Archives of Current Research International

21(4): 11-22, 2021; Article no.ACRI.71966
ISSN: 2454-7077

Dietary Diversity Choices of Women: Evidence from Cassava Farming Households in Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/ACRI/2021/v21i430240
Editor(s):
(1) Dr. Marco Muscettola, University of Bari, Italy.
Reviewers:
(1) Davide Frumento, University of Genoa, Italy.
(2) Hong Duck Kim, New York Medical College, USA.
Complete Peer review History: https://www.sdiarticle4.com/review-history/71966

Original Research Article

Received 25 May 2021
Accepted 30 July 2021
Published 02 August 2021

ABSTRACT

In this study, we examined dietary diversity of women in cassava farming households of South-West, Nigeria. Multi-stage sampling procedure was used to collect data on 352 farming households comprising 212 women members (158 women of child-bearing age (20-49 years) and 54 women above 49 years) between December 2019 and March 2020 in Oyo and Ogun States of South-West, Nigeria. The Minimum Dietary Diversity for Women (MDD-W) questionnaire was adapted and used to obtain the dietary diversity scores (DDS) of women of child bearing age over a 24-hour recall period. The individual version of the Household dietary diversity questionnaire was adapted and used to obtain the DDS of women above 49 years. Separate logistic regression models were fitted to determine the influence of selected variables on the dietary diversity of the two categories of women. Our results show that more than half of the women (55.1%) in the child-bearing category (20-49 years) did not attain the minimum score of 5 out of 10 food groups. In the older women category (> 49 years), more than half of the women (68.5%) met the required 4 or more food groups. In the child-bearing age category, the odds of attaining the minimum dietary diversity level were 0.04% smaller with an additional increase in transport cost. Also, women who had female household heads were approximately three times more likely to attain the minimum dietary diversity level than women who did not have female household heads. In the older women

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category, the odds of attaining the minimum dietary diversity level were 98.9% smaller for women with good road condition than for women with poor road condition. These results are useful for evidence-based decision making that can have positive impact on the lives of women in cassava farming households.

Keywords: Minimum dietary diversity for women; healthy diets; farm households; Individual dietary diversity score; Nigeria.

1. INTRODUCTION

Consumption of diverse diets is central to the attainment of Sustainable Development Goal 2 (Zero Hunger) because a poorly nourished population cannot produce goods and services optimally [1-3]. A diet consists of different foods an individual consumes. Eating varied diets ensure that essential macro and micro nutrients required for optimal health are available for the body's utilization. Low quality diets are one of the major risk factors contributing to the global burden of disease [1, 4].

In Sub-Saharan Africa, malnutrition in poor households, is mainly caused by limited dietary diversity [5-7]. Malnutrition contributes to a lot of sicknesses than any other cause and it is one of contributing factors to low life expectancies in Sub-Saharan Africa [8]. It encompasses both over-nutrition and under-nutrition and these can occur if the quality or variety of food is not enough even though the food is in large quantity [9-11]. It affects 1 in every 3 persons globally [12]. The estimated figure for the number of hungry people globally stood at 687.8 million in 2019 with Africa taking 250.3 million of this total figure [13-15]. A greater percentage of this figure comes from smallholder farming households of developing countries [16-17].

An individual's need for available and nutritious food is often not met because of different factors. Intra-household food consumption could be divided among family members, relatively depriving children and women compared to adult males [18]. Furthermore, men are usually given priority in food distribution leaving women and children with smaller and less nutritious portions [7, 19]. Women in charge of expenditure allocations have been shown to give priority to issues of health, nutrition and education of household members while men spend less on dietary quality and nutrition [20-21]. Women, especially those of child-bearing age need high quality diets to reduce micronutrient deficiencies, maternal underweights and other conditions that can lead to poor foetal growth and poor pregnancy outcomes [6, 22-27]. Older women who are not in the reproductive age bracket also require high quality diets for proper body functioning and higher productivity in their day to day activities. Agricultural practice, the main occupation of majority of rural women in most developing countries, still requires tedious work because agricultural mechanization rate is very low. Therefore, older women with good health are able to carry out more difficult tasks on and outside the farm leading to higher productivity [26].

Nigeria is the top producer of cassava in Africa and globally with about 59 million tonnes and 19.5% share of the world total production in 2019 [28-29]. Cassava is one of the most important crop in Nigeria while about ninety percent of the cassava roots are commonly consumed locally as food and just about ten percent is utilized as industrial materials [29-30]. The focus of most researches on dietary diversity has been on children, women of child-bearing age and men [6, 7, 19, 22-26]. Thus, in this paper, we examine dietary diversity choices and patterns of women (child-bearing age and older women) of Cassava farming households in South-West, Nigeria. This would provide important information useful for evidence-based decision making.

The remaining part of the paper is as follows: Section 2 presents a detailed description of the methodology. Section 3 presents results and discussion of the findings while the conclusion is presented in Section 4.

2. METHODOLOGY

2.1 Study Design

2.1.1 Study area

The study was conducted in Oyo and Ogun States, South-West Nigeria. Nigeria is located in West Africa and has a land mass of 923, 768 square kilometers with latitude 10^0 00^1 N and 8^0 and 00^1 E [31]. Nigeria has over 250 ethnic

groups but the major ones are Yoruba in the South-West, Igbo in the South-East and Hausa in the Northern part of the country. The South-West region, one of the six geo-political zones in Nigeria, has six states. They are Ekiti, Ogun, Ondo, Osun, Oyo and Lagos States. The region lies between latitude 9° 4.9199l N and longitude 8° 4.9199l E [32]. It is largely a Yoruba speaking region of the country, though there are different dialects within the states [32]. There are two distinct seasons in the zone (which is generally the same for the country) i.e. rainy and the dry seasons. The main cash crops mostly grown in the zone include cocoa, citrus and timber, while the food crops are cassava, yam, maize, cowpea, melon, and millet. Livestock production include pigs, rabbits, sheep, goats, poultry and snails [33].

2.1.2 Sampling procedure and data collection

Multi-stage sampling procedure was used in selecting the respondents used for the study. In the first stage, a random sample of two states (Oyo and Ogun) was selected from the six cassava producing states in the South-West region. In the second stage, five and three local government areas (LGAs) were randomly selected from Oyo and Ogun States respectively. In the third stage, a total of 24 villages was randomly selected from the 8 LGAs. Sixteen (16) cassava farming household were randomly selected from each of the 24 villages in the fourth stage resulting in a total of 384 farming households. After data cleaning, 32 of the questionnaires were excluded because of incomplete information. From the 352 remaining households, there were 212 women household members comprising of 158 women of child-bearing age (20-49 years) and 54 women above 49 years. Information collected included; farm and non-farm income, food expenditure, share of cassava sold, access to nutrition training among others. Also, over a 24-hour recall period, the Minimum Dietary Diversity for Women (MDD-W) questionnaire [34] was adapted and used to obtain the dietary diversity scores (DDS) of women of child bearing age. The MDD-W was calculated by adding together the number of different food groups consumed by a woman over the 24-hour recall period. A score of 1 was given to each food group consumed making a maximum value of 10 points. The proportion of women achieving the minimum of 5 food groups out of 10 was calculated. Furthermore, the individual version of the Household Dietary Diversity questionnaire was adapted and used to obtain the DDS of women above 49 years. The proportion of women who achieved the minimum number of food groups per day was computed by using a cut-off of 4 or more food groups out of 9 [35-36]. All foods consumed by each woman whether at home or outside irrespective of how they were prepared/gathered was captured in the questionnaire. Share of cassava sold was arrived at by computing the crop commercialization index defined as the gross value of crop sale to total gross value of all crop production [37-39]. These values were thereafter obtained for cassava households categorized into 4 levels namely: Zero Level = 1 (0.00), Low Level = 2 (0.01-0.49), Medium-High Level = 3 (0.50-0.75) and Very High Level = 4 (> 0.75).

2.2 Statistical Analysis

2.2.1 Logistic Regression Model

Separate logistic regression models were fitted to identify variables that may be influencing the dietary diversity of women members of the Cassava farming households.

The model is given as:

$$logit\ (p) = ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_i X_i + U_i \text{ [40]}$$

where p denotes the probability of attaining the dietary diversity of 4 or more food groups out of 9 (for women > 49 years) and dietary diversity of 5 or more food groups out of 10 (for women 20-49 years) respectively, the $\beta_i's$ are the parameter estimates of the independent variables, the $X_i's$ represent the independent variables and $U_i's$ are the stochastic error terms.

The selected independent variables are:
Women Age (years)
Household Head Gender (Dummy variable: 1 = Female, 0 = Male)
Household Size (Number)
Women Education (years)
Farm size (Ha)
Farm Income (₦)
Non-Farm Income (Naira (₦)
Farm Experience (years)
Road Status (Dummy variable: 1 = Good, 0 = Bad)
Food Expenditure (₦)
Transport Cost (₦)
Distance to market (Km)
Access to Health Care (1 = Yes, 0 = No)
Cassava Market Experience (years)

Access to Nutritional Training (1 = Yes, 0 = No)
Electricity (1 = Yes, 0 = No)
Crop Share ratio (Share of Cassava sold)

3. RESULTS AND DISCUSSION

3.1 Women of Child-bearing age (20-49 years) Dietary Diversity

Fig. 1 shows that all women (100%) in this category consumed grains, white roots and tubers while less than ten percent of the women of smallholder cassava farming households consumed nuts and seeds (7.6%), eggs (7.0%) and dairy products (7.0%) respectively, 24-hour before the survey. Furthermore, from Table 1, 55 percent of the women in the two states (Ogun = 58.5%; Oyo = 52.7%) did not meet up with the WHO recommended minimum of five food groups out of ten per day. The mean DDS was 4.37, with average scores of 4.34 and 4.40 in Ogun and Oyo states respectively. It results indicated that women (20-49 years) of cassava farming households had DD mean scores that were lower than the recommended 5 food groups per day in both Ogun and Oyo states. These results are in line with [27] which reported that the DDS of women of child-bearing age was low, with most women getting a score of 3 per day. Results from Table 2 showed that 50% of women from low commercialization households met the threshold of at least 5 food groups per day while more than 50% of the women in each of the other cassava commercialization households did not meet the threshold (zero level =61.1%; medium-High = 52.4%; Very High = 57.6%).

Table 1. Food Group Frequencies and DDS of women (20-49years)

S/N	Food Groups	Ogun (n=65)	Oyo (n=93)	Pooled (n=158)
		Frequency (%)	Frequency (%)	Frequency (%)
1	Grains, white roots and tubers, plantains	65 (100)	93 (100)	158 (100)
2	Pulses (cowpeas, peas and lentils)	33 (50.8)	51 (54.8)	84 (53.2)
3	Nuts and seeds	12 (18.5)	0 (0)	12 (7.6)
4	Dairy products	1 (1.5)	10 (10.8)	11 (7.0)
5	Meat, poultry and fish	57 (87.7)	82 (88.2)	139 (88.0)
6	Eggs	4 (6.2)	7 (7.5)	11 (7.0)
7	Dark green leafy vegetables	31 (47.7)	68 (73.1)	99 (62.7)
8	Other vitamins A-rich fruits and vegetables	63 (96.9)	90 (96.8)	153 (96.8)
9	Other vegetables	1 (1.5)	1 (1.1)	2 (1.3)
10	Other fruits	15 (23.1)	7 (7.5)	22 (13.9)
	Food groups cut-off			
	< 5 Food groups	38 (58.5)	49 (52.7)	87 (55.1)
	≥ 5 Food groups	27 (41.5)	44 (47.3)	71 (44.9)
	Mean score (± SD)	4.34 (±0.85)	4.40 (±0.85)	4.37 (±0.85)

Field Survey Data, 2020; Note: SD = Standard Deviation

Table 2. DDS of women (20-49 years) versus cassava commercialization levels

	Cassava Commercialization levels				
	Zero Level	Low Level	Medium-High Level	Very High Level	Pooled
Dietary Diversity	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
DDS <5	11 (61.1)	16 (50.0)	22 (52.4)	38 (57.6)	87 (55.1)
DDS ≥5	7 (38.9)	16 (50.0)	20 (47.6)	28 (42.4)	71 (44.9)
Total	18 (100)	32 (100)	42 (100)	66 (100)	158 (100)

Field Survey Data, 2020; Note: DDS = Dietary Diversity Score

3.2 Women (> 49 years) Dietary Diversity

Results from Fig. 2 showed that all the women of cassava farming households in the two states in this category (Ogun and Oyo) consumed starchy staples in the preceding 24-hour period. Only about 2 percent of them consumed eggs while milk and milk products were consumed by 18.5% of the women in the two states. However, none of the women consumed organ meat in the two states. The average dietary diversity scores, from Table 3, was 4.63, with average scores of 4.27 and 4.96 in Ogun and Oyo States respectively. This results indicated that average women of this category consumed a little above the recommended four food groups out of nine among cassava commercializing households in rural Ogun (4.27) and Oyo (4.96). Furthermore, about seventy percent (68.5%) of the women in the two states consumed a minimum of four or more food groups (Ogun =65.4%; Oyo =71.4%).

Also, Table 4 revealed that about 84 percent of women from very high commercialization households met the minimum requirement of four or more food groups per day. Nevertheless, the three other cassava commercialization households had between 66.7% -75.0% of the women above 49 years that met the recommended DDS of 4 food groups in 24-hour prior to the survey.

3.3 Determinants of Dietary Diversity of Women of Cassava Farming Households

The logistic regression results in Table 5 for women aged 20-49 years showed that the odds of attaining the minimum DD levels are 0.9996 times smaller or 0.04% smaller with an additional increase in transport cost (OR = 0.9996, 95% C.I. = .9994-.9999). High transportation costs discourage participation in marketing activities, resulting in reduced income that may affect the dietary pattern of households negatively. This is in line with the findings of [41]. Furthermore, women who had female household heads were approximately three times more likely to attain have female household heads(OR = 2.79, 95% C.I. = 1.2412 - 6.2768). This may not be

Table 3. Women (> 49years) of cassava farming households' food groups

S/N	Food Groups	Ogun (n=26)	Oyo (n=28)	Pooled (n=54)
		Frequency (%)	Frequency (%)	Frequency (%)
1	Starchy staples	26 (100)	28 (100)	54 (100)
2	Dark green leafy vegetables	10 (38.5)	20 (71.4)	30 (55.6)
3	Other vitamin A rich fruits and vegetables	24 (92.3)	28 (100.0)	52 (96.3)
4	Other fruits and vegetables	17 (65.4)	16 (57.1)	33 (61.1)
5	Organ meat	0 (0)	0 (0)	0 (0)
6	Meat and fish	18 (89.2)	18 (64.3)	36 (66.7)
7	Eggs	0 (0.0)	1 (3.6)	1 (1.9)
8	Legumes, nuts and seeds	13 (50.0)	18 (64.3)	31 (57.4)
9	Milk and milk products	3 (11.5)	7 (25.0)	10 (18.5)
	Food groups cut-off			
	< 4 Food groups	9 (34.6)	8 (28.6)	17 (31.5)
	≥ 4 Food groups	17 (65.4)	20 (71.4)	37 (68.5)
	Mean score(± SD)	4.27 (±1.25)	4.96 (±1.29)	4.63 (±1.31)

Field Survey Data, 2020; Note: DDS = Dietary Diversity Score; SD = Standard Deviation

Table 4. DDS of Women (>49years) versus Cassava Commercialization levels

	Commercialization levels				
	Zero Level	Low Level	Medium-High Level	Very High Level	Pooled)
Dietary Diversity	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)	Frequency (%)
DDS < 4	2 (33.3)	3 (33.3)	5 (25.0)	3 (15.8)	13 (24.1)
DDS ≥ 4	4 (66.7)	6 (66.7)	15 (75.0)	16 (84.2)	41 (75.9)
Total	6 (100)	9 (100)	20 (100)	19 (100)	54 (100)

Field Survey Data, 2020; Note: DDS = Dietary Diversity Score

unconnected to the fact that female-headed households with increased non-farm activities as alternative sources of generating income may have the opportunity of consuming more diverse diets hence, able to meet the MDD-W. This result is in line with the findings of [42] who reported that female-controlled income is usually beneficial for dietary quality. However, it negates the findings by [7] who reported that DDS for women was lower in households with female heads compared to households with male heads.

Results for women older than 49 years are presented in Table 6. The odds of attaining the minimum dietary diversity level are 0.011 times smaller or 98.9% smaller (OR = 0.011; 95% C. I. = 0.00095 - 0.1168) for women with better road condition than for those with poor road conditions. This implied that road condition had almost nothing to do with their dietary diversity levels. But, [41,43] reported that bad road networks is one of the factors affecting dietary patterns of households. Also, the odds of attaining the minimum dietary diversity level are 1350 times higher (OR = 1350.509; 95% C. I. = 5.2656 - 346376.9) for women with access to health care than for those without access to healthcare. In addition, the odds of attaining the minimum dietary diversity level are 0.028 times smaller or 97.2% smaller (OR = 0.028; 95% C. I. = 0.0028 - 0.2889) for women with access to nutritional training than for those without access to nutritional training.

Table 5. Logistic regression results for women (20-49 years) dietary diversity

Variable	OR	z	P>|z|	95% C. I.	
Women Age	1.0144	0.55	0.585	0.9635	1.0680
Household Head Gender	2.7911	2.48	0.013*	1.2412	6.2768
Household Size	1.0297	0.39	0.698	0.8884	1.1936
Women Education	1.0161	0.32	0.746	0.9224	1.1193
Farm Income	1.0000	2.34	0.019	1.0000	1.0000
Non-Farm Income	0.9999	-0.01	0.994	0.9999	1.0000
Road Status	1.9180	1.58	0.115	0.8541	4.3071
Food Expenditure	0.9999	-0.37	0.709	0.9999	1.0000
Transport Cost	0.9996	-2.78	0.005*	0.9994	0.9999
Access to Health Care	0.5039	-1.60	0.109	0.2181	1.1641
Cassava Market Experience	1.0328	1.29	0.196	0.9835	1.0847
Access to Nutritional Training	1.8096	1.23	0.220	0.7018	4.6662
Crop Share Ratio	0.1990	-1.90	0.058	0.0375	1.0561

*O.R. = Odd ratio; 95% C. I. = 95% Confidence Interval; No. of observations = 158; Prob >chi^2 = 0.0401; Wald chi^2 (13) = 23.13; Log pseudo likelihood = -97.568036; Pseudo R^2 = 0.1025; *Significant at 5%*

Table 6. Logistic regression results for women (>49 years) dietary diversity

Variable	OR	z	P>|z|	95% C.I.	
Women Age	1.028	0.58	0.564	0.9356	1.1298
Household Head Gender	0.013	-1.26	0.208	0.0000	11.1745
Household Size	1.160	0.62	0.538	0.7237	1.8586
Women Education	1.020	0.10	0.918	0.7016	1.4824
Farm size	0.318	-0.76	0.448	0.01645	6.1404
Farm income	1.000	1.37	0.171	0.9999	1.0001
Non-Farm Income	1.000	0.68	0.495	0.9999	1.0001
Distance to market	1.150	0.81	0.420	0.8191	1.6139
Road status	0.011	-3.71	0.000*	0.00095	0.1168
Farm experience	0.936	-1.08	0.279	0.8294	1.0554
Food expenditure	0.999	-1.95	0.051	0.9997	1.0000
Access to Electricity	0.296	-0.62	0.537	0.0062	14.0843
Access to Health care	1350.509	2.55	0.011*	5.2656	346376.9
Access to Nutritional Training	0.028	-3.01	0.003*	0.0028	0.2889
Crop share ratio	0.001	-1.87	0.061	9.62e-07	1.3714

*O.R. = Odd ratio; 95% C. I. = 95% Confidence Interval; No. of observations = 54; Prob>chi^2 = 0.0002; Wald chi^2 (15) = 41.81; Log pseudo likelihood = -14.26673; Pseudo R^2 = 0.4486; *Significant at 5%*

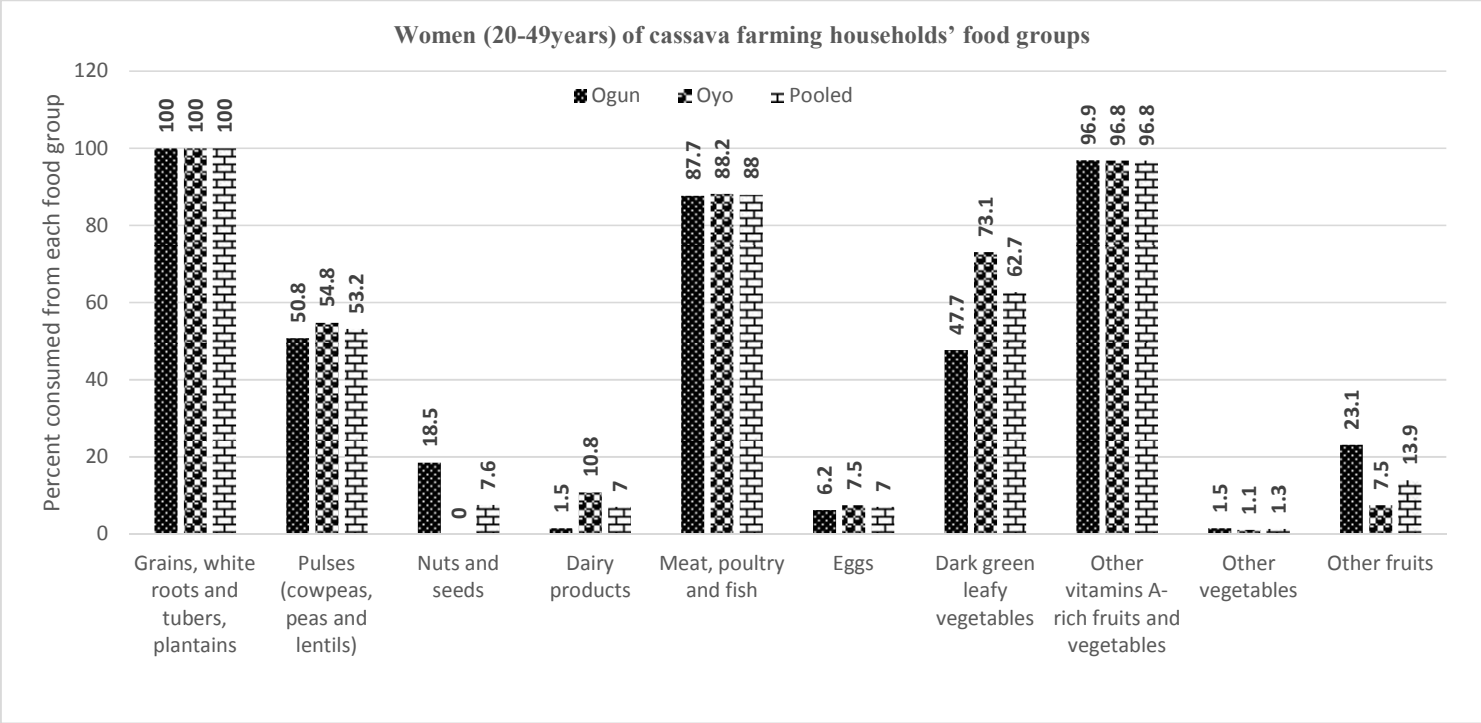

Fig. 1. Percent of women (%) (20-49 years) who consumed food from each food group in 24-hour period
Field Survey Data, 2020

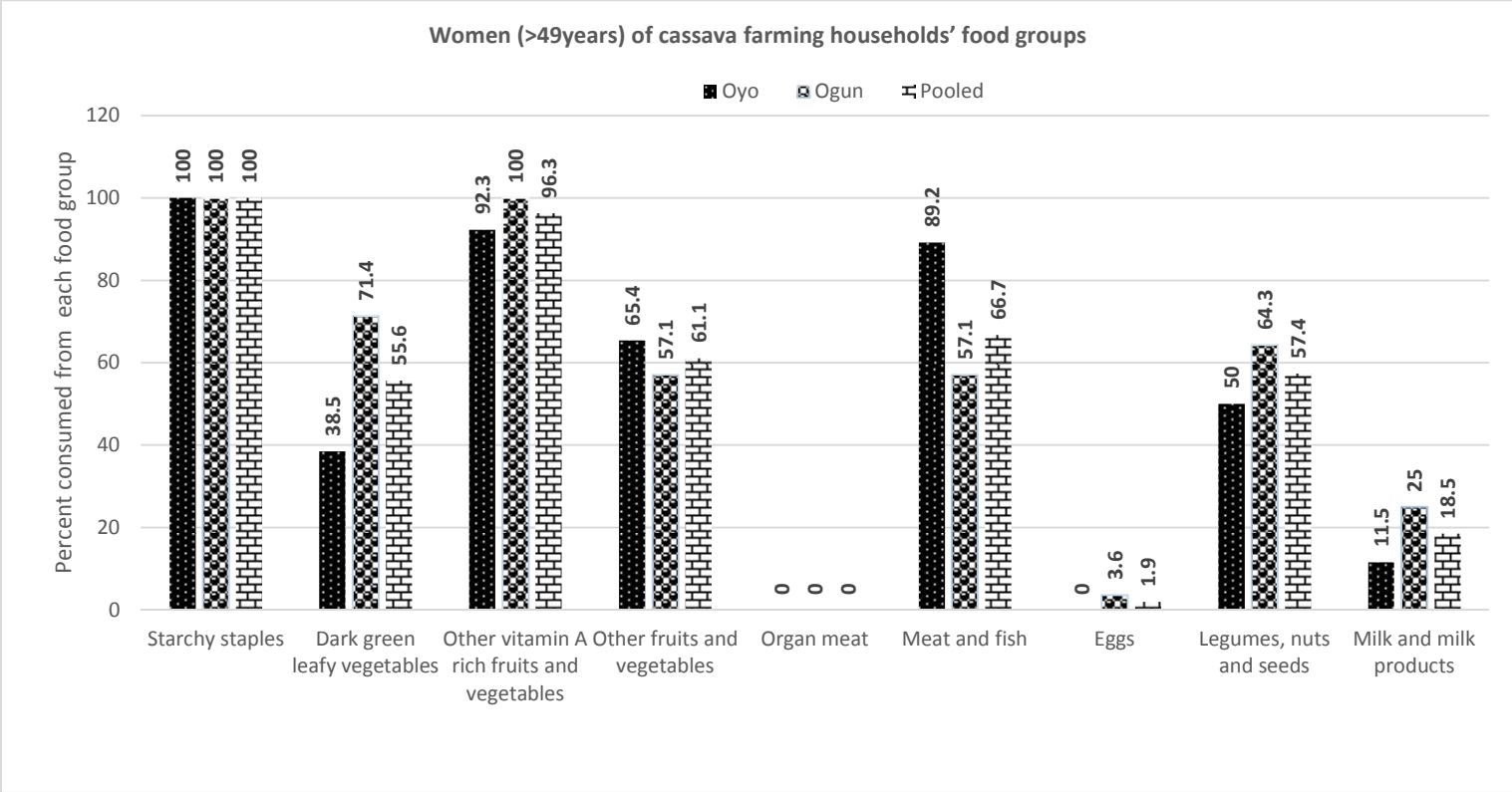

Fig. 2. Number of women (%) (>49 years) who consumed food from each food group daily.
Authors' graph using underlying field survey data, 2020

3.4 The Study Limitations

This study has two important limitations. Firstly, the study was targeted at women members of cassava farming households. This made the data not to be representative of all women in Nigeria and the results obtained were only applicable to women from cassava farming households. Secondly, the sample size for women who were older than 49 years was less than 100. This made the data to be relatively small for the statistical analysis.

3.5 Public Health Implications

Increased consumption of diverse diets among cassava women has important public health implications. These include proper body functioning, enhanced productivity on the farm and in other engagements, good foetal growth, better pregnancy outcomes and healthier families. The results of this study could spur governments of South-West, Nigeria to make policies that ensure that greater attention is given to the health and general welfare of farming households especially those of women and children. These policies should, among others, include:

- Increased public awareness about the importance of diverse diets.
- Provision of basic infrastructural facilities including good road networks.
- Development of appropriate control measures to reduce wastage of food crops, fruits and vegetables.
- Development of strategies that lead to reduction in food prices.

4. CONCLUSION

Low quality diets are major risk factors contributing to the global burden of disease. Women of child-bearing age need diverse diets to overcome challenges that can lead to poor foetal growth and poor pregnancy outcomes. Older women require diverse diets for proper body functioning and higher productivity in their daily activities. In this study, we examined dietary diversity choices of women members of cassava farming households in South-West, Nigeria. Factors associated with these choices were also determined. Using a 24-hour recall, our results showed that more than half of the women (55.1%) in the child-bearing category (20-49 years) did not attain the minimum score of 5 out of 10 food groups per day. The average DDS for this group was 4.37. Also, 50 percent of women who were from households with low cassava commercialization level met the criterion of at least 5 food groups per day. In the older women category (> 49 years), the average DDS was 4.63 and more than half of the women (68.5%) met the required 4 or more food groups per day. Also, 84.2% of women from households with very high cassava commercialization level met the criterion of at least 4 food groups per day. In the child-bearing age category, the odds of attaining the minimum dietary diversity level were 0.04% smaller with an additional increase in transport cost. Also, women who had female household heads were approximately three times more likely to attain the minimum dietary diversity level than women who did not have female household heads. In the older women category, the odds of attaining the minimum dietary diversity were 98.9% smaller for women with good road condition than for women with poor road condition. This implied that road condition had almost nothing to do with their dietary diversity levels. Also, the odds of attaining the minimum dietary diversity level were 1350 times higher for women who had access to health care compared to women with no access to health care. Furthermore, the odds of attaining the minimum dietary diversity level were 97.2% smaller for women who had access to nutritional training compared to women with no nutritional training. These results are useful for evidence-based decision making that can have positive impact on the lives of women in Cassava farming households.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Otekunrin OA, Otekunrin OA. Healthy and Sustainable Diets: Implications for Achieving SDG2 in W. Leal Filho et al. (eds.), *Zero Hunger*, Encyclopedia of the UN Sustainable Development Goals. Springer Nature Switzerland AG; 2021.

Available: https://doi.org/10.1007/978-3-319-69626-3_123-1
2. Garnett T. Plating up solutions Science. 2016;353(6305):1202–1204. Available:https://doi.org/10.1126/science.aah4765
3. Willett W, Rockström J, Loken B, Springmann M et al. Food in the Anthropocene: The EAT–lancet commission on healthy diets from sustainable food systems. The Lancet. 2019;393(10170):447–492
4. Kadiyala S, Harris J, Headey D, Yosef S, Gillespie S. Agriculture and nutrition in India: mapping evidence to pathways. Annals of the New York Academy of Sciences. 2014;1331(1): 43-56.
5. Arimond M, Ruel MT. Dietary diversity is associated with child nutritional status: Evidence from 11 demographic and health surveys. J Nutr. 2004; 134(10): 2579-85. DOI: 10.1093/jn/134.10.2579.
6. Arimond M, Wiesmann D, Becquey E, Carriquiry A, Daniels MC, Deitchler M, et al. Simple food group diversity indicators predict micronutrient adequacy of women's diets in 5 diverse, resource-poor settings. Journal Nutr. 2010;140(11): 2059S-69S. DOI: 10.3945/jn.110.123414.
7. Ochieng J, Afari-Sefa V, Lukumay PJ, Dubois T. Determinants of dietary diversity and the potential role of men in improving household nutrition in Tanzania. PLoS ONE 2017;12(12): e0189022. Available:https://doi.org/10.1371/journal.pone.0189022
8. Yaya OS, Otekunrin OA, Ogbonna AE. Life expectancy in West African countries: Evidence of convergence and catching up with the north. Statistics in transition. 2021;22(1): 75-88. Available:https://doi.org/10.21307/stattrans-2021-004
9. Global Nutrition Report. Action on equity to end malnutrition. Development Initiatives; 2020. Bristol.
10. United Nations Children's Fund (UNICEF), World Health Organization, International Bank for Reconstruction and Development/The World Bank. Levels and trends in child malnutrition: Key Findings of the Edition of the Joint Child Malnutrition Estimates. Geneva: World Health Organization; 2020. Licence: CC BY-NC-SA 3.0 IGO.
11. International Food Policy Research Institute. Global Nutrition Report 2015: Actions and Accountability to Advance Nutrition and Sustainable Development. Washington, DC; 2015.
12. International Food Policy Research Institute (IFPRI). Global Food Policy Report. Washington, DC: International Food Policy Research Institute; 2016. Available:https://doi.org/10.2499/9780896292529
13. FAO, IFAD, UNICEF, WFP & WHO. The State of Food Security and Nutrition in the World 2020. Transforming Food Systems for Affordable Healthy Diets. Rome, FAO; 2020.
14. Otekunrin OA, Otekunrin OA, Sawicka B, Ayinde IA. Three decades of fighting against hunger in Africa: Progress, challenges and opportunities. World Nutrition. 2020;11(3):86-111.
15. Otekunrin, OA. Is Africa ready for the SDG 2 (Zero Hunger) Target by 2030? Current Agriculture Research Journal. 2021;9(1): 1-3.
16. Carletto C, Corral P, Guelfi A. Agricultural commercialization and nutrition revisited: Empirical evidence from three African countries. Food Policy. 2017;67:106-118. Available:http://dx.doi.org/10.1016/j.foodpol.2016.09.020
17. Ayinde IA, Otekunrin, OA, Akinbode SO, Otekunrin OA. Food Security in Nigeria: Impetus for growth and Development. Journal of agricultural Economics and Rural Development. 2020;6(2):808-820.
18. Otieno PE, Farnworth CR, Banda N. Involving Men in Nutrition. GFRAS Good Practice Notes for Extension and Advisory Services Note 26. GFRAS: Lausanne, Switzerland; 2016.
19. Fischer E, Qaim M. Gender, Agricultural Commercialization, and Collective Action in Kenya. Food Security. 2012;4(3):441-53.
20. Jones AD. Ngure FM. Pelto G, Young SL. What Are We Assessing When We Measure Food Security? A Compendium and Review of Current Metrics. .Adv. Nutr. 2013;4:481–50. DOI:10.3945/an.113.004119.
21. Kennedy G, Fanou-Fogny N, Seghieri C, Arimond M, Koreissi Y, Dossa R. et al. Food groups associated with a composite measure of probability of adequate intake

of 11 micronutrients in the diets of women in Urban Mali. J Nutr. 2010;140(11): 2070S-78S.
DOI: 10.3945/jn.110.123612.

22. Savy M, Martin-Pr´evel Y, Sawadogo P, Kameli Y, Delpeuch F. Use of variety/diversity scores for diet quality measurement: relation with nutritional status of women in a rural area in Burkina Faso. Eur J Clin Nutr. 2005;59(5):703-16. DOI: 10.1038/sj.ejcn.1602135.
23. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, De Onis M, et al. Maternal and child undernutrition and overweight in low-income and middle-income countries. The Lancet. 2013;382: 427–51.
DOI:10.1016/S0140-6736(13)60937-X
24. Nguyen PH, Avula R, Ruel MT, et al. Maternal and child dietary diversity are associated in Bangladesh, Vietnam, and Ethiopia. J Nutr. 2013;143(7):1176-1183. DOI: 10.3945/jn.112.172247.
25. Slavchevska V. Agricultural Production and the Nutritional Status of Family Members in Tanzania, the Journal of Development Studies. 2015;51(8):1016-33.
26. Zerfu TA, Umeta M, Baye K. Dietary diversity during pregnancy is associated with reduced risk of maternal anemia, preterm delivery, and low birth weight in a prospective cohort study in rural Ethiopia. Am J Clin Nutr. 2016;103(6):1482-1488. DOI: 10.3945/ajcn.115.116798.
27. Bellows AL, Canavan CR, Blakstad MM, Mosha, D, Noor, RA, Webb, P. et al. The Relationship between Dietary Diversity among Women of Reproductive Age and Agricultural Diversity in Rural Tanzania. Food and Nutrition Bulletin 2019;1-11. DOI: 10.1177/0379572119892405
28. FAOSTAT. Food and Agriculture Organisation of the United Nations Statistical Database. Statistical Division; FAO: Rome, Italy; 2021.
Available: http://www.fao.org/statistics/en/
29. Otekunrin OA, Sawicka B. Cassava, a 21st Century Crop: How can Nigeria Harness its Enormous Trade Potential? Acta Scientific Agriculture. 2019;3(8):194-202.
30. Samuel FO, Akinwande BA, Opasola RO, Azeez, LA, Abass AB. Food intake among cassava value chain. Nutr. Food Sci. 2019;49(6):1051-1062.
31. Maps of World; 2021.
Available:https://wwww.mapsofworld.com/lat_long/nigeria-lat-long.html
32. My Guide Nigeria; 2021.
Available:https://www.myguidenigeria.com/
33. Lawal BO, Samuel FO. Determinant of Nutritional Status of Children in Farming Households in Oyo State, Nigeria. African Journal of Food Agriculture Nutrition and Development. 2010;10 (10):4235-4253.
34. FAO and FHI 360. Minimum Dietary Diversity for Women: A Guide for Measurement; 2016. Rome: FAO.
35. Kennedy G, Ballard T, Dop M. Guidelines for measuring household and individual dietary diversity. Nutrition and Consumer Protection Division, Food and Agriculture Organization of the United Nations. Rome; 2010.
36. Steyn NP, Nel J, Labadarios D, Maunder EMW, Kruger HS. Which dietary diversity indicator is best to assess micronutrient adequacy in children 1 to 9 y? Nutrition 2014; 30:55-60.
Available:https://doi.org/10.1016/j.nut.2013.06.002
37. Strasberg P, Jayne T, Yamano T, Nyoro JK, Karanja DD, Strauss J. Effects of Agricultural Commercialization on Food Crop Input Use and Productivity in Kenya, Policy Synthesis for USAID – Africa Bureau Office of Sustainable Development 41, East Lansing MI: Michigan State University; 1999.
38. Carletto C, Corral P, Guelfi, A. Agricultural commercialisation and nutrition revisited: Empirical evidence from three African countries. Food Policy. 2017;67:106-118.
Available:http://dx.doi.org/10.1016/j.foodpol.2016.09.020
39. Otekunrin OA, Momoh S, Ayinde IA. Smallholders' Farmers' Market Participation: Concepts and Methodological Approaches from Sub-Saharan Africa. Current Agriculture Research Journal. 2019a;7(2):139-157.
Available:http://dx.doi.org/10.12944/CARJ.7.2.02
40. Gujarati DN, Porter DC. Basic Econometrics Fifth edition; 2009.
41. Okoye BC, Abass A, Bachwenkizi B, Asumugha, G, Alenkhe B, Ranaivoson R. et al. Effect of Transaction Costs on Market Participation among Smallholder Cassava Farmers in Central Madagascar. Cogent Economics & Finance. 2016;4:1-20.

Available:https://doi.org/10.1080/23322039.2016.1143597

42. Chege CGK, Andersson CIM, Qaim M. Impacts of Supermarkets on Farm Household Nutrition in Kenya. World Development. 2015;72(1):394-407.

43. Otekunrin OA, Otekunrin OA, Momoh S, Ayinde IA. How far has Africa gone in achieving the Zero Hunger Target? Evidence from Nigeria. Glob Food Sec. 2019b;22:1–12.
Available:https://doi.org/10.1016/j.gfs.2019.08.001

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle4.com/review-history/71966