In addition, 39.25% are engaged in gardening. The

proportion of mothers engaged in gardening is particularly low in the non-garden sectors (4.29%) and in the Tillabéri market (24.29%), which is also significant (p<0.001). (43.93%) were not in school and this rate was higher at the level of the municipality of Dosso (81.08%), the difference was significant (p < 0.001). There was a significant difference between the two study areas for all characteristics studied (p 0.05).

**Food profile of children aged 6 to 59 months according to the food consumption score (FCS)**

Figure 1 shows the consumption rate of food groups according to the areas of children aged 6 to 59 months. In all areas, starchy foods (cereals, roots, tubers) 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 area level, consumption shows disparities depending on the potency and availability of food. Children in the market gardening area of Dosso (N'Gonga) and the non-market gardening area (Dosso urban commune) not only consumed 100% of starchy foods but also fruits and vegetables rich in vitamin A. The difference is being no significant between the areas (P>0.05). Other fruits and vegetables were more consumed (94.4%) in the market gardening area of the commune of Liboré (Tillabéri region), a significant difference was observed according to the areas (P< 0.001). In addition, legumes and nuts, dairy products (milk, yogurt, and cheese) and meat products (meat, fish, poultry, and liver/offal) are more consumed in the non-market gardening area of the urban commune of Dosso, so, respectively, 50.0.0% and 50.0%. The proportions were statistically significant according to this area (P<0.05). However, no difference was observed between the areas concerning the consumption of legumes and nuts, (P>0.05).




The percentages of food groups consumed by area: dairy products (milk, yogurt, cheese): $p<10^{-3}$; meat products (meat, fish, poultry, liver/offal): $\mathbf{p<10^{-3}}$; other fruits and vegetables: $\mathbf{p<10^{-3}}$

**Relationships between variables**

The chi-two association's results indicate that the dietary diversity of children was statistically associated with certain sociodemographic and economic characteristics. Table 3 provides details of all these results.

**Table 3:** The minimum dietary diversity of children aged 6 to 59 months is influenced by socio-demographic and economic characteristics.

| | Less than 4 groups | At least 4 groups | Total | p |
|---|---|---|---|---|
| | N(%) | N(%) | N(%) | |
| areas | | | | |
| **Market gardener Dosso** | 71(95.9) | 3(4.1) | 74(100.0) | **$< 10^{-3}$** |
| **Market gardener TIllabéri** | 32(45.7) | 38(54.3) | 70(100.0) | |
| **Not-market gardening Dosso** | 24(34.3) | 46(65.7) | 70(100.0) | |

| | | | | |
|---|---|---|---|---|
| **Total** | 127(59.3) | 87(40.7) | 214(100.0) | |
| Educational level | | | | |
| **Higher level** | 0(0.0) | 7(100.0) | 7(100.0) | **< $10^{-3}$** |
| **Secondary level** | 19(46.3) | 22(53.7) | 41(100.0) | |
| **Primairy level** | 18(36.7) | 31(63.3) | 49(100.0) | |
| **Koranic School** | 16(69.6) | 7(30.4) | 23(100.0) | |
| **Out of school** | 74(78.7) | 20(21.3) | 94(100.0) | |
| **Total** | 127(59.3) | 87(40.7) | 214(100.0) | |
| Mains source of income | | | | |
| **Employees** | 2(15.4) | 11(84.6) | 13(100.0) | **< $10^{-3}$** |
| **Farmers** | 28(87.5) | 4(12.5) | 32(100.0) | |
| **traders** | 37(56.9) | 28(43.1) | 65(100.0) | |
| **Without income** | 61(58.8) | 43(41.2) | 104(100.0) | |
| **Total** | 127(59.3) | 87(40.7) | 214(100.0) | |
| Agricultural practice | | | | |
| **No** | 18(34.6) | 34(65.4) | 52(100.0) | **< 10-3** |
| **yes** | 109(67.3) | 53(32.7) | 162(100.0) | |
| **Total** | 127(59.3) | 87(40.7) | 214(100.0) | |
| Gardening Pratice | | | | |
| **No** | 60(46.2) | 70(53.8) | 130(100.0) | **< 10-3** |
| **Yes** | 67(79.8) | 17(20.2) | 84(100.0) | |
| **Total** | 127(59.3) | 87(40.7) | 214(100.0) | |
| Briefing Pratice | | | | |
| **No** | 40(44.0) | 51(56.0) | 91(100.0) | **< $10^{-3}$** |
| **Yes** | 87(70.7) | 36(29.3) | 123(100.0) | |
| **Total** | 127(59.3) | 87(40.7) | 214(100.0) | |
| Gender of child | | | | |
| **Male** | 68(59.1) | 47(40.9) | 115(100.0) | 0.940 |
| **Female** | 59(59.6) | 40(40.4) | 99(100.0) | |
| **Total** | 127(59.3) | 87(40.7) | 214(100.0) | |

The analysis reveals that the Dietary Diversity of children aged 6 to 59 months is low in all study areas (40.7%). The proportion of children who consumed at least 4 food groups (adequate dietary diversity) increases as we move from the market gardening areas of N'Gonga (Dosso), the commune of Liboré (Tillabéri) to that of the non-market gardening area of the urban commune of Dosso. It is 4.1% respectively; 54.3% and 65.7%. Regarding the level of education of mothers, children from educated mothers were less likely to have a low dietary diversity compared to their counterparts. Children born to mothers whose main source of income is wages were less likely to be food insecure (84.6%). Regarding practices, children from households engaged in agriculture, gardening or livestock farming have a low food

diversity composed of less than four (4) food groups. In terms of sex, it did not influence the Minimum Dietary Diversity of children (P >0.05).

**Correlation between food diversity determinants and minimum dietary diversity score of children aged 6-59 months**

***Relationships between variables***

According to the results of the bivariate analysis in figure 2, some characteristics are associated with an increase in the probability that a child has Minimum Acceptable Food Diversity, it is: the area (Market gardener Tillabéri, Not-marketgardening Dosso), Educational Level (secondary level, primary level) and Mains source of income (Employees), (OR>1).

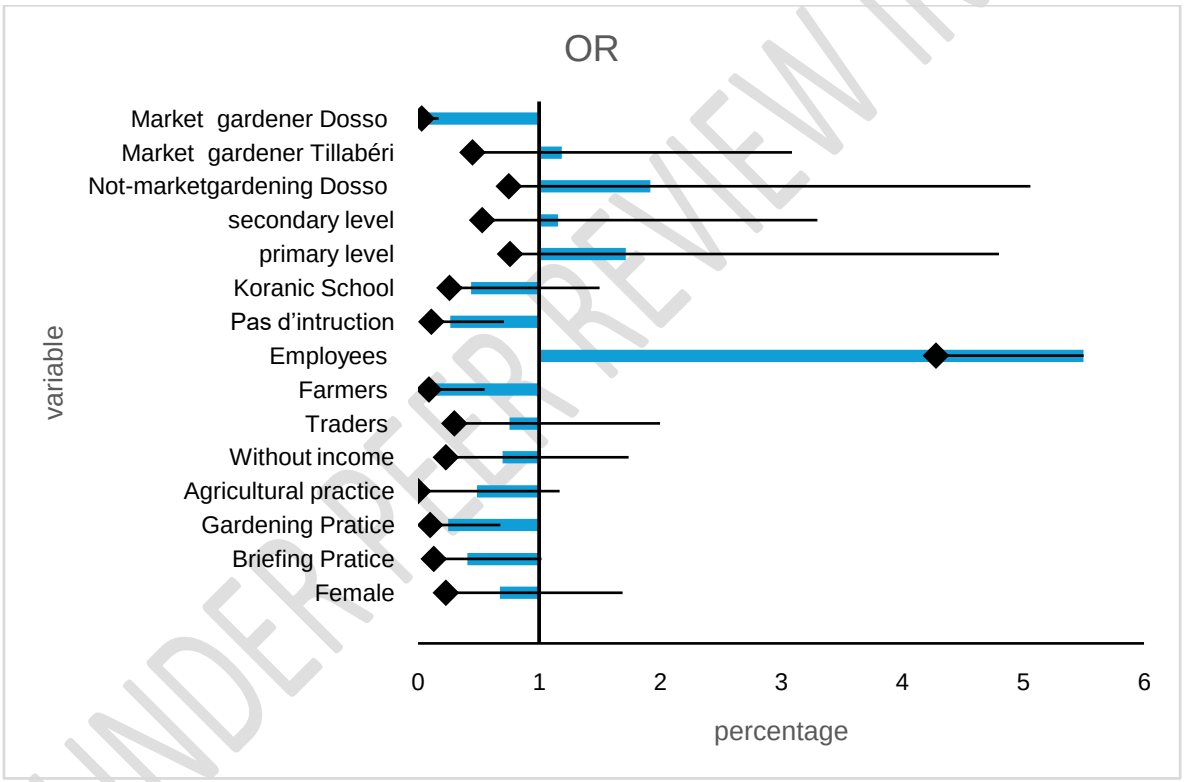



**Figure 2:** Relationship between sociodemographic and economic characteristics and Minimum Dietary Diversity of children aged 6 to 59 months according to bivariate analysis

To study the determinants of dietary diversity in children, a bivariate analysis of selected explanatory variables (figure 2) was performed. Then, using a logistic model, the simultaneous effects of the variables selected in the first step (household characteristics) on the children's dietary diversity are determined.

Table 4 presents the factors associated with minimum dietary diversity. The model estimates to identify two relevant variables influencing the dietary diversity of children aged 6-59 months. These are the non-market gardening area "Dosso urban commune" and the market gardening area of Tillabéri "commune of Liboré" which have significant links with the minimum acceptable dietary diversity regime of children (P<0.05).

***Table 4:*** Logistic regression of variables related to the Minimum Acceptable Dietary Diversity of children aged 6 to 59 months

| Variables | ORa [IC95% ] | p |
|---|---|---|
| **Areas** | | |
| Market gardener Dosso | 1 | - |
| Market gardener Tillabéri | 30.01[5.90-152.50] | **< $10^{-3}$** |
| Not-marketgardening Dosso | 44.59752 | **< $10^{-3}$** |
| **Educational Level** | | |
| Higher level | 1 | - |
| secondary level | 0.93[0.33-2.59] | 0.891 |
| primary level | 1.64[0.61-4.39] | 0.329 |
| Koranic School | 0.75[0.21-2.66] | 0.659 |
| **Mains source of income** | | |
| Employees | 1 | . |
| Farmers | 0.30[0.03-2.90] | 0.300 |
| Traders | 0.93[0.15-5.82] | 0.939 |
| Without income | 0.41[0.07-2.26] | 0.306 |
| **Agricultural practice** | | |
| No | 1 | . |
| Yes | 0.48[0.20-1.17] | 0.107 |
| **Gardening Pratice** | | |
| No | 1 | . |
| Yes | 2.30[0.62-8.53] | 0.212 |
| **Briefing Pratice** | | |
| No | 1 | . |
| Yes | 1.38[0.61-3.09] | 0.441 |
| **Gender of child** | | |
| Male | 1 | . |
| Female | 1.14[0.55-2.38] | 0.725 |

Areas are a very important feature in the analysis of food diversity. Children aged 6 to 59 months in the non-garden area "Urban Dosso " (ORa [IC95%] =44.60 [5.90-152.50]; p=0.000) and the Tillabéri market gardening area (ORa [IC95%] =30 [7.67-259.40], p=0.000) were less likely to have low food diversity compared to their Dosso market gardening area counterpart

**Predictive power of the logistic model of minimum dietary diversity in children aged 6-59 months**

The results of the estimates of the predictive power of the logistic model, the identification of the determinants of the Minimum Dietary Diversity of children as well as their interpretations are presented in Table 6.

***Table 6:*** Predictive power of the logistic model of minimum dietary diversity in children aged 6-59 months

| **Prévisions** | **Minimal dietary diversity in children** | | | P |
|---|---|---|---|---|
| | **Less than 4 groups n(%)** | **At least 4 groups n(%)** | **Total n(%)** | |
| Less than 4 groups | 92 (72.44) | 35 (27.56) | 127 (100) | 0.5000 |
| At least 4 groups | 18 (20.69) | 69 (79.31) | 87 (100) | |
| Total | 110 (51.40) | 104 (48.60) | 214 (100) | |

The ranking table (Table 5) shows that the model has a low predictive power as it predicts the dietary diversification of children at 48.60%. However, it appears that the dietary diversity of at least 4 groups is correctly classified (79.31%) than the minimal dietary diversity of less than 4 groups (72.44%).

## DISCUSSION

The results show that the most representative age group is 6-23 months with a proportion of 64.0% ($p < 0.01$). This is in disagreement with the INS (2021). According to the analyses, 43.93% of mothers had no formal education. This very high percentage of uneducated women could be due to the Nigerian education system, which is characterized by a low rate of schooling for girls in rural areas. These results are consistent with the national INS documentation (2017; 2021). Furthermore, 24.29% of mothers in the non-gardening area of Dosso were uneducated, this same percentage was obtained in the market gardening area of Tillabéri. This percentage was significantly lower ($P < 0.01$) than the percentage of mothers interviewed in the market gardening area of Dosso (81.08%). This very high proportion of uneducated women in the market garden area of Dosso could be due to the characteristic of the commune, which is a very rural commune, or in rural areas, from a young age, the girl is perceived as a woman destined to perform specific functions such as reproduction (marriage) and maintenance of family members. Among the respondents, 47.66% were without income, and rates varied considerably between zones ($p < 0.01$). The market gardening area of Dosso had a very low rate of no income, which is 27.03% compared to the non-market gardening area of Dosso and the market gardening area of Tillabéri. These results are different from the national INS documentation (2022). This may be due to the nature of the area, which is a natron production area par excellence where almost all women participate in the production

and are paid. This is comparable to studies conducted by Berde et al. (2019) in 23 countries in sub-Saharan Africa where 43.8% of women had no formal education and 34.5% were without income. Similarly, our results are similar to the studies conducted by Lucha et al. (2022) in Ethiopia where more than one third (48.6%) of mothers had no education. These results are also consistent with the study conducted by Jones et al. (2014b) in Madagascar where they found a significant difference for all socio-demographic characteristics.

Analysis of the dietary profile of children shows that cereals and vitamin A-rich fruits and vegetables were frequently consumed in the areas. The high consumption of these products in this study could be due to their physical availability. These results are consistent with those of Moursi et al. (2008) and several studies on food consumption and the national INS documentation (2015; 2017; 2019; 2020; 2021). In contrast, animal products are consumed sparingly. Meat is eaten either once a week or monthly. Milk and dairy products are also consumed at low levels. The majority of respondents told us that their children almost never eat eggs. The low consumption of these foods and the predominant consumption of cereals in the diets of children living in rural households such as those in our study has already been observed in other rural communities in Sudan, Niger, Burkina Faso, in Madagascar, and Ethiopia (Workicho et al., 2016; Khalid et al., 2017; Rakotonirainy et al., 2018; Sanou et al., 2018; Ouedraogo et al., 2019; INS, 2022). Although consumption of animal products is generally low, it was higher in the non-gardener area of the urban municipality of Dosso. This could be explained by the availability of these products, as the area is not only urban (these products are available and accessible), but also parents are more educated so they know the advantage of their children's consumption of these products.

Diets based on the consumption of cereals or starches as staple foods and low in fruits and animal products are common in low-income countries (Jones et al., 2014b; Sanou et al., 2018). The risk of such a diet is micronutrient deficiency and, as a result, malnutrition and poor health Sanou et al. (2018).

The analysis of variables related to the dietary diversity of children aged 6-59 months shows that the area, the source of income and the level of education of mothers have an influence on the dietary diversity of children. Apart from these characteristics mentioned above, the practice of agriculture, gardening and livestock farming are also associated with food diversity. These results are similar to those of Rakotomanana et al. (2017). They found that the main risk factors for low dietary diversity were low levels of maternal education and socio-economic status. These results are similar to those of Arimond et al. (2004) who

reported, through their bivariate regression analysis of their study carried out on recent data from EDS surveys (Demographic and Health Surveys) from 11 countries, an association between urban/rural conditions and the nutritional status of children (Arimond and Ruel, 2004). They are also similar to the results reported by Jones et al. (2014b); Workicho et al. (2016). Previous studies have reported the positive influence of market gardening on children's food diversity (Sibhatu et al., 2015; Ouedraogo et al., 2019). The results of the logistic regression show that the area was positively associated with high food diversity. It revealed that the food diversity varied according to place of residence.

It appears that children living in the market gardening area of Tillabéri are 30 times more likely to have an adequate minimum food diversity compared to a child living in the market gardening area of Dosso (ORa [IC95%] =30 [7.67-259.40], p=0.000). These results could be due to the availability and accessibility of food to the population, which is explained by the proximity of the municipality to the capital and the river. In addition, the fact that a child is in the non-garden area of Dosso urban commune multiplies by 44 his chance to have a diversified diet compared to a child who is in the market gardening area of Dosso (ORa [IC95%] =44.60 [5.90-152.50]; P=0.000). These results are different from those of H. Rakotomanana et al. (2017). They found that the main risk factors for low food diversity were low levels of education and low socio-economic status. These results are consistent with studies conducted among Chinese preschool children and children from eleven (11) African countries. These previous studies indicated that food diversity is positively influenced by the urban environment (Mary Arimond and Ruel, 2004; Luo et al., 2012). This data is consistent with the results of a study conducted in eight (8) cities in China by Zhao et al. (2017).

## CONCLUSION

In this study, the aim was to establish a correlation between the determining factors of dietary diversification and the Minimum Dietary Diversity of children aged 6 to 59 months in two areas of different horticultural specificity.

The analysis shows that the determining factors are the residential environment (the area) which was correlated with a high dietary diversity for children aged 6 to 59 months. The dietary situation of children aged 6 to 59 months remains a concern. The quality of children's diet during their early years depends mainly on the behavior and decisions of mothers or people who usually take care of the child. Hence the need to develop actions for women's education and awareness-raising integrated into a long-term multi-sectoral development program to increase the diversity of agricultural production and access to nutritious foods.

## COMPETING INTERESTS

The authors declare no competing interest relating to the content of this article.

## AUTHORS' CONTRIBUTIONS.

All authors contributed to the conduct of this work. The authors of this article have read and approved its content.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