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The Determinants of Dietary Diversity among Women of Reproductive Age in the Kolda Region in 2020

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Abstract

Introduction: The lack of dietary diversity among women of reproductive age (WRA) is a public health problem in Senegal, particularly in the southern regions. The good nutritional status of women is one of the factors in the fight against maternal mortality and thus promotes a healthy pregnancy. The aim of this study was to investigate the determinants of dietary diversity among WRA in the Kolda region.

Methods: The quantitative, descriptive and analytical cross-sectional study took place in January-February 2020 in the Kolda region. It covered 1231 women of reproductive age (15- 49 years) in the Kolda region. Data were collected at household level using a questionnaire administered after informed consent. Ordinal logistic regression was performed to identify factors associated with dietary diversity among WRA in the Kolda region.

Results: A total of 1,231 WRA were surveyed, of whom 59.5% were neither pregnant nor breastfeeding, 30.7% breastfeeding and 9.8% pregnant. The mean age of the women was 27.62 years, with a standard deviation of 7.2 years. The median age was 27. Most women surveyed lived in rural areas (72.1%) and 58.5% were uneducated. Taking classification into account, 44% of WRAs in the Kolda region had average dietary diversity, compared with 24.7% who had low diversity and 31.3% who had high diversity.

Risk factors associated with dietary diversity in WRA after adjustment were living in an urban environment (OR=1.52 [1.29 ; 1.78]), breastfeeding (OR=1.43 [1.13 ; 1.82]), head of household with higher level of education (OR=2.59 [1.55 ; 4.41]), household income greater than or equal to minimum wage (OR=1.23 [1.04 ; 1.45]), existence of fruit trees in the household (OR=1.28 [1.06 ; 1.55]), the existence of funding or support for processing local produce (OR=1.56 [1.10 ; 2.22]), knowledge of micronutrient-rich foods (OR=1.39 [1.13 ; 1.71]), good level of knowledge of good nutritional practices (OR=1.61 [1.35 ; 1.92]), women's average level of information on good hygiene and care practices (OR=1.27 [1.08 ; 1.48]).

Conclusion: the accessibility and availability of nutrient-rich foods, the level of education of the head of household, the household's standard of living, awareness-raising, access to financing and the empowerment of women all help to improve the dietary diversity of WRA. Consequently, in the fight against food insecurity and malnutrition, the synergy of actions across sectors such as health, agriculture, the economy and social development, in particular gender and women's empowerment, is paramount for good women's nutritional status.

Keywords: Determinants, dietary diversity, women of reproductive age, Kolda

1. Introduction

Dietary diversity is an essential concept in the fight against malnutrition, whether excessive or deficient, in all age groups, especially in developing countries. It is the secret of a healthy, balanced diet, particularly for women of reproductive age (WRA) who have specific nutritional needs to ensure the growth, development, health and care of their offspring. Dietary diversity refers to the number of different food groups consumed by an individual or household over a given period (Picciano, 2003).

Internationally, dietary guidelines recommend eating a sufficient variety of foods, which is supposed to ensure adequate intakes of the nutrients essential for good health. However, with the current recognition of the importance

of dietary factors in increasing the risk of chronic disease, a good-quality diet must also meet criteria of balance and moderation in the consumption of certain foods that can be harmful to health if consumed in excess (Randall et al., 1985; Krebs-Smith et al., 1987).

Today, more than 820 million people in the world still suffer from hunger, and around 02 billion people, including 675 million in Africa, are in a situation of moderate or severe food insecurity. Without access to enough nutritious food on a regular basis, these people, the majority of whom are women, are at greater risk of malnutrition, and their health is jeopardized. Maternal and child undernutrition is responsible for over 10% of the global burden of disease (FAO, 2019).

In developing countries, the concept of dietary diversity has developed considerably over the last few years but experiments to measure dietary diversity are much rarer and mainly concern the diets of young children (OMS, 2017).

The few studies carried out in these countries have highlighted the value of simple indices measuring diversity through the number of food groups or sub-groups consumed over a given period (Tarin et al., 1999; Leroy et al., 2003). However, they have also revealed major disparities between the methods used to compile these indices. Despite the lack of homogeneity observed, diversity indices have been shown to be very good tools for helping to measure the overall quality of diets, in both industrialized and developing countries (Arimond et al., 2002; Hatloy et al., 2000).

In addition, increasing the variety of foods or food groups consumed is essential in these developing countries, where nutrient deficiencies are a major problem. Lack of dietary diversity is a particularly serious problem among poor populations, whose daily diet is generally based on one source of starch (cereals, root tubers and plantains) accompanied by one or two additional components. This type of diet tends to be low in several micronutrients, and the micronutrients it does contain often have low bioavailability (Dop et al., 1994; Drewnowsk et al., 1997).

In Senegal, around 16% of households have an unsatisfactory (poor and limited) food intake based mainly on cereals and a few vegetables, sugar and oil, with the occasional animal protein and legume. The Kolda region has one of the highest proportions in the country, with 26.7% of households having unsatisfactory food consumption, which remains deficient and concerns at least a quarter of the population (SECNA, 2016).

Senegal, like other Sahelian countries, is still suffering the consequences of four consecutive food and nutrition crises (2005, 2008, 2010, 2012). This situation seems to accentuate household vulnerabilities and consequently impacts on eating habits within households, thus altering nutritional quality (ANDS, 2017; SECNA/SAP, 2020). The factors involved are often environmental, behavioral, socio-cultural and economic. Several studies have been carried out with the aim of facilitating a better understanding of diet during the life cycle, but they have been conducted in a fragmented way on women of reproductive age, and on children under five. Some of these studies have contributed to the development of tools for assessing the quantity and quality of food consumption in these two groups (Gibson et al., 2017; Korkalo et al., 2011), while others have addressed the nutritional quality of the diet. However, there are still gaps (Institute of Medicine, 2000; Lauritsen et al., 2004).

In view of all this, it would be timely to study the determinants of dietary diversity among women of reproductive age in the Kolda region.

2. Materials and methods

2.1 Type of Study

This was a quantitative, descriptive, and analytical cross-sectional study conducted in the months of January - February 2020 in the Kolda region.

2.2 Study Population

The survey covered women of reproductive age (15-49) in the Kolda region.

- Inclusion criteria

All women aged 15-49 living in the selected households or present the night before the survey were eligible to be surveyed. In each household drawn, one woman aged 15-49 was selected.

- Non-inclusion criteria

- Women of reproductive age who did not agree to take part in the survey,
- Any woman included but with a medical/surgical history that could influence diet diversification, such as:

- Diabetes
- Dyslipidemia
- Gastric surgery
- Women who have undergone a voluntary or contextual dietary modification (e.g. fasting, participation in a family ceremony, etc.).

2.3 Sampling

2.3.1 Statistical Unit

The statistical unit was women of reproductive age (15-49) in the Kolda region.

2.3.2 Sampling Procedure

The sampling method for this study was based on a stratified random survey:

- At the first stage, 20 Census Districts (CD) were drawn in each department of the Kolda region (Vélingara, Medina Yoro Foulah and Kolda) from the list of Enumeration Zones established during the General Census of Population and Housing of, Agriculture and Livestock carried out in 2013, using a systematic draw with probability proportional to size (number of households in the CD). These CDs were divided between Rural/Urban environments, considering the urbanization rate. This approach made it possible to capture the differences between the two environments.
- In the second stage, 20 households were selected in each CD, i.e. a total of 400 households for each department, after identification of the concessions by raking and elementary sampling of the households to be surveyed.
- In the third stage, one woman aged 15-49 was selected from each household. The women selected were divided proportionally according to their status (pregnant, breastfeeding and neither pregnant nor breastfeeding).

For this survey, we therefore had a total representative sample of 1,200 women of reproductive age for the Kolda region, evenly distributed, i.e. 400 women for each department, who were distributed in proportion to their status.

Table 1. Distribution of the sample of women after data collection

Counties	**Sample Women**	**Pregnant women**	**Nursing mothers**	**Women who are neither pregnant nor nursing**
Kolda	410	41	125	244
Velingara	415	40	130	245
MYF	406	40	123	243
Kolda region	1231	121	378	732

2.4 Data Collection

2.4.1 Data Collection Tools

The data collected for the purposes of the survey were entered directly onto the tablet.

Variables collected

- Dietary diversity

Women's dietary diversity is a measure of food consumption that considers the variety of foods to which women have access. At the individual level, it is an approximate measure of the nutritional adequacy of the diet. The dietary diversity score was assessed through the number of food groups consumed by women of reproductive age in the 24 h preceding the survey. The different dietary diversity scores were calculated by counting the food groups consumed by the women in the 24 h preceding the interview. We used a World Food Programm study to classify WRA according to their level of dietary diversity in each department. Those who had consumed fewer than 4 food groups (<or=3) had a poorly diversified diet, those who had consumed between 4 and 5 food groups had a moderately diversified diet, and those who had consumed more than 5 groups (>or=6) had a highly diversified diet (PAM, 2014).

- Independent variables
  - Socio-demographic characteristics
  - Socio-economic characteristics
  - Knowledge of good eating habits

Data entry

Data entry was carried out using Open Data Kit (ODK) software, which enabled us to design a data entry mask while offering the possibility of collecting and transferring data to a server.

Data analysis

Once the survey data had been stabilized, they were analyzed using R software. This was done in two phases:

Descriptive part

We described the frequency (absolute and relative) for qualitative variables, and determined the mean, standard deviation and median for quantitative variables.

2.5 Analytical Part

Bivariate analysis was used to compare proportions. The relationship between the dependent variable (dietary diversity) and the independent variables was estimated by giving the p-value directly. It was considered significant if p-value<0.05 (Rothman et al., 1998).

Multivariate analysis was performed using an ordinal multiple logistic regression model. In the initial model, all variables with a bi-variate p-value of less than 0.25 were included to investigate factors associated with dietary diversity in women of reproductive age. The top-down stepwise nested model method was used to select the final model by removing at each level the variable with the highest p-value. The Anova function was used to compare two nested models after removing one variable, and the significance level of the test was set at 5%. The Akaike Information Criterion (AIC) and Lrtest (likelihood ratio) were used to select and validate the final model. The adequacy of the model was studied using Pearson's goodness-of-fit test, the model being considered adequate if the p-value was greater than 0.05. The predictive capacity of the chosen model was obtained by calculating Cox and Snell's R2 coefficient of determination. Associations were measured by odds ratios with their confidence intervals (Draper et al., 1998).

3. Results

3.1 Descriptive Section

3.1.1 Socio-Demographic Characteristics

Table 2. Distribution of WRA by socio-demographic characteristics (N = 1231)

Variables	Modalities	Absolute frequencies (n)	Relative frequencies (%)
Counties	Kolda	410	33.3
	Médina Yoro Foulah	406	33
	Vélingara	415	33.7
Physiological state of women	Women who are neither pregnant nor nursing	732	59.5
	Nursing mothers	378	30.7
	Pregnant women	121	9.8
Age group WRA	[15-22]	334	27.1
	[23-32]	604	49.1
	[33-49]	293	23.8
Living environment	Urban	343	27.9
	Rural	888	72.1

Age group head of household	[16-29]	129	10.5
	[30-59]	832	67.6
	[60 and over]	270	21.9
Gender head of household	Male	1087	88.3
	Female	144	11.7
Marital status Head of household	Monogamous husband	705	57.3
	Polygamous husband	454	36.9
	Widowed	50	4.1
	Single	14	1.1
	Divorced / separated	8	0.6
Ethnic group	Al poulaar	969	78.7
	Ouolof	105	8.5
	Mandingue	69	5.6
	Other ethnic groups	88	7.2
Number of persons in household	[0-8]	378	30.7
	[9-16]	575	46.7
	[17 and over]	278	22.6

3.2 Socioeconomic Characteristics

Table 3. Distribution of WRA by socioeconomic characteristics (N=1231)

Variables	Modalities	Absolute frequencies (n)	Relative frequencies (%)
WRA education level	None	720	58.5
	Primary	300	24.4
	Secondary	201	16.3
	Tertiary	10	0.8
Type of income generating activity / WRA	None	645	52.4
	Salaried employment	83	6.7
	Small business	293	23.8
	Cash crop	160	13
	Other income generating activities	50	4.1
Economic interest group member	Yes	538	43.7
	No	693	56.3
Education level head of household	None	790	64.2
	Primary	276	22.4
	Secondary	137	11.1
	Tertiary	28	2.3
Head of household's occupation	Civil servant	68	5.5
	Worker/artisan	119	9.7
	Cultivator/breeder/fisherman	685	55.6
	Merchant	132	10.7
	Surface technician	13	1.1
	Driver/Truck driver	32	2.6

	Retired	27	2.2
	Unemployed	68	5.5
	Other occupations	87	7.1
Household income over the last 30 days, including money transfer	Below minimum wage	261	21.2
	Above or equal to minimum wage	970	78.8
Proportion of expenditure controlled by women	Less than 50%	644	52.3
	More than or equal to 50%.	587	47.7
Percentage of land managed by women	Less than 50%	978	79.4
	More than or equal to 50%.	253	20.6
Family security grant	Yes	387	31.4
	No	844	68.6
Activities focused on the production of food products	Yes	270	21.9
	No	961	78.1
Financing or support production of local products	Yes	50	4.1
	No	1181	95.9
Practice of breeding by the household	Yes	984	79.9
	No	247	20.1
Household gardening practice	Yes	396	32.2
	No	835	67.8

3.3 Knowledge of Good Dietary Practices

Table 4. Distribution of WRA according to knowledge of good eating habits (N=1231)

Variables	**Modalities**	**Absolute frequencies (n)**	**Relative frequencies (%)**
Knowledge of different foods rich in micronutrients for the household	Yes	1067	86.7
	No	164	13.3
Level of knowledge of good nutrition practice	Low level	378	30.7
	Medium level	394	32
	Good level	459	37.3
Level of knowledge of good hygiene practices Food	Low level	491	39.9
	Medium level	371	30.1
	Good level	369	30
Knowledge of good food preparation practices	Low level	851	69.1
	Medium level	215	17.5
	Good level	165	13.4
Level of information on good nutritional, hygiene and care practices	Low level	816	66.3
	Medium level	326	26.5
	Good level	89	7.2

3.4 Dietary Diversity Score

Table 5. Distribution of women's dietary diversity score (SDAF) according to counties

Counties	Women's Dietary Diversity Score (WDDS)			
	Average	Standard deviation	Median	Workforce
Kolda	4,7	1,6	5	410
Medina Yoro Foulah	4,3	1,6	4	406
Vélingara	4,2	1,7	4	415
Kolda region	**4,4**	**1,7**	**4**	**1231**

3.5 Analytical Part

3.5.1 Bivariate Analysis

3.5.1.1 Relationship between socio-demographic characteristics and dietary diversity among WRAin the Kolda region

Table 6. Distribution of socio-demographic characteristics according to dietary diversity among WRA in the Kolda region

Variables /modalities	Low WDDS		Medium WDDS		High WDDS		P value
	n	(%)	n	(%)	n	(%)	
Counties							
Kolda	102	**(24.9)**	184	**(44.9)**	124	**(30.2)**	Réf
Medina Yoro Foulah	127	**(31.3)**	190	**(46.8)**	89	**(21.9)**	0.005**
Vélingara	156	**(37.6)**	168	**(40.5)**	91	**(21.9)**	< 0.001 ***
Living environment							
Rural	320	**(36)**	379	**(42,7)**	189	**(21,3)**	Réf
Urban	65	**(19)**	163	**(47.5)**	115	**(33.5)**	< 0.001***
Physiological state of women							
Pregnant women	45	**(37.2)**	53	**(43.8)**	23	**(19)**	Réf
Women who are neither pregnant nor nursing	253	**(34.6)**	314	**(42.9)**	165	**(22.5)**	0.40
Nursing mothers	87	**(23)**	175	**(46.3)**	116	**(30.7)**	< 0.001 ***
Age group WRA							
[15-22]	114	**(34.1)**	150	**(44.9)**	70	**(21)**	0.12
[23-32]	173	**(28.6)**	276	**(45.7)**	155	**(25.7)**	0.04 *
[33-49]	98	**(33.4)**	116	**(39.6)**	79	**(27)**	0.27
Age group head of household							
[16-29]	40	**(31)**	54	**(41.9)**	35	**(27.1)**	Réf
[30-59]	246	**(29.6)**	359	**(43.1)**	227	**(27.3)**	0.82
[60 and over]	99	**(36.7)**	129	**(47.8)**	42	**(15.6)**	0.03*
Marital status Head of household							
Single	2	**(14.3)**	10	**(71.4)**	2	**(14.3)**	Réf
Monogamous	215	**(30.5)**	320	**(45.4)**	170	**(24.1)**	0.75

Polygamous	151	**(33.3)**	188	**(41.4)**	115	**(25.3)**	0.69
Widowed	16	**(32)**	20	**(40)**	14	**(28)**	0.86
Divorced/separated	1	**(12.5)**	4	**(50)**	3	**(37.5)**	0.45
Ethnicity of head of household							
Al poular	320	**(33)**	425	**(43.9)**	224	**(23.1)**	Réf
Ouolof	30	**(28.6)**	48	**(45.7)**	27	**(25.7)**	0.35
Mandingue	17	**(24.6)**	31	**(44.9)**	21	**(30.4)**	0.09
Other ethnic groups	18	**(20.5)**	38	**(43.4)**	32	**(36.4)**	0.002 **
Number of people in the household							
[0-8]	112	**(29.6)**	152	**(40.2)**	114	**(30.2)**	Réf
[9-16]	174	**(30.3)**	276	**(48)**	125	**(21.7)**	0.07
[17 and over]	99	**(35.6)**	114	**(41)**	165	**(23.4)**	0.03 *

*: statistically significant

3.5.1.2 Relationship between socio-economic characteristics and dietary diversity among WRA in the Kolda region

Table 7. Distribution of socio-economic characteristics according to dietary diversity among WRA

Variables /modalities	Low WDDS		Medium WDDS		High WDDS		P value
	n	(%)	n	(%)	n	(%)	
WRA education level							
None	251	**(34.8)**	303	**(42.1)**	166	**(23.1)**	Réf
Primary	69	**(23)**	146	**(48.7)**	85	**(28.3)**	<0.001*
Secondary	64	**(31.8)**	91	**(45.3)**	46	**(22.9)**	0.62
Higher	1	**(10)**	2	**(20)**	7	**(70)**	0.002*
Income-generating activity (IGA)							
No	226	**(35)**	298	**(46.2)**	121	**(18.8)**	Réf
Salaried employment	21	**(25.3)**	40	**(48.2)**	22	**(26.5)**	0.04 *
Small business	78	**(26.6)**	109	**(37.2)**	106	**(36.2)**	<0.001 *
Cash crop	49	**(30.6)**	66	**(41.2)**	45	**(28.1)**	0.03*
Other IGA	11	**(22)**	29	**(58)**	10	**(20)**	0.18
Education level head of household							
None	274	**(34.7)**	336	**(42.5)**	180	**(22.8)**	Réf
Primary	84	**(30.4)**	126	**(45.7)**	66	**(23.9)**	0.29
Secondary	25	**(18.2)**	73	**(53.3)**	39	**(28.5)**	0.001*
Higher	2	**(7.1)**	7	**(25)**	19	**(67.9)**	<0.001*
Occupation Head of household							
Unemployed	16	**(23.5)**	40	**(58.8)**	12	**(17.6)**	Réf
Civil servant	10	**(14.7)**	28	**(41.2)**	30	**(44.1)**	0.005*
Worker/artisan	40	**(33.6)**	50	**(42)**	29	**(24.4)**	0.75
Cultivator/breeder/fisherman	241	**(35.2)**	293	**(42.8)**	151	**(22)**	0.42

Shopkeeper	37	**(28)**	55	**(41.7)**	40	**(30.3)**	0.47
Surface technician	7	**(53.5)**	4	**(30.8)**	2	**(15.4)**	0.14
Driver/Truck driver	5	**(15.6)**	16	**(50)**	11	**(34.4)**	0.12
Retired	9	**(33.3)**	13	**(48.1)**	5	**(18.5)**	0.59
Other professions	20	**(23)**	43	**49.4)**	24	**(27.6)**	0.39
Household income over the last 30 days including transfers							
Below the minimum wage	02	**(39.1)**	110	**(42.1)**	49	**(18.8)**	Réf
Above or equal to the minimum wage	283	**(29.2)**	432	**(44.5)**	255	**(26.3)**	<0.001 *
Proportion of expenditure controlled by women							
Less than 50% of the total	184	**(28.6)**	300	**(46.6)**	160	**(24.8)**	Réf
Greater than or equal to50	201	**(34.2)**	242	**(41.2)**	144	**(24.5)**	0.16
Percentage of land managed by women							
Less than 50% of the total	286	**(29.2)**	438	**(44.8)**	254	**(26)**	Réf
Greater than or equal to50	99	**(39.1)**	104	**(41.1)**	50	**(19.8)**	0.002 *
Treated household drinking water							
No	97	**(42.5)**	89	**(39)**	42	**(18.4)**	Réf
Yes	288	**(28.7)**	453	**(45.2)**	262	**(26.1)**	<0.001*
Activities geared towards the production of food products							
No	295	**(30.7)**	427	**(44.4)**	239	**(24.9)**	Réf
Yes	90	**(33.3)**	115	**(42.6)**	65	**(24.1)**	0.50
Financing or support for the production of local products							
No	377	**(31.9)**	523	**(44.3)**	281	**(23.8)**	Réf
Yes	8	**(16)**	19	**(38)**	23	**(46)**	<0.001 *
Livestock rearing by the household							
No	85	**(34.4)**	97	**(39.3)**	65	**(26.3)**	Réf
Yes	300	**(30.5)**	445	**(45.2)**	239	**(24.3)**	0.71
Household gardening							
No	262	**(31.4)**	383	**(45.9)**	190	**(22.8)**	Réf
Yes	123	**(31.1)**	159	**(40.2)**	114	**(28.8)**	0.17

3.5.1.3 Relationship between knowledge of good dietary practices and dietary diversity among WRA in the Kolda region

Table 8. Distribution of knowledge of good dietary practices as a function of dietary diversity among WRA

Variables /modalities	**Low WDDS**		**Medium WDDS**		**High WDDS**		**P value**
	n	**(%)**	**n**	**(%)**	**n**	**(%)**	
Knowledge of different micronutrient-rich foods for the household							
No	83	**(50.6)**	64	**(39)**	17	**(10.4)**	Réf
Yes	302	**(28.3)**	478	**(44.8)**	287	**(26.9)**	<0 .001***
Knowledge of good nutrition practice							
Low level	151	**(39.9)**	182	**(48.1)**	45	**(11.9)**	Réf
Medium level	129	**(32.7)**	174	**(44.2)**	91	**(23.1)**	<0 .001***

Good level	105	**(22.9)**	186	**(40.5)**	168	**(36.6)**	0.58
Knowledge of good food hygiene practices							
Low level	185	**(37,7)**	243	**(49,5)**	63	**(12,8)**	Réf
Medium level	243	**(49.5)**	169	**(45.6)**	100	**(27)**	<0.001***
Good level	63	**(12.8)**	130	**(35.2)**	141	**(38.2)**	0.20
Knowledge of culinary practices and food preparation							
Low level	296	**(34.8)**	384	**(45.1)**	171	**(20.1)**	Réf
Medium level	63	**(29.3)**	77	**(35.8)**	75	**(34.9)**	<0.001***
Good level	26	**(15.8)**	81	**(49.1)**	58	**(35.2)**	0.58
Level of information on good nutritional, hygiene and care practices							
Low level	285	**(34.9)**	375	**(46)**	156	**(19.1)**	Réf
Medium level	67	**(20.6)**	143	**(43.9)**	116	**(35.6)**	0.08
Good level	33	**(37.1)**	24	**(27)**	32	**(36)**	<0.001 ***

*: statistically significant

3.5.2 Multivariate Analysis

Multiple ordinal logistic regression was used to identify the factors associated with dietary diversity among women of reproductive age in the Kolda region by calculating adjusted odds ratios. The model identifies the risk of moving from low dietary diversity to high dietary diversity by passing through the different levels.

Table 9. Factors associated with dietary diversity among women of reproductive age in the Kolda region

Factors	**OR a**		**IC 95%**	**P value**
	Intercept			
Low WDDS | Medium WDDS	1.83		[1.18; 2.85]	
Medium WDDS | High WDDS	6.94		[4.42 ;10.90]	
Sociodemographic characteristics				
Departement	Kolda	Réf	-	-
	MYF	0.77	[0.65;0.92]	0.004
	Vélingara	0,83	[0.70 ;0.99]	0.037
Living environment	Rural	Réf	-	-
	Urban	1.52	[1.29;1.78]	<0.001
Physiological state of women	Pregnant	Réf	-	-
	Breastfeeding	1.43	[1.13;1.82]	0.003
	Neither pregnant nor breastfeeding	1.10	[0.88;1.38]	0.412
Ethnic group Head of household	Al poular	Réf	-	-
	Mandingue	1.11	[0.84;1.48]	0.459
	Ouolof	1.34	[1.04;1.73]	0.023
	Other ethnic groups	1.23	[0.95;1.59]	0.118
Socioeconomic characteristics				
WRA education level	None	Réf	-	-
	Primary	1.10	[0.93;1.29]	0.275

	Secondary	0.77	[0.64;0.94]	0.010
	Higher	1.61	[0.69;3.95]	0.283
Level of education head of household	None	Réf	-	-
	Primary	0.92	[0.78;1.09]	0.33
	Secondary	1.12	[0.90;1.40]	0.32
	Higher	2.59	[1.55;4.41]	<0.001
Household income including transfers over the last 30 days	Below the minimum wage	Réf	-	-
	Above or equal to the minimum wage	1.23	[1.04;1.45]	0.015
Proportion of land managed by women	Less than 50	Réf	-	-
	50% or more	0.78	[0.66; 0,92]	0.003
Existence of fruit trees in the household	No	Réf	-	-
	Yes	1.28	[1.06 ; 1.54]	0.009
Financing or support for processing of local products	No	Réf	-	-
	Yes	1.56	[1.10; 2,22]	0.012
Knowledge of good food practice				
Knowledge of foods rich in Micronutrients	No	Réf	-	-
	Yes	1.39	[1.13; 1.71]	0.002
Level of knowledge of good nutrition practices	Low	Réf	-	-
	Medium	1.21	[1.03 ; 1.44]	0.024
	Good	1.61	[1.35; 1.92]	<0.001
Level of information on good nutritional hygiene and care practices	Low	Réf	-	-
	Medium	1.27	[1.08; 1.48]	0.003
	Good	0.82	[0.62; 1.09]	0.168

R^2= 0.205, i.e. 20.5 %.

Lrm test = P< 0.0001 (likelihood ratio)

Pearson residual test P = 1 (good model fit p > 0.05)

Good model convergence (0).

4. Discussion

4.1 Dietary Diversity Score for Women of Reproductive Age in the Kolda Region

The Dietary Diversity Score for Women is used as a proxy measure of the nutritional quality of the diet of women of reproductive age (pregnant, lactating or neither pregnant nor lactating). At the individual level, it is an approximate measure of the macronutrient and/or micronutrient adequacy of the diet in women (Kennedy et al., 2013; Martin-Prével et al., 2004).

This study found a mean dietary diversity score for women of reproductive age of 4.4 with a standard deviation of 1.7 in the Kolda region. This is comparable with the results of the study by Béchir et al, who found a mean diversity score of 4.5 for a sample of 734 women (Bechir et al., 2011).

In contrast, a study conducted in Senegal in 2015 found an average dietary diversity score for women of reproductive age of 3 with a standard deviation of 1.4 in the Kolda region (Tine et al., 2018). There has therefore been a positive change in the dietary diversity of women of reproductive age between 2015 and 2020 in the Kolda region, which could be explained by the various actions carried out in the field by the different technical and financial partners working in the field of nutrition in the area. In particular, Nutrition International, through its PINKK project (Projet Intégré de Nutrition dans les régions de Kolda et Kédougou), which adopts a multisectoral

approach to improve the nutritional status of the most vulnerable population groups, in particular women and children (NI-PINKK, 2019).

Taking the classification into account, 44% of women of reproductive age in the Kolda region had average dietary diversity, compared with 24.7% who had low diversity and 31.3% who had high diversity. In other words, most women had consumed between 4 and 5 food groups. A study carried out in Burkina Faso showed that women who had consumed fewer than six food groups had low or inadequate diversity, whereas those who had consumed more than six groups were considered to have adequate diversity. These differences in results reflect the fact that eating habits differ from one country and community to another. In fact, it is very difficult for dietary diversity indices to be the same from one locality to another (Savy et al., 2004). According to Prével, women who achieve minimal dietary diversity, i.e. those who consume five or more of ten groups, are likely to have more adequate intakes of micronutrient intakes. They are also more likely to have eaten one animal food, one legume or nut and two fruits or vegetables on the day before the survey (Martin-Prével et al., 2015).

4.2 Dietary Diversity and Socio-Demographic Characteristics of WRA

The dietary diversity of women of reproductive age is linked to their physiological state Analysis showed that breastfeeding women had a more diversified diet than pregnant women, with an OR (1.43 [1.13; 1.82]). A study carried out in Madagascar showed that the diet of women at the start of breastfeeding was richer than that of pregnant women. All the dishes offered to post-partum women were said to have the virtues of encouraging the milk to rise and helping women in labour to gradually recover their strength (Ravaoarisoa et al., 2018).

Living environment was also statistically linked to dietary diversity in women of reproductive age. Women living in urban areas were more likely to have a diverse diet than those in rural areas, with an OR of 1.52 [1.29; 1.78]. In other words, living in a rural area has an impact on women's dietary diversity. According to Werema, urban households value the choice of quality products such as milk, fish, alcohol and soft drinks more than their rural counterparts (Huffman et al., 2007). This result can be explained by the fact that rural households are mostly subsistence with difficult access to markets. Consequently, they need easier access to markets so that they can sell their produce and buy other products. In addition, improving their nutritional status can also involve producing a diversified diet at household level.

The marital status of the head of household and the gender of the head of household had no effect on the quality of the diet of women of reproductive age. However, the age of the head of household was significantly associated with dietary diversity among women. Women of reproductive age with an older head of household (60 years and over) were less likely to have a diversified diet than women with a younger head of household (16-29 years), with an OR of 0.72 [0.56; 0.93]. According to Tankari's study in Uganda, the age of the head of household has a negative impact on dietary diversity. In other words, households with older heads have lower dietary diversity than households with younger heads (Tankari, 2016). As a result, these households cannot have a diversified diet because they lack resources. Furthermore, the ethnicity of the head of household is a factor that improves the dietary diversity of women with an equal OR (1.34 [1.04; 1.73]) due to the culinary practices of certain ethnic groups. This result is similar to a study carried out in Mali by *Action Contre la Faim* on the dietary diversity of mothers and children aged 6-59 months in three intervention communes, which showed that the ethnicity of the head of household favoured dietary diversification in women (Action contre la faim, 2015).

4.3 Dietary Diversity and Economic Characteristics of WRA

In this study, the level of education was significantly related to the dietary diversity of women. The level of education of the head of household improved the dietary diversity of women of reproductive age. Women whose head of household was educated to a higher level were more likely to have a more diverse diet, with an OR equal to 2.59 ([1.55; 4.41]). In reality, this is not surprising given the importance of heads of household in African societies. They have a direct influence on the diet of the whole family, since they are the ones who decide on food purchases and, in some cases, meal choices. In a study by Lee (1987) and Rashid et al. (2006), they concluded that having at least a primary education improves dietary diversity compared with having no education at all (Hoddinott et al., 2002).

These different results highlight the role of education in the ability of women of reproductive age to have a diverse diet or to put into practice the recommendations for good nutrition. Efforts in terms of nutritional policies must therefore be directed at women of reproductive age whose heads of household have no formal education.

Our study also showed that household income had an influence on the quality of the diet of women of reproductive age by improving their dietary diversity. Women with a household income equal to or greater than the minimum wage had a more diversified diet than those with a household income below the minimum wage, with an OR equal

to 1.23 [1.04; 1.45]. Women's dietary diversity was notably linked to economic variables, meaning that wealthier women were better able to diversify their diets. Hoddinott and Yohannes had shown that wealthier households diversified their diets and had also specified that this diversification involved an increase in the consumption of prestigious foods rather than an increase in the consumption of staple foods such as cereals. Another study on the relationship between agricultural income and dietary diversity in rural Burkina Faso showed that women receiving a cash transfer from the head of the farm or household had better dietary diversity in all seasons (Lourme et al., 2016).

There is a significant link between women's land management and the dietary diversity of women of reproductive age. Women who managed 50% or more of the agricultural land were less likely to have a more diverse diet than others, with an OR equal to 0.78 (IC95% [0.66; 0.92]). This could lead us to say that land management by women does not necessarily lead to greater dietary diversity. This can be explained by the low productivity of the farms, the lack of additional resources and the low decision-making power of women. It is also worth noting that most women do not have access to agricultural resources, training or funding to increase and diversify their agricultural production in order to provide their families with a rich and diversified diet.

Our study also showed that receiving a social security grant, engaging in food production and raising livestock in the household had no effect on the diet quality of women of reproductive age. On the other hand, the existence of fruit trees at household level (1.28 [1.06; 1.54]), drinking water treatment (1.23 [1.03; 1.46]) and funding or support received for processing local produce (1.56 [1.10; 2.22]) were in favour of better dietary diversity among women of reproductive age.

4.4 Dietary Diversity and Knowledge of Good Dietary Practices among WRA

Knowledge of micronutrient-rich foods is a factor that improves the dietary diversity of women of reproductive age. Women who knew about micronutrient-rich foods had a more diverse diet than those who did not, with an OR equal to 1.39 ([1.13; 1.71]).

However, women of reproductive age who had a good level of knowledge of good nutritional practices were more likely to have a more diversified diet (OR 1.61 [1.35; 1.92]) than those who had a low level of knowledge of good nutritional practices.

The study also showed us that an average level of information about good nutritional, hygiene and care practices is a factor that improves the dietary diversity of women of reproductive age, with an OR equal to 1.27 (95% CI [1.08; 1.48]). It therefore seems necessary to make good information on good nutritional practices accessible and popularised via different communication channels in order to improve dietary diversity among women.

4.5 Limitations of the Study

The general aim of this study, which involved a representative population of women of reproductive age in the Kolda region, was to investigate the determinants of dietary diversity in women of reproductive age, using a methodology that respected statistical principles. The main limitation of this study was the classification of certain local foods. The study was carried out in January-February, just after the October harvest, which optimised food availability. The seven-day diversification assessment was not used because of memory bias.

5. Conclusion

A diversified and balanced diet for women of reproductive age is essential to meet their nutritional needs and is positively associated with the health of the mother, foetus and child. This study gave us an overview of the current situation in Kolda in terms of dietary diversity. Women of reproductive age in the Kolda region have an average dietary diversity that is influenced by several socio-demographic factors (physiological state of the woman, living environment, age of the head of household, etc.), socioeconomic factors (level of education of the head of household, household income, existence of fruit trees in the household, etc.) and by knowledge of good food practices.) and knowledge of good dietary practices (knowledge of micronutrient-rich foods, level of good nutritional practice, level of information on good hygiene and care practices).

Our study shows that taking into account the factors determining food choice in the population, with appropriate communication based on nutrition and diet, could contribute to better dietary diversity in women of reproductive age.

However, more in-depth studies on the foods to be mapped, food consumption during the 07 days and biological analysis of the nutritional status of women of reproductive age could be envisaged in order to gain a better understanding of other factors, both quantitative and qualitative. Anthropological studies of current eating habits and ways of adapting to particular events or crises (lean season, drought, pandemic, etc.) would provide a better

understanding of the nutritional status of women and of the intervention area, so that more effective and efficient strategies can be put in place to improve the dietary diversity of women.

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The authors declare that there are no competing or potential conflicts of interest.

References

Action contre la faim. Enquête Soudure sur la Diversité Alimentaire des Mères et des Enfants de 6-59 mois dans trois communes d'intervention du projet PADABA. 77p.

ANDS. (2017). *Enquête Démographique et de Santé Continue* (EDS-Continue). 2017 .

Arimond, M., & Ruel, M. T. (2002). *Progress in developing an infant and a child feeding index: an example using the Ethiopia Demographic and Health Survey 2000* (No. 583-2016-39595).

Bechir, M., Schelling, E., Moto, D. D., Tanner, M., & Zinsstag, J. (2011). Statut nutritionnel et diversité alimentaire chez les femmes nomades et sédentaires rurales de la rive sud-est du Lac Tchad. *Médecine tropicale*, *71*(6), 582-587. PMID: 22393625.

Dop, M. C., Milan, C. H., Milan, C. L., & N'diaye, A. M. (1994). The 24-hour recall for Senegalese weanlings: a validation exercise. *European journal of clinical nutrition*, *48*(9), 643-653.

Draper, N. R., & Smith, H. (1998). *Applied regression analysis* (Vol. 326). John Wiley & Sons. https://doi.org/10.1002/9781118625590

Drewnowski, A., Renderson, S. A., Driscoll, A., & Rolls, B. J. (1997). The Dietary Variety Score: assessing diet quality in healthy young and older adults. *Journal of the American Dietetic Association*, *97*(3), 266-271. https://doi.org/10.1016/S0002-8223(97)00070-9

Elizabeth Randall Ph D, R. D., Nichaman, M. Z., & Contant Jr, C. F. (1985). Diet diversity and nutrient intake. *Journal of the American Dietetic Association*, *85*(7), 830-836. https://doi.org/10.1016/S0002-8223(21)03718-4

FAO, FIDA, OMS, PAM et UNICEF. L'état de la sécurité alimentaire et de la nutrition dans le monde 2019.

Gibson, R. S., Charrondiere, U. R., & Bell, W. (2017). Measurement errors in dietary assessment using self-reported 24-hour recalls in low-income countries and strategies for their prevention. *Advances in Nutrition*, *8*(6), 980-991. https://doi.org/10.3945/an.117.016980

Greenland, S. (1998). Meta-analysis. In Rothman KJ, Greenland S.(eds), *Modern Epidemiology*.

Hatløy, A., Hallund, J., Diarra, M. M., & Oshaug, A. (2000). Food variety, socioeconomic status and nutritional status in urban and rural areas in Koutiala (Mali). *Public health nutrition*, *3*(1), 57-65. https://doi.org/10.1017/S1368980000000628

Hoddinott, J., & Yohannes, Y. (2002). *Dietary diversity as a household food security indicator* (p. 44). Food and Nutrition Technical Assistance Project (FANTA), Academy for Educational Development. Washington, D.C.: IFPRI

Huffman W. E., & Orazem P. F. (2007). Agriculture and human capital in economic growth: WRAmers, schooling and nutrition. In: R. Evenson, P. Pingali (Eds), *Handbook of Agricultural Economics* (Vol. 3, Chapter 43). Elsevier/North Holland. https://doi.org/10.1016/S1574-0072(06)03043-X

Institute of Medicine (US) Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. (2000). DRI Dietary Reference Intakes: applications in dietary assessment. https://doi.org/10.17226/9956

Kennedy, G., Ballard, T., & Dop, M. C. (2013). Guide pour mesurer la diversité alimentaire au niveau du ménage et de l'individu. *Rome: FAO*. Retrieved from http://www.fao.org/3/a-i1983f.pdf

Korkalo, L., Hauta-alus, H., & Mutanen, M. (2011). Food composition tables for Mozambique. *Department of Food and Environmental Sciences, Finland, 55pp*.

Krebs-Smith, S. M., Smiciklas-Wright, H., Guthrie, H. A., & Krebs-Smith, J. (1987). The effects of variety in food choices on dietary quality. *Journal of the American dietetic association*, *87*(7), 897-903. https://doi.org/10.1016/S0002-8223(21)03212-0

Lauritsen, J. M. (2004). EpiData (version 3.1). *A comprehensive tool for validated entry and documentation of data*.

Leroy, J. L. P., Habicht, J. P., Ruel, M. T., Simler, K., & Dittoh, S. Household dietary diversity is associated with child dietary diversity and nutritional status. *Federation of American Societies for Experimental Biology (FASEB) Journal, 17*(4), A483.1 p. A713.

Lourme Ruiz, A., Dury, S., & Martin-Prével, Y. (2016). Consomme-t-on ce que l'on sème? Relations entre diversité de la production, revenu agricole et diversité alimentaire au Burkina Faso. *Cahiers Agricultures, 25*(6), 2016, 11. https://doi.org/10.1051/cagri/2016038

Martin-Prével, Y., Allemand, P., Wiesmann, D., Arimond, M., Ballard, T., Deitchler, M., ... & Moursi, M. (2015). Moving forward on choosing a standard operational indicator of women's dietary diversity. Food and Agriculture Organization of theUnited Nations ROME, 2015.

Martin-prével, Y., et al. (2004). Relationship between food variety/diversity scores and nutritional status of adults and adolescents in rural Burkina Faso.

NI-PINKK. Bulletin d'information Projet PINKK Sénégal FINAL FR. Retrieved June 3, 2021, from https://old.nutritionintl.org/fr/content/user_files/sites/2/2019/12/NI-PINKK-Factsheet-Senegal-FINAL_Fr_WEB.pdf

Organisation mondiale de la santé (OMS). Les10 faits sur la nutrition. Aout 2017. Retrieved June 7, 2020, from https://www.who.int/features/factfiles/nutrition/fr/

Picciano, M. F. (2003). Pregnancy and lactation: physiological adjustments, nutritional requirements and the role of dietary supplements. *The Journal of nutrition*, *133*(6), 1997S-2002S. https://doi.org/10.1093/jn/133.6.1997S

Programme alimentaire Mondial (PAM), Systéme d'Alerte Précoce du Mali (SAP). Enquête de mis à jour des indicateurs de la sécurité alimentaire au Mali. Février 2014.

Ravaoarisoa, L., Rakotonirina, J., Andriamiandrisoa, D., Humblet, P., & Rakotomanga, J. D. D. M. (2018). Habitude alimentaire des mères pendant la grossesse et l'allaitement, région Amoron'i Mania Madagascar: étude qualitative. *Pan African Medical Journal*, *29*(1), 1-8. https://doi.org/10.11604/pamj.2018.29.194.12873

SECNA. (2016). Rapport enquête national de sécurité alimentaire au Sénégal (ENSAS) (p. 72).

SECNA/SAP. (2020). *Enquête nationale sur la sécurité alimentaire et la nutrition*.

Tankari. Déterminants de la nutrition des ménages en Ouganda: le cas de la diversité alimentaire. Stateco n°110 2016. 93p. Retrieved October 17, 2020, from https://dial.ird.fr/publications/stateco/stateco-n-110

Tarini, A., Bakari, S., & Delisle, H. (1999). The overall nutritional quality of the diet is reflected in the growth of children from Niger. *Cahiers d'études et de recherches francophones/Santé*, *9*(1), 23-31.

Tine, J. A. D, Niang, K., Faye, A., & Dia, A. (2018). Évaluation de la diversité alimentaire des femmes dans le sud du Sénégal. *Sciences de l'alimentation et de la nutrition, 9*, 1192-1205. https://doi.org/10.4236/fns.2018.910086

Tine, J. A. D., Niang, K., Faye, A., & Dia, A. T. (2018). Assessment of Women's Dietary Diversity in Southern Senegal. *Food and Nutrition Sciences*, *9*(10), 1192-1205.