SOCIOECONOMIC DETERMINANTS OF MICRONUTRIENT FOODS INTAKE AMONG HOUSEHOLDS IN NORTH-CENTRAL NIGERIA

Ayantoye Kayode, Yah-ya Ibrahim Abubakar, and Shehu Abdulganiyu Salahu
Department of Agricultural Economics and Extension, Faculty of Agriculture,
Kwara State University, Malete, Nigeria
Corresponding Email: yahya.shola@gmail.com

ABSTRACT
This study examined the relationship between socioeconomic characteristics and households' micronutrient foods intake. A three stage random sampling technique was employed to select the respondents for the study. The data collected from 494 household heads using a well-structured questionnaire were analyzed using descriptive statistics and ordinary least square regression. The finding revealed that, majority of the respondents (89.68%) were male with a mean age of 48.82 years. Micronutrient food intake was low and scores were below the recommended levels among the households. The average scores for greens and beans intake, total vegetable intake, total protein foods intake, sea food and plant protein intake, fruit intake and dairy foods intake were 11.07, 8.53, 7.39, 9.10, 8.12 and 0.12 respectively. The average total score among the households was 44.33 which indicate poor intake of micronutrient foods. The study further revealed that age (-0.072), household size (-0.466), farming experience (0.056), access to credit (1.333), educational status (1.336), off-farm income (1.321), farm income (0.720) and sex (1.713) are the important socioeconomic factors influencing households' micronutrient food intake. Based on these findings, the study concludes that, there is low intake of micronutrient foods, particularly total vegetables, total proteins, fruits and dairy foods in the study area. Thus, nutritional adequacy programmes should form a core part of any food security intervention.

Keywords: Micronutrient foods, Healthy eating index, socioeconomic characteristics, rural households.

INTRODUCTION
Food is an important part of everyday life, supplying essential energy and nutrients for normal functioning of the body. Food provides the body with different nutrients, among which, vitamins and minerals represent an important aspect (Beal and Ortenzi, 2022). The major sources of these nutrients in human body are micronutrient foods (Mitsopoulou et al., 2020). Micronutrient foods are foods that contain substances that are important for normal growth, and are required in small quantity. These substances are obtained from diets as they cannot be produced within the body in sufficient quantity for healthy development. Yet, micronutrient malnutrition affects about half of the world population, causing considerable human suffering with huge economic cost (Miller and Welch, 2013).

This is more apparent in low and middle income nations where diets are deficient in micronutrients, particularly in Iron, Zinc, Folate, Vitamin A, Calcium and Vitamin B_{12} (WHO, 2021; White et al., 2021). The major consequences of micronutrient deficiency are high rate of mortality in women and children, poor pregnancy outcome, high morbidity, retarded mental and physical development in children and low productivity in adults (Stevens et al., 2022).

Previous studies have reported low micronutrient foods intake especially among women, adolescence, refugees and less privileged settlements. M'bobda et al., (2020) assessed the dietary intake of women of childbearing age in Cameroon and found that few of the respondents had a high intake of vegetables, fruits, milk and dairy foods, meat, fish, egg and pulse food in a week. In a similar study, Paola et al., (2020) found that about 54.1% of Italian Adolescence did not consume fruits and/or vegetables daily. Atayoglu et al (2023) in their study of the nutritional status of Syrian refugees living outside the Refugee camp in Turkey found that that the mean fruit consumption was 101.9 g/day, while that of vegetables was 142.2 g/day, and 77.7% of the respondents fell under poor micronutrient food consumption. Bárdos et al., (2022) assessed the diet quality of Hungarian Roman living in settlements of Northeast Hungary and compared it to those of Hungarian adults in the general population. The study reported low intake of fruits, greens and beans, whole grains, seafood, and plant proteins among both groups, but significantly lower among the Hungarian Roman population. Zhang et al., (2023) also noted that regular and appropriate intake of greens and beans, vegetables, total protein foods, seafood and plant proteins, and unsaturated fatty acids, as well as moderate consumption of empty calories, were related to about 21–29% lower risk of all-cause of death.

The main sources of micronutrients are vegetables, fruits, dairy products, legumes and animal source foods (Allen, 2008; Beal and Ortenzi, 2022). Given the significance of these foods to human health and development, and the corresponding micronutrient deficiencies in low and medium income countries like Nigeria, this study intend to examine the relationship between socioeconomic characteristics and micronutrient food intake among households in North-central Nigeria based on the United States Department of Agriculture (USDA) healthy eating index (HEI-2015) recommendations.

METHODOLOGY

Study Area and Sampling Procedures.

This study was conducted in North-central Nigeria. Specifically, Kwara and Niger states represent the sampling frame within which samples were selected. Thus, the research consisted of all the rural households in Kwara and Niger states. A three stage random sampling technique was used to select respondents for the study. Proportionate representation was ensured in each state by adopting the existing cluster which is the senatorial districts in each of the two states.

Kwara state and Niger state have three senatorial districts respectively. In the first stage, two Local Government Areas were selected randomly in each senatorial district. In the second stage, two rural communities were selected randomly in each Local Government Area. In the final stage, every fifth building was selected within the community. In total, 560 households were selected for the study. Table 1 highlights the proportionate sample distribution.

Table 1: Proportionate Sample Distribution

	Kwara State			Niger State		
	Selected L.G.As	**Estimated Population of LGA**	**Total Selected/LGA**	**Selected L.G.As**	**Estimated Population of LGA**	**Total Selected/LGA**
1	Asa	88,452	40	1. Gbako	102,816	32
2	Oyun	67,000	30	2. Lavun	170,000	48
3	Irepodun	145,388	64	3. Shiroro	190,984	56
4	Isin	42,194	26	4. Rafi	150,822	44
5	Moro	77,112	36	5. Magama	147,089	44
6	Edu	143,025	64	6. Kontagora	123,180	36
	Total number of selected households		260			260

The estimated population of LGA was based on 47.25% rural population (World Bank, 2022)

Micronutrient food consumption

This was based on micronutrient food scores as enshrined in the healthy eating index (HEI-2015). The micronutrient food groups under the HEI-15 are total fruits, whole fruits, total vegetables, greens and beans, dairy foods, total protein foods, and seafood and plant protein foods. Based on the flexibility of this tool, particularly when considering prevailing local situation where the consumption of fruit juice is very low, whole fruit and total fruit were narrowed into fruits. Thus, fruits, total vegetables, greens and beans, dairy products, total protein foods, and seafood and plant foods were evaluated as proxy for micronutrient food intake in the study. Measurement was based on the quantity consumed within the household in the previous 24 hours and each food group was evaluated in cup or ounce as recommended in HEI-2015. Subsequently, micronutrient foods score was obtained by categorizing the foods into four groups, namely fruit group, vegetable group (total vegetable and green and beans group), protein group (total protein food and seafood and plant protein group) and diary food group, and each of the group was assigned a maximum score of twenty-five. This equals to a total maximum score of hundred where higher scores suggest higher intake.

In this research, the maximum and minimum intake were based on individual household's daily calorie requirement and scores were assigned based on every 1000kcal consumed within the household as recommended in HEI-2015. The criteria for the award of minimum and maximum scores were as highlighted in Table 2. Finally, proportional scores were assigned to intake between minimum and maximum standards.

Table 2: Micronutrient Components and Scoring Standards

Food Component	Maximum score	Standard for Maximum Score	Standard for Minimum score of Zero
Fruit	25	≥ 0.4 cup equiv. / 1,000kcal	No fruits
Total Vegetable	12.5	≥ 1.1 cup equiv. / 1,000kcal	No vegetables
Greens and Beans	12.5	≥ 0.2 cup equiv. / 1,000kcal	No dark-green vegetables, beans, or peas
Dairy	25	≥ 1.3 cup equiv. / 1,000kcal	No dairy
Total Protein Foods	12.5	≥ 2.5 ounce equiv. / 1,000kcal	No protein foods
Seafood and Plant proteins	12.5	≥ 0.8 ounce equiv. / 1,000kcal	No seafood or plant proteins

Source: Krebs-Smith et al., 2018 (Modified for the study)

Furthermore, individual household's score based on each of the food groups were summed up to get the household's micronutrient food score. That is:
Household's micronutrient foods score = FTscore+ GBscore + TVscore + SPPscore + TPscore + DPscore
Where:
FTscore = household's score for intake of fruits; GBscore = household's score for intake of greens and vegetables; TVscores = household's score for intake of total vegetables; SPPscore = household's score for intake of seafood and plant proteins; TPscore = household's score for intake of total protein foods; DPscore = household's score for intake of dairy products.

Statistical Analysis

Frequency and percentage were used to summarize the categorical data while mean and standard deviation were used to summarize the continuous data. Ordinary Least square regression (OLS) was used to examine the relationship between socioeconomic characteristics and households' micronutrient foods intake.

The OLS model is as illustrated below:

$Y = a_0 + \beta_1 Age + \beta_2 \text{GD} + \beta_3 FEX + \beta_4 \text{EDU} + \beta_5 \text{HZ} + \beta_6 FLO + \beta_7 \text{FZ} + \beta_8 \text{FI} + \beta_9 \text{OFFI} + \beta_{10} \text{ATC} + \varepsilon$ 3.11

Where

Y= households' micronutrient food intake scores (count)

a_0 = constant or *"Y-Intercept"*

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7, \beta_8, \beta_9,$ and β_{10} = Parameter estimates

ε = the random error term or residuals.

Age = age of household heads (years),

Sex = sex of household heads (Male = 1, Female = 0)

FEX = farming experience of household heads (years)

EDU = educational status of household heads (Educated = 1 or Uneducated = 0)

HZ = household size (count)

FLO = households' farmland ownership (Owned = 1, Not owned = 0)

HZ = households' farm size (count)

FI = households' farm income (Naira/year)

OFFI = households' off-farm income (Naira/month)

ATC = households' access to credit (Yes = 1, No = 0)

RESULTS AND DISCUSSION

Socioeconomic Characteristics of the Respondents

Out of 520 distributed questionnaires, 494 were appropriately filled and usable for this study (this represents 95.0% of administered questionnaires). Tables 3 revealed that majority of the household heads are males. The fact that majority of the households are male-headed can boost micronutrient food intake as male heads can put in more physical effort in farming activities than female heads (Bogale and Shimelis, 2010)., The mean age of the respondents was 48.82 years which indicates that most of the household heads are still within their productive ages. According to Amao and Ayantoye (2015), the ability to perform tedious activities associated with farming operations may decrease as the household heads get older. Thus, the older an individual gets, the lower his/her energy in term of labour contribution which as well can impact general productivity. The result of the farming experience of the respondents revealed that majority of the household heads, which is 66.60% have been farming for over 20 years. The farming experience of the household heads may have positive influence on their micronutrient food consumption as household heads with more farming experience have higher likelihood of being food secure (Wudil et al., 2023).

Furthermore, the average household size in the study area is 6.21 which is a bit higher than the national average rural household size of 5.42 (NBS,2020). Household size can have implications both on supply of labour and micronutrient food consumption. Large households can have more hands in form of farm labour that can be harnessed to improve the agricultural output of the household. On the hand, the larger the household, the lower the tendency of household micronutrient food intake since food requirement increases with the number of individuals in a household.

Table 3: Socioeconomic Characteristics of the Respondents

	Categories	Frequency	Percentage	Mean
Sex	Male	443	89.68	
	Female	51	10.32	
Age (years old)	20 – 45	185	37.45	48.82
	46 – 65	293	59.31	
	66 – 75	14	2.83	
	Above 75	2	0.41	
Farming experience (years)	Less than 20	127	25.71	28.61
	21 – 40	329	66.60	
	Above 40	38	7.69	
Household size	Less than 4	99	20.04	6.21
	5 – 8	306	61.94	
	9 – 12	78	15.78	
	Above 12	11	2.23	
Educational status	No formal	267	54.05	
	education	140	28.34	
	Primary education	59	11.94	
	Secondary	28	5.67	
	education			
	Tertiary education			
Farmland ownership	Borrowed	304	61.54	
	Rented	85	17.21	
	Purchased	22	4.45	
	Inherited	83	16.80	
Farm size (Ha)	Less 4	409	82.79	2.76
	5 – 8	65	13.16	
	Above 8	20	4.05	
Farm income (year)	150,000 –	291	58.91	
	1,000,000	129	26.11	
	1,000,001 –	74	14.98	
	2,000,000			
	Above 2,000,000			
Off-farm income (month)	Less than 20,000	289	58.50	17350.88
	20,000 – 50,000	142	28.75	
	Above 50,000	63	12.75	
Access to credit	Yes	49	9.92	
	No	445	90.08	

(Source: survey, 2023)

With regards to educational status, most of the respondents have no formal education. This low educational level in the study area can reduce the receptiveness of the rural households to new ideas and recede the adoption of new and improved techniques that can enhance their faming activities. Thus, higher level of education increases the likelihood of being food secure (Diallo and Maxwell, 2019). It was also observed that majority of the households borrowed the land employed for farming activities. Thus, they will always be at the mercy of the land owner and to a larger extent, it can affect the type of crop that can be cultivated on the land. Furthermore, majority of the households cultivated less than 4ha. This low level of cultivation may have important implication on agricultural production and micronutrient food availability. Subsequently, the finding revealed that most of the respondents earned not more than ₦1,000,000 per annum in farm income.

Also, majority of the respondents earned less than ₦20,000 per month from off-farm activities. These level of incomes are quite low and can pose significant influence on household food consumption (Agada and Igbokwe, 2014). Also, Off-farm income can improve the sum total of the household income, and consequently, may increase households access to micronutrient foods. Finally, it was found that majority of the respondents (90.08%) lack access to credit facilities. Inadequate access to credit facilities is normally due to collateral and high interest rate as well as short-term and fixed payback period for agricultural loans by financial institution (Dayo, Nkonya, Pender and Oni, 2009). This can have important implication on micronutrient food consumption as lack of capital may limit the scope of farming operations, and this can reduce the general level of food production within the household. The low level of income and stark lack of access to credit, coupled with high lack of formal education and limited farm size can have significant influence on general food availability and specifically, on micronutrient foods consumption.

Households' Micronutrient Foods Intake

Table 4 displays the average micronutrient food scores among the households. Pertaining to greens and beans intake, the average score was 11.07. The average score for total vegetable intake was 8.53. This shows that both scores were above average but the score of greens and beans is higher than that of total vegetable. In essence, even though vegetable intake is above average in the study area, it is still below the recommended level as these scores are below 12.5 which is the ideal score for maximum standard (Krebs-Smith et al., 2018). With regards to the protein foods intake, the average score for total protein foods intake was 7.39 while that of sea foods and plant protein intake was 9.10. This indicates that both scores were above average but the score of sea foods and plant protein is higher than that of total protein foods. However, even though both scores are above average, they are still below the recommended levels that meets required standard for an active and productive living.

The average score for fruit intake was 8.12, which is way below the maximum recommended score of 25. The low intake of fruits might be due to the time of the study as most of the fruits are seasonal coupled with general inadequate storage facilities in the country. In cases where fruits are available during the off-season, affordability might be the issue for the households. Nonetheless, this finding is consistent with the research of Ahmed et al., (2017) who reported infrequent intake of fruits as one of the poor dietary habits exhibited by adolescents in Abuja municipal area council. The average scores for dairy foods was low (0.12 out of 25). This indicates very low intake of dairy foods such as milk and cheese in the study area. Looking at the total score, the study reveals a total score of 44.33 which reflects poor intake of micronutrient foods. That is, micronutrient food intake is generally low in the area and intervention is urgently required due to the impact of these foods on the general well-being of the households. This finding is consistent with other findings around the world especially among male workers (Putri et al., 2018), ethnic minorities (Bárdos et al., 2022), and refugees (Atayoglu et al., 2023).

Table 4: Micronutrient Food Intake

Food Scores	Mean score (SD)	Recommended score	Average score
Green and Beans Intake	11.07 (2.47)	12.5	6.25
Total Vegetable Intake	8.53 (1.69)	12.5	6.25
Total Protein Foods Intake	7.39 (2.66)	12.5	6.25
Seafood and Plant Proteins Intake	9.10 (3.59)	12.5	6.25
Fruit Intake	8.12 (10.82)	25.0	10.0
Dairy foods Intake	.12 (0.04)	25.0	10.0
Total	**44.33**	**100**	**50**

(Source: survey, 2023) (n = 494)

Influence of Socioeconomic Characteristics on Households' Micronutrient Food Intake

Ordinary least square regression was used to examine the influence of socioeconomics characteristics on rural households' micronutrient food intake. The dependent variable (micronutrient food score) is continuous, which is the sum of individual household's scores from micronutrient foods intake. Table 5 presents the result of the OLS model estimation. The result shows that age of household heads and household size have statistically significant negative coefficients while farming experience, access to credit, educational status, off-farm income, farm income and sex of head of households have statistically significant positive coefficients.

The significant negative coefficient of household heads' age indicates that a point increase in the age of household head will lead to a decrease in households' micronutrient foods intake by 0.072 points. This shows that household heads' strength, as per labour supply for farming activities reduces as they become older, and this may impact food availability within the household, and consequently micronutrient food intake (Amao and Ayantoye 2015). Similarly, the significant negative coefficient of household size indicates that a point increase in household size will lead to a decrease in households' micronutrient food intake by 0.466 points. That is, household size, particularly small family size might increase the likelihood of micronutrient foods consumption within the households. Larger household size has been widely reported to be related to higher dependency ratio, such that majority of the household members do not contribute to the households' income and thereby, increasing the strain on the available food (Ribar and Hamrick, 2003; and Amao and Ayantoye, 2017). On the other hand, the significant positive coefficient of farming experience implies that a point increase in farming experience will lead to a rise in households' micronutrient foods intake by 0.056 points. This is emphasizing the fact that experience is an excellent way of learning on the job and improving on prevailing practices. Wudil et al., (2013) noted that the likelihood of being food secure increases with increase in households' head farming experience, thus, similar implication is also revealed for micronutrient foods intake.

The significant positive coefficient of access to credit implies that households that have access to credit are 1.333 times more likely to consume micronutrient foods than those without access to credit. Access to credit can have significant influence on the extent of households' farming operations, and consequently their farm output and micronutrient food consumption. Furthermore, the significant positive coefficient of educational status of household heads indicates that a point increase in education status will lead to a rise in households' micronutrient foods intake by 1.336 points. This signifies that educational status plays significant role in the micronutrient food intake of household as it can improve individuals' receptiveness to innovation both on agricultural production and nutritional changes that can be of immense benefit. This result corroborates the finding of Ayantoye et al., (2011), and Agada and Igbokwe, (2014) who reported a negative and significant relationship between educational level of household heads and households inadequate access to sufficient and nutritious foods.

Similarly, the significant positive coefficients of off-farm income and farm income indicate that a point increase in off-farm income and farm income will lead to a rise in household's micronutrient foods intake by 1.321 points and 0.720 points respectively. Households' income to a large extent determine their purchasing power as foods not produced within the households will need to procured from the market. In such cases, households with more income at their disposable will be able to afford and consume more micronutrient foods while those with less income may invariably consume less micronutrient foods. This finding is consistent with Mbwana et al., (2016), who reported that farm income increases the likelihood of households' food availability and access. Diallo and Maxwell (2019) also noted that off-farm income decreases the likelihood of households' food insecurity. Finally, the significant positive coefficient of sex indicates that male headed households are 1.713 more likely to consume micronutrient foods than female headed households.

This might be because male headed household can contribute more to food production than female headed households, particularly in term of energy supply for farming operations. This finding is consistent with the research of Paola et al., (2020) and Zhang et al., (2021). Furthermore, Amao (2013) reported that age, income, gender and affordability were the significant factors that determine the level of protein consumption. Thus, age of household head, household size, farming experience, access to credit, educational status, off-farm income, farm income and sex of household head are the important socioeconomic factors influencing households' micronutrient foods intake. The reported R-squared value of 0.410 implies that about 41% of the variations in households' micronutrient foods intake are explained by the model. The reported F-statistics of 21.673 and its p-value of 0.000 indicate that the statistics is significant and therefore, the overall model is statistically significant.

Table 5: OLS Regression Result for Micronutrient Foods Index

Variables	Coefficient	Std. Error	t	p-value
C	9.763	1.209	8.073	.000
Age	-.072	.016	-4.491	.000
FE	.056	.020	2.829	.005
HZ	-.466	.059	-7.902	.000
FZ	-.014	.070	-.205	.838
ATC	1.333	.603	2.211	.028
EDU	1.336	.491	2.721	.007
OFFI	1.321	.387	3.418	.001
FLO	.318	.444	.716	.474
FI	.720	.306	2.357	.019
Sex	1.713	.429	3.993	.000
R^2	0.410			
F-stat	21.673			0.000

(Source: survey, 2023)

Note:EDU is educational status; FEX is farming experience; HZ is household size; FZ is farm size FLO is farmland ownership; FI is farm income; OFFI is off-farm income; ATC is access to credit;

CONCLUSION AND RECOMMENDATIONS

Micronutrient food intake scores are below the recommended level, signifying that there is low intake of micronutrient foods, particularly total vegetables, total proteins, fruits and dairy foods in the study area. The socioeconomics characteristics of the households was observed to have significant influence on their micronutrient food intake. This is particularly obvious with regards to age of household heads, household size, farming experience, access to credit, educational status, off-farm income, farm income and sex of household heads. Based on these findings, the study highlighted the following recommendations:

1. Nutritional adequacy programmes that include orientation on the benefits and implication of these foods on the wellbeing of the households should form a core part of any food security intervention.
2. Low-level of education among rural farming households in the study area is a serious cause for alarm. Therefore, more deliberate focus is required in educating the future rural farmers.
3. The level of income of the households is very low and more deliberate efforts is required in training them to modern standards that can improve their efficiency and subsequently their income level.

REFERENCES

Agada, M. O., and Igbokwe, E. M. (2014). Food Security and Coping Strategies among Ethnic Groups in North Central Nigeria. Developing Country Studies, 4(8), 31–44. www.iiste.org

Ahmed PA, Otuneye AT, Shatima DR, Abdulkarim AA, and Aluko OO. (2017). Relationship between dietary habits and nutritional status among adolescents in Abuja municipal area council. Niger J Paediatr 2017; 44 (3): 128 –135

Allen, L. H. (2008). To what extent can food-based approaches improve micronutrient status?. Asia Pacific Journal of Clinical Nutrition, 17.

Amao, J. O. (2013). Determinants of Protein Consumption among Households in ILA Local Government Area of Osun State , Nigeria Department of Agricultural Economics ,. 15(10), 1401–1410. https://doi.org/10.5829/idosi.mejsr.2013.15.10.11049

Amao, J. O., and Ayantoye, K. (2015). Correlates of Food Insecurity Transition and its Determinants among Farming Households in North Central , Nigeria . Journal of Economics and Sustainable Development, 6(24), 230–244.

Amao, J. O., and Ayantoye K. (2017). Analysis of food insecurity status among farming households in North Central Nigeria. Ijaar, 5, 10–22.

Atayoglu, A. T., Firat, Y., Kaya, N., Basmisirli, E., Capar, A. G., Aykemat, Y., Atayolu, R., Khan, H., Atayoglu, A. G., & Inanc, N. (2023). Evaluation of Nutritional Status with Healthy Eating Index (HEI-2010) of Syrian Refugees Living Outside the Refugee Camps.

Ayantoye, K., Yusuf, S. A., Omonona, B. T., and Amao, J. O. (2011). Food Insecurity Dynamics and its Correlates among Rural Households in South- Western Nigeria. International Journal of Agricultural Economics and Rural Development, 4(1), 43–55.

Bárdos, H., Llanaj, E., Vincze, F., Diószegi, J., & Pikó, P. (2022). Diet quality as assessed by Healthy Eating Index - 2015 among Hungarian Roma living in settlements of Northeast. Scientific Reports, 1–11. https://doi.org/10.1038/s41598-022-23670-3

Beal, T., & Ortenzi, F. (2022). Priority micronutrient density in foods. Frontiers in nutrition, 9, 379.

Bogale, A. and Shimelis, A. (2010), Household level determinants of food insecurity in rural areas of Dare Dawa, Eastern Ethiopia. [Online] Available from: file:1111/systembiller/shareddocuments/socioeconomic of Ethiopia.htm. [Accessed: 22nd April 2023].

Dayo, P., Nkonya, E., Pender, J. and Oni, O.A. (2008), Constraints to increasing agricultural productivity in Nigeria, Nigeria strategy support program (NSSP) Brief, 4, 1-3.

Diallo, A., and Maxwell Toah, A. (2019). Determinants of Food Insecurity among Maize Farming Households in the Southern Region of Mali. Journal of Food Security, 7(5), 151–158.

Krebs-Smith SM, Pannucci TE, Subar AF, et al. (2018). Update of the Healthy Eating Index: HEI-2015. Journal of the Academy of Nutrition and Dietetics

M'bobda, C. M., Ngondi, J. L., Ntentie, F. R., Tchuente, B. R. T., Nguedjo, M. W., Azantsa, B. G. K., & Oben, J. E. (2020). Assessment of Dietary Habits and Nutritional Status of Women of Childbearing Age in Cameroon: A Cross Sectional Study. Open Journal of Epidemiology, 10(04), 369–392. https://doi.org/10.4236/ojepi.2020.104030

Mbwana, H. A., Kinabo, J., Lambert, C., & Biesalski, H. K. (2016). Determinants of household dietary practices in rural Tanzania: Implications for nutrition interventions. Cogent Food & Agriculture, 2(1), 1224046.

Miller, D. D., & Welch, R. M. (2013). Food system strategies for preventing micronutrient malnutrition. Food policy, 42, 115-128.

Mitsopoulou, A. V., Magriplis, E., Dimakopoulos, I., Karageorgou, D., Bakogianni, I., Micha, R., ... & Zampelas, A. (2020). Micronutrient intakes and their food sources among Greek children and adolescents. Public Health Nutrition, 23(13), 2314-2326.

NBS (2020). Nigeria Living Standards Survey (in collaboration with the World Bank). http://dx.doi.org/10.1016/j.rser.2015.07.050%0Ahttp://documents.worldbank.org/curated/en

Paola Nardone, Daniela Pierannunzio, Silvia Ciardullo, Giacomo Lazzeri, Nazario Cappello, and Angela Spinelli (2020). Dietary habits among Italian adolescents and their relation to socio-demographic characteristics. Ann Ist Super Sanità 2020 | Vol. 56, No. 4: 504-513. DOI: 10.4415/ANN_20_04_15

Peterson, K. (2023). The Acceptable R-square in Empirical Modelling for Social Science Research. January 2023, 1–9. Munich Personal RePEc Archive.115769.

Putri, P. A., Briawan, D., & Ekayanti, I. (2018). Application of Healthy Eating Index to Assess Diet Quality in Male Workers. 13(12), 39–46. https://doi.org/10.25182/jgp.2018.13.1.39-46

Ribar, D.C, and K.S. Hamrick. (2003). Dynamics of Poverty and Food Insufficiency: Food Assistance and Nutrition Research Report No. 36 FANRR Washington, DC: USDA

Stevens, G. A., Beal, T., Mbuya, M. N., Luo, H., Neufeld, L. M., Addo, O. Y., ... & Young, M. F. (2022). Micronutrient deficiencies among preschool-aged children and women of reproductive age worldwide: a pooled analysis of individual-level data from population-representative surveys. The Lancet Global Health, 10(11), e1590-e1599.

White JM, Beal T, Chimanya K, Arsenault JE, Okronipa H, Hinnouho G-M, Chimanya K, Matji K, and Garg J. (2021). Micronutrient gaps during the complementary feeding period in Eastern and Southern Africa: a comprehensive nutrient gap assessment. Nutrition Reviews, Volume 79, Issue (Suppl. 1):16–25. doi: 10.1093/nutrit/nuaa142.

WHO. Vitamin and Mineral Nutrition Information System (VMNIS). (2021). Available online at: https://www.who.int/teams/nutrition-and-food-safety/databases/vitamin-and-mineral-nutrition-information-system (accessed June 13, 2021)

Wudil, A. H., Ali, A., Aderinoye-Abdulwahab, S., Raza, H. A., Mehmood, H. Z., & Sannoh, A. B. (2023). Determinants of food security in Nigeria: Empirical evidence from beneficiaries and non-beneficiaries rice farmers of the Kano River Irrigation Project. Frontiers in Sustainable Food Systems, 7. https://doi.org/10.3389/fsufs.2023.999932

Zhang, J., Song, P. K., Zhao, L. Y., Ye, S. U. N., Kai, Y. U., Jing, Y. I. N., ... & Zhao, W. H. (2021). Malnutrition in relation with dietary, geographical, and socioeconomic factors among older Chinese. Biomedical and Environmental Sciences, 34(5), 337-347

Zhang Y, Li D and Zhang H (2023). Associations of the Healthy Eating Index-2010 with risk of all-cause and heart disease mortality among adults with hypertension: Results from the National Health and Nutrition Examination Survey 2007–2014. Front. Nutr. 10:1077896. doi: 10.3389/fnut.2023.1077896.