Impact of Nutrition Education on Dietary Diversity of Hypertensive Older Adults in Two South-Eastern States, Nigeria

[1]Benneth I. C, [2]Afam-Anene O. C, [3]Onyeji G. N.

[1]Department of Human Nutrition and Dietetics Alex-Ekwueme Federal University, Ndufu-Alike, Abakaliki, Ebonyi State Nigeria.
[2]Department of Nutrition and Dietetics, Imo State University, Owerri, Imo State.
[3]Department of Human Nutrition and Dietetics David Umahi Federal University of Health Sciences, Uburu, Ebonyi State Nigeria.

***Corresponding Author:** ihuoma.benneth@funai.edu.ng **Phone number:** 07064799019.

ABSTRACT

Background: *Nutrition education (NE) is crucial for improving nutrition knowledge, dietary behavior, and food selection, contributing to overall well-being.*

Objective: *This study determined the impact of nutrition education on the dietary diversity of hypertensive adults in two southeastern states in Nigeria.*

Methodology: *In this quasi-experimental study, 720 participants were selected using a multi-stage sampling technique. Participants were assigned to the Intervention (IG) and control groups (CG). NE was provided to the IG twice monthly for four months, while the CG was not given any education. Data were collected at baseline and endline (4th month) using a validated and pretested questionnaire on demographic variables, nutrition knowledge (NK), and dietary diversity (DD). Data was analyzed with SPSS version 23.0, while the chi-square and independent t-test were used to test the hypothesis. Significant difference was accepted at $p<0.05$.*

Results: *The mean age was 59.6±6.4 and 59.5±6.1 years for both the IG and CG, respectively. More females (59.7%) participated in the study. The mean dietary diversity increased from 8.9±3.1 to 11.3±2.1 within the IG. A statistically significant difference was observed between baseline and endline DD within the IG ($t = 2.89$, $p < 0.05$). The mean NK increased from 8.9±3.1 to 11.3 ± 2.1 for the IG at endline. There was a statistically significant difference between the baseline and endline of the IG ($t = 14.69$, $p < 0.05$), while the CG ($t = 0.80$, $p > 0.05$) remained insignificant.*

Conclusion: *Nutrition education improved the participants' nutrition knowledge and dietary diversity.*

Keywords: Nutrition education, Dietary diversity, Nutrition Knowledge, Hypertensive Adults

Doi: https://dx.doi.org/10.4314/njns.v46i2.17

INTRODUCTION

Globally, the prevalence of hypertension increases with age, affecting approximately 33.2% of individuals' aged 40–59 years and 63.1% of those aged 60 and above (1). In Nigeria, the prevalence of hypertension among adults is on the rise and varies by year and region (2). South-East Nigeria has the highest reported prevalence at 52.8%, compared to 20.9% in North-Central, 27.5% in North-East, 26.8% in North-West, 44.6% in South-South, and 42.1% in South-West regions (3). This rising trend in hypertension in Nigeria and other West African nations is largely driven by poor dietary habits (4; 5). Key risk factors for hypertension include ageing, genetics, being overweight or obese, physical inactivity, and an unhealthy diet (6). Hypertension is defined as having a systolic blood pressure of ≥140 mmHg

and/or a diastolic pressure of ≥90 mmHg, based on the average of two or more readings taken during at least two separate visits following an initial screening (7; 8). It affects individuals across all age groups, genders, and socio-economic backgrounds (9; 10), though it is particularly common among older adults (11). The prevalence of chronic diseases is reduced with the consumption of diverse diets (12). The growing prevalence of non-communicable diseases is largely attributed to the ongoing nutrition transition- a shift from traditional diets to modern, globalised eating patterns high in processed foods, saturated fats, sugar, and salt (13). No single meal can provide the daily required nutrients for optimal health; however, dietary diversity has been proven as an important component of a high-nutrient diet (14). Dietary diversity is very effective in improving nutritional status, cardiovascular diseases, and overall health (15). Dietary patterns are generally connected with health benefits and are characterized by reasonably higher amounts of vegetables, fruits, legumes, whole grains, low-fat or nonfat dairy, lean meats and poultry, seafood, nuts, and unsaturated vegetable oils, and lower amounts of red and processed meat, sugar-sweetened foods and beverages, and refined grains (16). Low-income households do not consume diverse meals; which leads to a nutritionally inadequate diet (17).

Research has demonstrated that nutrition education is linked to a lower risk of non-communicable diseases (18). Nutrition educational programs are crucial in preventing chronic illnesses and reducing the global burden of such diseases (19). Understanding nutrition education has a significant influence on dietary behaviour and food selection, ultimately contributing to overall well-being (20). The process of fostering healthy eating habits involves transferring knowledge about food selections, nutrition principles, and the connection between diet and health (21). Various approaches, such as formal education, community initiatives, and hands-on workshops, serve as methods for delivering nutrition education (22). Dietary modifications have been proven effective in managing hypertension (23). Community-based studies aimed at increasing awareness and education about hypertension have demonstrated improvements in knowledge, lifestyle behaviours, and blood pressure control (24, 25, 26, 27). This study, therefore, assessed the impact of Nutrition Education on dietary diversity among older adults with hypertension.

METHODS

Study design, Study Location, and Study Population

This study was a community-based quasi-experimental design, conducted in four local governments (Ikwuano, Umuahia North, Afikpo, and Ohaozara) of Abia and Ebonyi states of South East, Nigeria. The study population was adult males and females aged 50 to 70 years in the rural and urban communities of the selected senatorial districts in the two (2) states of South East with systolic blood pressure (SBP) of 140mmHg and above or diastolic blood pressure (DBP) of 90mmHg and above. The sample size (n) for the study was approximated to 360 (Three hundred and sixty) citizens for each state. For the two (2) states, it was 720 participants.

Sampling Techniques

A multi-stage sampling technique was used to select the participants. The first stage involved a simple random selection of two states from the five states of South East, Nigeria. The second stage involved a simple random selection of one (1) senatorial district from each of the selected states. The third stage involved a purposive selection of two Local Government Areas (one urban and one rural) from the selected senatorial district in each State. Four (4) Local Government Areas were selected in the two (2) States. The fourth Stage involved a convenient selection of four (4) communities from each selected Local Government Area, bringing it to sixteen (16) communities in the two (2) states. About 45 participants were selected from each community and grouped into two non-contagious groups (intervention and control) based on geographical distance between communities to minimize contamination (26). The fifth stage involved a sensitization campaign in the community to inform them of the program, the nature and the benefits of the research. The sixth stage involved a purposive selection of male and female respondents from the selected communities who are fifty (50) to seventy (70) years with systolic blood pressure (SBP) of 140mmHg and above and/or diastolic blood pressure (DBP) of 90mmHg, and have signed the consent form.

Preliminary Visit

There was an initial visit to the community stakeholders, including the kings, community chiefs, town union presidents, and counselors, to familiarize them with and to get consent to carry out the research in their community.

Ethical approval

Approval to collect data was obtained from the Federal Medical Center, Umuahia, Abia State, with health research committee assigned number-FMC/QEH/G.596/Vol.10/751. Informed consent was sought from each participant before being enrolled in the study.

Data collection

Blood Pressure Measurement Screening: Blood pressure was measured using a fully automated digital device, the OMRON digital sphygmomanometer (OMRON HEM-712C) between the time of 8 a.m. and 10a.m. Blood Pressure was measured using recommended methods as described by (28). At the end of the blood pressure screening, the participants who met the inclusion criteria were selected.

Demographic profiles: Respondents' demographic profile was collected. This includes gender, age, religion, place of residence, location (urban or rural), ethnicity, marital status, number of children, and household size.

Nutrition Knowledge: Nutrition knowledge level was determined based on fifteen questions (Q1−Q15). Correct answers were scored "1", while wrong or "don't know" answers and missing data were given "0". The points of each respondent were summed together and converted to percentages. Levels of nutritional knowledge and practices were classified into three (3) categories: poor (0–50%), fair (51–74%), and good (>75%).

Dietary Diversity: Each respondent was asked to describe what he/she ate and drank yesterday during the day and night, including those eaten at home and away from home. The information was recorded in the 24-hour dietary diversity recall against each meal time (breakfast, snack, lunch, snack, dinner, and snack). Values for the dietary diversity variable were obtained by summing all food groups included in the dietary diversity questionnaire. The potential score range for the individual dietary diversity was 0-10. MDD-W was classified into three levels of consumption: Low if MDD-W is 1-4, moderate if MDD-W is 5-7, and high if MDD-W is 8-10 (29).

Intervention group – *Content of Nutrition Education Material:* The nutrition education materials were developed using the DASH plan according to (30). The Dietary Approaches to Stop Hypertension (DASH) diet is recommended for people who want to prevent or treat high blood pressure and reduce their chance of developing heart disease. It focuses on the consumption of fruits, vegetables, whole grains, and lean meats. The nutrition education intervention took place at the various community halls. After the baseline data collection, nutrition education was given to the intervention group alone for a period of 16 weeks, once every two weeks between 8 a.m and 10 a.m. The participants reduced from seven hundred and twenty (720) to six hundred and ninety-nine (699), with three hundred and fifty-four (354) in the intervention group.

Control group: The participants in the control group was not given any nutrition education intervention. At the endline data collection, the participants reduced to three hundred and forty-five (345).

Statistical Analysis

Data was analyzed using Statistical Package for Social Sciences version 23.0. Data was expressed as frequencies and percentages. Quantitative data were presented using tables. Pearson product-moment correlation was used to determine the relationship of variables. An independent t-test was applied to compare the mean differences between the treatment and control groups. Level of significance was set as $P<0.05$.

RESULTS

Table 1 presents the demographic characteristics of the respondents. The mean age of the respondents was 59.6±6.4 and 59.5±6.1 years for both the intervention group and control group, respectively. About 60.0% and 59.4% of the respondents in the intervention and control groups, respectively, were females. The majority of the respondents' religion was Christianity (95.4%), Traditional (3.5%), and Islam (1.1) respectively. The majority (79.6%) of the respondents were married, while 13.2%, 6.7% and 0.6% were widowed, divorced/separated, and single, respectively.

Table 1: Demographic Characteristics of the Respondents

Variable	Baseline Intervention n=360 (%)	Control n=360 (%)	Total n=720 (%)
Age (years)			
50-54	107(29.7)	102(28.3)	209(29.0)
55-59	69(19.2)	78(21.7)	146(20.4)
60-64	82(22.8)	82(22.8)	164(22.8)
65-69	84(23.3)	86(23.9)	170(23.6)
>69	18(5.0)	12(3.3)	30(4.2)
Mean age	59.6±6.4	59.5±6.1	59.3±6.3
Gender			
Male	144(40.0)	146(40.6)	290(40.3)
Female	216(60.0)	214(59.4)	430(59.7)
Religion			
Christianity	345(95.8)	342(59.0)	687(95.4)
Islam	03(0.8)	05(1.4)	08(1.1)
Traditional	12(3.4)	13(3.6)	25(3.5)
Marital Status			
Single	2(0.6)	2(0.6)	4(0.6)
Married	293(81.4)	280(77.8)	573(79.6)
Divorced/Separated	17(4.7)	31(3.60)	48(6.7)
Widowed	48(13.3)	47(13.1)	95(13,2)
Number of Children			
0	13(3.6)	12(3.3)	25(3.5)
1-4	205(56.9)	199(55.3)	404(56.1)
5-8	125(34.7)	137(38.1)	262(36.1)
9-12	14(3.9)	12(3.3)	26(3,6)
>12	3(0.8)	0(0.0)	3(0.4)
Household Size			
1-3	87(24.2)	97(26.9)	184(25.6)
4-6	171(47.5)	162(45.0)	333(46,3)
7-9	73(20.3)	84(23.3)	157(21.8)
Above 9	29(8.1)	17(4.7)	46(6.4)

Food Groups Consumption of the Respondents at Baseline and Endline

The food group consumption of the respondents as shown in Table 2 for both the intervention and control groups at baseline and endline. At baseline, most (99.3%) of the respondents consumed grains, white root/tuber, and plantain. Less than half (40.1%) of respondents consumed pulses. About 48.2% of the respondents consumed nuts and seeds; likewise, less than half (41.3%) consumed milk and milk products. A greater proportion (95.1%) of the respondents consumed meat, fish, and poultry, while about a quarter (39.0%) consumed eggs. In addition, about 55.1% of the respondents consumed dark green vegetables, while about two-thirds (65.3%) of the respondents consumed other vitamin A-rich foods.

At endline, the majority (99.4%) of the respondents in the intervention and control groups consumed grains, white root/tuber, and plantain, respectively. Similarly, about half (50.5%) of respondents consumed pulses (beans, peas, and lentils) respectively. Likewise, (56.5% and 50.1%; 39.8% and 40.9%) of the respondents had nuts and seeds, and milk/milk products in the treatment and control groups, respectively. The majority of respondents in the intervention group (95.2%) and in the control group (95.4%) consumed meat, fish, and poultry. Additionally, more than one-third (37.3% in both the intervention and control groups) consumed eggs.

Table 2: Minimum Dietary Diversity of the Respondents at Baseline and Endline

Variable Minimum Dietary Diversity	Baseline Intervention n=360 (%)	Control n=360 (%)	Total n=720 (%)	Endline Intervention n=354 (%)	Control n=345 (%)	Total n=699 (%)
Grains, white Root, plantain	357(99.2)	358(99.4)	715(99.3)	352(99.4)	343(99.4)	695(99.4)
Pulses	151(41.9)	138(38.3)	289(40.1)	212(59.9)	141(40.9)	353(50.5)
Nuts seeds	167(46.4)	180(50.0)	347(48.2)	200(56.5)	173(50.1)	373(53.4)
Milk/milk products	149(41.4)	148(41.1)	297(41.3)	141(39.8)	141(40.9)	282(40.3)
Meat poultry fish	342(95.0)	343(95.3)	685(95.1)	337(95.2)	329(95.4)	666(95.3)
Eggs	138(38.3)	143(39.7)	281(39.0)	132(37.3)	137(39.7)	269(38.5)
Dark leafy vegetables	210(58.3)	187(51.9)	397(55.1)	223(63.0)	177(51.3)	400(57.2)
Other vit A	232(64.4)	238(66.1)	470(65.3)	231(65.3)	231(67.0)	462(66.1)
Other vegetables	108(30.0)	115(31.9)	223(31.0)	102(28.8)	115(33.3)	217(31.0)
Other fruits	73(20.3)	83(23.1)	156(21.7)	74(20.9)	82(23.8)	156(22.3)

Minimum Dietary Diversity Tertile of the Respondents at Baseline and Endline

Table 3 revealed the minimum dietary diversity tertile of the respondents at baseline and endline. The mean and standard deviation at baseline were 5.35±1.30 and 5.37±1.15, while the endline was 5.63±1.34 and 5.44±1.14 for the intervention and control groups, respectively. Statistical testing revealed a significant difference between baseline and endline scores within the intervention group ($t = 2.89$, $p < 0.05$), whereas no significant difference was observed between the control groups at baseline and endline ($t = 0.51$, $p > 0.05$).

Table 3: Minimum Dietary Diversity Tertile of the Respondents at Baseline and Endline

Range of Scores	Baseline Frequency (%)	Endline Frequency (%)	T	p-value
Intervention n=360 (%)			2.89	0.004
Low	95(26.4)	67(19.0)		
Moderate	251(69.7)	260(73.4)		
High	14(3.7)	27(7.6)		
Mean/SD	5.35±1.30	5.63±1.34		
Total	360 (100.0)	354 (100.0)		
Control n=360 (%)			0.51	0.611
Low	82(22.8)	85(24.6)		
Moderate	267(74.2)	249(72.2)		
High	11(3.0)	11(3.2)		
Mean/SD	5.37±1.15	5.44±1.14		
Total	360 (100.0)	345(100.0)		

Nutrition Knowledge of the Respondents at Baseline and Endline

The knowledge of nutrition of the respondents is shown in Table 4. Majority (75.7%) of the respondents reported they have not received any form of nutrition education. Many of them (67.5%) reported that yam contains carbohydrate and a greater proportion (71.4%) reported that the function of carbohydrate is for provision of energy. The majority (77.1%) of the respondents reported that soft drinks contain sugar while less than two-third (35.1%) reported that vegetables are rich in fibre. Less than half (45.6%) of the respondents reported that fruits are lowest in fat, similarly, less than half (41.3%) also reported that meat is rich in protein. About 46.9% of the

respondents reported that fruits are rich in vitamins, while more than half (52.9%) reported that it is good to eat fruits/ vegetables daily. A high proportion of the respondents (91.0%) reported that it is good to take water; also, many (84.6%) agreed that eating an adequate diet contributes to good health. Many (74.9%) of the respondents were aware that an adequate diet is a diet that is rich in different food groups; similarly, the majority (72.8%) also indicated that it is not good to be fat.

Table 4: Nutrition Knowledge of the Respondents

Variable	Baseline Intervention 360 (%)	Control n=360 (%)	Total n=720 (%)	Endline Intervention=354 (%)	Control n=345 (%)	Total n=699 (%)
Ever had Nutrition education	83(23.1)	92(25.6)	175(24.3)	336(94.9)	91(26.4)	427(61.1)
Foods that contain Carbohydrates	246(68.3)	240(66.7)	486(67.5)	305(86.2)	222(64.3)	527(75.4)
Functions of carbohydrate	264(73.3)	250(69.4)	514(71.4)	296(83.6)	239(69.3)	535(76.5)
Soft drinks contains sugar	278(77.2)	277(76.9)	555(77.1)	308(87.0)	264(76.5)	572(81.8)
Food rich in fiber	128(35.6)	125(34.7)	253(35.1)	270(76.3)	126(36.5)	396(56.7)
Food is lowest in fat	161(44.7)	167(46.4)	328(45.6)	272(76.8)	161(46.7)	433(61.9)
Food rich in protein	158(43.9)	164(45.6)	297(41.3)	244(68.9)	160(46.4)	404(57.8)
Functions of protein	158(43.9)	164(45.6)	322(44.7)	259(73.2)	167(48.4)	426(60.9)
Food substance which contains more energy	158(43.9)	180(50.0)	322(44.7)	240(67.8)	174(50.4)	414(59.2)
Food rich in vitamins	183(50.8)	198(55.0)	338(46.9)	259(73.2)	191(55.4)	450(64.4)
Is it necessary to eat fruit/ vegetable daily	299(83.1)	304(84.4)	381(52.9)	299(84.5)	295(85.5)	594(85.0)
Importance of drinking water	327(90.8)	328(91.1)	655(91.0)	323(91.2)	312(90.4)	635(90.8)
Eating adequate food contribute to good health	311(86.4)	298(82.8)	609(84.6)	315(89.0)	252(73.0)	599(85.7)
Contribution of an adequate diet	283(78.6)	256(71.1)	539(74.9)	297(83.9)	252(73.0)	549(78.5)
Implications of being fat	276(76.7)	248(68.9)	524(72.8)	302(85.3)	241(69.9)	543(77.7)

Level of Nutrition Knowledge of the Respondents

After the data analysis in Table 5, at baseline, about 41.7% and 43.3% had poor nutrition knowledge, 37.5% and 34.7 % had fair nutrition knowledge, while 20.8% and 21.9% had good nutrition knowledge in the treatment and control groups, respectively. However, at endline, 10.5% and 42.9% had poor nutrition knowledge, 37.3% and 33.6% had fair nutrition knowledge, and 52.3% and 23.5% had good nutrition knowledge in treatment and control groups, respectively. The mean nutrition knowledge at baseline was 8.9 ± 3.1 and 8.9 ± 3.1 in the intervention and control groups, respectively. The mean nutritional knowledge score increased significantly in the treatment group to 11.3 ± 2.1, while the control group remained almost static at 9.0 ± 3.1. Statistical analysis using a paired t-test confirmed the effectiveness of the intervention. The intervention group experienced a statistically significant improvement in nutritional knowledge between baseline and end line ($t = 14.69$, $p < 0.05$), while the control group showed no significant change ($t = 0.80$, $p > 0.05$).

Table 5: Level of Nutrition Knowledge of the Respondents

	Baseline	Endline		
Treatment n=360 (%)	Frequency (%)	Frequency (%)	t	p-value
Level of Nutrition Knowledge				
Poor	150 (41.7)	37(10.5)	14.69	0.000
Fair	135(37.5)	132(37.3)		
Good	75(20.8)	185(52.3)		
	360 (100.0)	354 (100.0)		
Mean/SD	8.9±3.1	11.3±2.1		
Control n=360 (%)				
Poor	156(43.3)	148(42.9)	0.80	0.438
Fair	125(34.7)	116(33.6)		
Good	79 (21.9)	81(23.5)		
Total	360 (100.0)	354 (100.0)		
Mean/SD	8.9±3.1	9.0±3.1		

DISCUSSIONS

In the present study, the mean age of the participants was 59.3 (±6.3). This study agrees with the mean age of 59.4 (±13.1) and 59.5 (±12.4) reported in Ilorin, Nigeria (31) and the United States of America (32). The result is in contrast with the study of (33; 34; 35) who reported lower mean ages of 51.46 ± 1.44 years, 50 ± 6 years, 53.1 ± 13.6 years, and 55.7±13.32 years, 56.08 ± 6.1 years, respectively. The higher mean age of hypertensive adults observed in this study could be attributed to the narrowing of the arteries, which reduces blood flow and increases blood pressure as people get older. Participants in this study were more females (59.7%) than males (40.3%). This is similar to the report by (36), who reported a female population of 55.2% and 56.3% respectively. The reason for more females in this study could be that they are housewives, farmers, or petty traders who are not involved in white collar jobs or serious businesses.

The result showed a significant ($p<0.05$) increase in nutrition knowledge in the intervention group after the nutrition education intervention. This agrees with the findings of (37, 38, and 39), who observed a significant increase in the level of nutritional knowledge after nutrition education intervention. However, the control group showed no significant difference ($p>0.05$) between the baseline and endline nutrition knowledge of the respondents. The greater improvements observed in the intervention group compared to the control group can reasonably be attributed to the nutrition education intervention they received. This program provided participants with relevant dietary knowledge, such as the role of fruits and vegetables, reduced salt intake and processed foods, in addition to understanding food labels, which could influence their food choices and dietary patterns.

The result showed an increase in the mean dietary diversity score of the intervention group at the endline which was statistically significant ($p<0.05$). Individuals with higher levels of nutrition knowledge were observed to consume diverse diets. This study agrees with the study in Brazil (41), in Ghana (42), and Nigeria (43; 44; 45; 46), which reported that higher nutrition knowledge is associated with the consumption of a diverse diet. The result showed a significant positive relationship between dietary diversity and nutrition knowledge ($p<0.05$) in the intervention group at endline. This agrees with the study of (47, 48, and 49). However, the result is in contrast with the findings of (50), who observed no significant relationship between improved nutrition knowledge and consumption of diverse diets.

The stronger correlation between dietary diversity and nutrition knowledge observed in the intervention group implies that targeted nutrition education interventions, designed to improve nutritional knowledge, can enhance the ability of individuals to make informed dietary choices, leading to a more varied and balanced diet (44). A higher dietary diversity score is associated with lower measurements of blood pressure and other chronic diseases (51). A diverse diet contains foods from various food groups, which helps in

achieving both macronutrients and micronutrients. These findings advocate for continuous investment in nutrition education as a means of addressing dietary inadequacies and promoting better health outcomes, particularly in settings where dietary diversity is a challenge. For policymakers and program implementers, this finding emphasizes the importance of incorporating nutrition education components into nutrition-related interventions.

CONCLUSIONS

In conclusion, this study confirmed that nutrition education improved the nutrition knowledge and the dietary diversity of the participants in the intervention group, showing that nutrition education had a positive impact on nutrition knowledge and diet diversity. Nutrition education should be given to adults periodically in the community. This will help parents to eat right and give their children the right kind of food. Nutrient-dense foods such as fruits and vegetables should be encouraged, while calorie-dense foods such as unhealthy snacks, sugary beverages, and fried foods should be discouraged.

REFERENCES

1. Centers for Disease Control and Prevention. (2017). *Hypertension treatment and control: Evidence-based education and self-management support for hypertension and other chronic diseases*. https://www.cdc.gov/pcd/issues/2020/19_0058.htm.
2. Adeloye, D., Owolabi, E. O., Ojji, D. B., Auta, A., Dewan, M. T., Olanrewaju, T. O., Ogah, O. S., Omoyele, C., Ezeigwe, N., Mpazanje, R. G., Gadanya, M. A., Agogo, E., Alemu, W., Adebiyi, A. O., & Harhay, M. O. (2021). Prevalence, awareness, treatment, and control of hypertension in Nigeria in 1995 and 2020: A systematic analysis of current evidence. *Journal of clinical hypertension (Greenwich, Conn.)*, *23*(5), 963–977. https://doi.org/10.1111/jch.14220.
3. Odili, A. N., Chori, B. S., Danladi, B., Nwakile, P. C., Okoye, I. C., Abdullahi, U., Nwegbu, M. N., Zawaya, K., Essien, I., Sada, K., Ogedengbe, J. O., Aje, A., & Isiguzo, G. C. (2020). Prevalence, awareness, treatment and control of hypertension in Nigeria: Data from a nationwide survey 2017. *Global Heart, 15*(1), 47. https://doi.org/10.5334/gh.848.
4. Diarz, E. J., Leyaro, B. J., Kivuyo, S. L., Ngowi, B. J., Msuya, S. E., Mfinanga, S. G., Bonfoh, B., & Mahande, M. J. (2020). Red meat consumption and its association with hypertension and hyperlipidaemia among adult Maasai pastoralists of Ngorongoro Conservation Area, Tanzania. *PLOS ONE, 15*(6), e0233777. https://doi.org/10.1371/journal.pone.0233777.
5. Akpa, O. M., Okekunle, A. P., Asowata, O. J., Chikowore, T., Mohamed, S. F., Sarfo, F., Akinyemi, R., Akpalu, A., Wahab, K., Obiako, R., Komolafe, M., Owolabi, L., Osaigbovo, G. O., Ogbole, G., Tiwari, H. K., Akinyemi, J., Fakunle, A., Uvere, E., Adeoye, A. M., Lackland, D., & Owolabi, M. (2022). Frequent vegetable consumption is inversely associated with hypertension among indigenous Africans. *European Journal of Preventive Cardiology, 29*(18), 2359–2371. https://doi.org/10.1093/eurjpc/zwac129.
6. Dolui, M., Sarkar, S., Ghosh, P., & Hossain, M. (2023). Dietary diversity and association with non-communicable diseases (NCDs) among adult men (15–54 years): A cross-sectional study using National Family and Health Survey, India. *PLOS Global Public Health, 3*(4), e0001775. https://doi.org/10.1371/journal.pgph.0001775.
7. World Health Organization. (2016). *Hypertension*. https://www.who.int/news-room/fact-sheets/detail/hypertension.
8. American Heart Association. (2021). *Blood pressure guidelines*. https://www.heart.org/en/health-topics/high-blood-pressure.
9. Williams, B., Mancia, G., Spiering, W., Agabiti Rosei, E., Azizi, M., Burnier, M., Clement, D., Coca, A., De Simone, G., Dominiczak, A., Kahan, T., Mahfoud, F., Redon, J., Ruilope, L., Zanchetti, A., Kerins, M., Kjeldsen, S., Kreutz, R., Laurent, S., Desormais, I. (2018). Practice guidelines for the management of arterial hypertension of the European Society of Cardiology and the European Society of Hypertension. *Blood Pressure, 27*(6), 314–340. https://doi.org/10.1080/08037051.2018.1527177.
10. Forouzanfar, M. H., Liu, P., Roth, G. A., Ng, M., Biryukov, S., Marczak, L., Alexander, L., Estep, K., Hassen Abate, K., Akinyemiju, T. F., Ali, R., Alvis-Guzman, N., Azzopardi, P., Banerjee, A., Bärnighausen, T., Basu, A.,

Bekele, T., Bennett, D. A., Biadgilign, S., Catalá-López, F., & Murray, C. J. (2017). Global burden of hypertension and systolic blood pressure of at least 110 to 115 mm Hg, 1990–2015. *JAMA, 317*(2), 165–182. https://doi.org/10.1001/jama.2016.19043.

11. Raji, R. Y., Taiwo, A., & Oye, G. (2017). Awareness of hypertension and its impact on blood pressure control among elderly Nigerians: Report from the Ibadan study of aging. *Pan African Medical Journal, 27*, 190. https://doi.org/10.11604/pamj.2017.27.190.10598.
12. Mukherjee, A., Paul, S., Saha, I., Som, T., & Ghose, G. (2018). Dietary diversity and its determinants: A community-based study among adult population of Durgapur, West Bengal. *Medical Journal of Dr. D.Y. Patil Vidyapeeth, 11*, 296–301. https://doi.org/10.4103/MJDRDYPU.MJDRDYPU_13_17.
13. Batal, M., Steinhouse, L., & Delisle, H. (2018). The nutrition transition and the double burden of malnutrition. *Médecine et Santé Tropicales, 28*(4), 345–350. https://doi.org/10.1684/mst.2018.0843.
14. Verger, E. O., Le Port, A., Borderon, A., Bourbon, G., Moursi, M., Savy, M., Mariotti, F., & Martin-Prével, Y. (2021). Dietary diversity indicators and their associations with dietary adequacy and health outcomes: A systematic scoping review. *Advances in Nutrition, 12*(5), 1659–1672. https://doi.org/10.1093/advances/nmab008
15. Blakstad, M. M., Mosha, D., Bellows, A. L., Canavan, C. R., Chen, J. T., Mlalama, K., Noor, R. A., Kinabo, J., Masanja, H., & Fawzi, W. W. (2021). Home gardening improves dietary diversity: A cluster-randomized controlled trial among Tanzanian women. *Maternal & Child Nutrition, 17*(2), e13096. https://doi.org/10.1111/mcn.13096.
16. USDA Food and Nutrition Service. (2020). *Nutrition education*. https://www.fns.usda.gov/nutrition-education.
17. Lubeka, C., Kimiywe, J., & Nyambaka, H. (2020). Impact of school garden on dietary diversity and micronutrient level of pre-school children in Makueni County, Kenya. *Research Journal of Food Science and Nutrition, 5*, 750–759. https://doi.org/10.31248/RJFSN2020.096.
18. Faiz, A., Raza, Q., Nawaz, S., & Atmadja, T. F. A. (2024). Effectiveness of nutrition education on weight loss and body metrics among obese adults: An interventional study. *BIO Web of Conferences, 153*, 02026. https://doi.org/10.1051/bioconf/202415302026.
19. Mohammed, S., Alghanim, A., Aljbr, A., Alhamadah, A., Alanazi, S., Alotaibi, F., Faleh, A., Alsahari, A., Alresheedi, S., Swed, E., Albeshri, N., & Sharahili, A. (2022). Impact of nutrition education programs on chronic disease prevention: A collaborative study integrating nursing, epidemiology, family medicine, and nutrition perspectives. *Journal of Population Therapeutics and Clinical Pharmacology, 29*(4), 1442–1450. https://doi.org/10.47750/jptcp.2022.885.
20. Tektunalı Akman, C., Gönen Aydın, C., & Ersoy, G. (2024). The effect of nutrition education sessions on energy availability, body composition, eating attitude and sports nutrition knowledge in young female endurance athletes. *Frontiers in Public Health, 12*, 1289448. https://doi.org/10.3389/fpubh.2024.1289448.
21. Burkhart, S., Beckford, C., Mathews, E., Daba, A. K., & Milton, A. H. (2024). Nutrition and sustainable development goal quality education. *Frontiers in Nutrition, 11*, 1447032. https://doi.org/10.3389/fnut.2024.1447032.
22. Rosales, A., Young, S., Mendez, T., Shelden, K., & Holdaway, M. (2023). Collaborative strategies to improve nutrition security and education: Lessons learned during a pandemic. *The Journal of School Health, 93*(2), 148–152. https://doi.org/10.1111/josh.13222.
23. World Health Organization. (2022). *Global Health Observatory: Prevalence of hypertension among adults aged 30–79 years*. https://www.who.int/data/gho/data/indicators/indicator-details/GHO/prevalence-of-hypertension-among-adults-aged-30-79-years.
24. Lee, H. M., Kim, S. K., & Park, J. W. (2020). The role of dietary interventions in managing hypertension: A systematic review and meta-analysis. *Journal of Hypertension, 38*(3), 432–442. https://doi.org/10.1097/HJH.0000000000002347.
25. Onaibre, T. (2025). Development of diets for management of overweight among undergraduates in Delta State. *International*

Journal of Agriculture and Food Science, 1(1), 1–22.
26. Abu, H., Aboumatar, H., Carson, K. A., Goldberg, R., & Cooper, L. A. (2018). Hypertension knowledge, heart-healthy lifestyle practices and medication adherence among adults with hypertension. *European Journal for Person-Centered Healthcare, 6*(1), 108–114. https://doi.org/10.5750/ejpch.v6i1.1377.
27. Darrat, M., Houlihan, A., Gibson, I., Rabbitt, M., Flaherty, G., & Sharif, F. (2018). Outcomes from a community-based hypertension educational programme: The West of Ireland hypertension study. *Irish Journal of Medical Sciences, 187*(3), 675–682. https://doi.org/10.1007/s11845-017-1716-z.
28. Ajayi, I., Soyannwo, M., Asinobi, A., Afolabi, N., Ayede, A., & Bamgboye, E. (2017). Blood pressure pattern and hypertension-related risk factors in an urban community in southwest Nigeria: The Mokola Hypertension Initiative Project, Ibadan, Nigeria. *Journal of Public Health and Epidemiology, 9*(3), 51–64. https://doi.org/10.5897/JPHE2016.0860.
29. FAO. (2021). *Minimum Dietary Diversity for Women (MDD-W)*. https://openknowledge.fao.org/server/api/core/bitstreams/3da8a8c8-55d4-429b-9455-163713117cfe/content.
30. Ogunkoya, O. E., & Besidonne, C. E. (2019). A review of the DASH plan in Nigeria. *Journal of Public Health Catalog, 2*(2), 156–160.
31. Jamiu, M. O., Maiha, B. B., Danjuma, N. M., & Abdulganiyu, G. (2024). Educational intervention on knowledge of hypertension and lifestyle/dietary modification among hypertensive patients attending a tertiary health facility in Nigeria. *Mediterranean Journal of Pharmacy and Pharmaceutical Sciences, 4*(1), 1–11.
32. Abu, H., Aboumatar, H., Carson, K. A., Goldberg, R., & Cooper, L. A. (2018). Hypertension knowledge, heart-healthy lifestyle practices and medication adherence among adults with hypertension. *European Journal for Person-Centered Healthcare, 6*(1), 108–114. https://doi.org/10.5750/ejpch.v6i1.1377.
33. Mehrabian, F., Farmanbar, R., Mahdavi-Roshan, M., Omidi, S., & Aghebati, R. (2018). The effect of nutrition education based on DASH diet on blood pressure and dietary adherence among patients with hypertension. *Caspian Journal of Health Research, 3*(2), 48–52. http://cjhr.gums.ac.ir/article-1-73-en.html
34. Kataria, N., Kalyani, V. C., Gulia, S., & Kaleeswari, G. (2023). Knowledge regarding hypertension and amount of diet consumption among adults from Uttarakhand: A comparative survey. *Cureus, 15*(5), e39065. https://doi.org/10.7759/cureus.39065.
35. Adeke, A. S., Chori, B. S., Neupane, D., Sharman, J. E., & Odili, A. N. (2022). Socio-demographic and lifestyle factors associated with hypertension in Nigeria: Results from a countrywide survey. *Journal of Human Hypertension, 38*, 365–370. https://doi.org/10.1038/s41371-022-00668-w.
36. Mohebbi, B., Tafaghodi, B., Sadeghi, R., Tol, A., & Yekanenejad, M. S. (2021). Factors predicting nutritional knowledge, illness perceptions, and dietary adherence among hypertensive middle-aged women: Application of trans theoretical model. *Journal of Education and Health Promotion, 10*, 212. https://doi.org/10.4103/jehp.jehp_667_20.
37. Yuliyana, T., Kusnandar, K., & Hanim, D. (2018). Associations between nutrition knowledge, vitamin C intake, nutritional status, and blood pressure among elderly with hypertension in Klaten, Central Java, Indonesia. *International Journal of Integrated Health Sciences*, 6, 22–29. https://doi.org/10.15850/ijihs.v6n1.1114.
38. Akujobi, I., & Agbaghara, O. (2018). Nutrition knowledge and nutrition status of elderly hypertensive patients in Ehime Mbano Local Government Area Imo State. *Journal of Dietitians Association of Nigeria*, *9*, 1–10. https://doi.org/10.4314/jdan.v9i.
39. Anyanti, J., Akuiyibo, S. M., Fajemisin, O., Idogho, O., & Amoo, B. (2021). Assessment of the level of knowledge, awareness and management of hypertension and diabetes among adults in Imo and Kaduna states, Nigeria: A cross-sectional study. *BMJ Open, 11*(3), e043951. https://doi.org/10.1136/bmjopen-2020-043951.
40. Larasati, C. D., & Yulian, V. (2024). The effect of nutrition education based on DASH diet on dietary knowledge among patients with hypertension. *Malahayati International Journal of Nursing and Health Science*, 7(4), 514–518. https://doi.org/10.33024/minh.v7i4.277.

41. Corona, L. P., Silva, G. M., & Freiria, C. N. (2024). Factors associated with dietary diversity in community-dwelling Brazilian older adults. *Foods, 13*(21), 3449. https://doi.org/10.3390/foods13213449.
42. Apprey, C., Mensah, M., Agyarko, D., Klu, Y. A. K., & Acquah, S. (2023). The influence of nutrition knowledge, attitude, practices, and dietary diversity on obesity among market women in the Cape Coast Metropolis, Ghana: A cross-sectional study. *Health Science Reports, 6*(12), e1742. https://doi.org/10.1002/hsr2.1742.
43. Muhammad-Lawal, M. (2017). Assessment of dietary diversity and food calorie consumption among rural households in Kwara State, Nigeria. *Applied Tropical Agriculture, 22*(1), 134–141.
44. Akinmoladun, O. F., Oluyede, O. J., Femi, F. A., Olaitan, O. O., & Nesamvuni, C. N. (2021). Association between nutrition knowledge, lifestyle, dietary practices, and nutritional status among civil servants in western Nigeria. *African Journal of Food, Agriculture, Nutrition and Development, 21*(10), 18824–18838. https://doi.org/10.18697/ajfand.100.20970 .
45. Okondu, O., Maitanmi, J., Akinola, M., Akingbade, O., Abubakar, K., Faleti, D., Chigeru, C., Oladimeji, T., Alao, E., Umahi, E., & Maitanmi, B. (2022). Dietary Knowledge and Practices among Non-Medical Staff at Babcock University in Ogun State, Nigeria. *Babcock University Medical Journal*, *4*(2), 112–119. https://www.ajol.info/index.php/bumj/article/view/223801.
46. Latifat, Y. O., & Sanni, S. A. (2023). Nutritional knowledge, diet diversity and physical activity of selected secondary school students in Sagamu Local Government Area of Ogun State. *Journal of Nutrition and Food Sciences*, 13, 894. https://doi.org/10.35248/2155-9600.23.13.894.
47. Shuremu, M., Abate, K. H., & Belachew, T. (2023). Effect of nutrition education intervention to improve dietary diversity practice and nutritional status of the older people: A cluster randomized controlled trial. *Food Science & Nutrition, 11*(11), 7383–7395. https://doi.org/10.1002/fsn3.3667.
48. Yetkin, B., & Başer, A. (2025). Enhancing knowledge and attitudes through the 'healthy nutrition' education program: A Solomon four-group experimental study with older adults at a social life campus. *BMC Geriatrics, 25*, 436. https://doi.org/10.1186/s12877-025-05861-5.
49. Ezenwosu, I. L., & Ezenwosu, O. U. (2023). Effect of nutrition education on dietary diversity among HIV patients in Southeast Nigeria. *African Health Sciences, 23*(1), 170–177. https://doi.org/10.4314/ahs.v23i1.19.
50. Davidson, K. A., Kropp, J. D., & Rahman, M. W. (2025). Effectiveness of participatory trainings in improving nutrition knowledge and dietary diversity in rural Bangladesh. *Agriculture & Food Security, 14*(1), 1-10. https://doi.org/10.1186/s40066-024-00517-w.
51. Yang, G. (2022). Effect of nutrition education on dietary diversity. *Journal of Nutritional Disorders & Therapy, 12*, 179. https://doi.org/10.4172/2161-0509.1000179.