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Nutritional Status and Non-communicable Diseases in Older Ghanaians

Charles Apprey*, Gabriel L.S. Kalog, Odeafo Asamoah-Boakye and Reginald A. Annan

Department of Biochemistry and Biotechnology, Faculty of Biosciences, College of Science, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana

***Corresponding author:**
Charles Apprey

appreycharles@gmail.com

Department of Biochemistry and Biotechnology, College of Science, Kwame Nkrumah University of Science and Technology, Private Mail Bag, University Post Office, Kumasi, Ghana.

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Abstract

Understanding the dietary habits of the elderly population is essential to the evaluation of their nutritional status and health. This study assessed the dietary patterns and association with NCDs of older adults in the Sunyani Municipality of Ghana. A cross-sectional study was conducted among 375 older people aged 60 years and above in the Municipality. Dietary patterns were drawn using 25 food items identified through food frequency questionnaire. The weight, height and blood pressure were measured and BMI calculated. Serum vitamin C and E were also determined for each respondent. The prevalence of overweight, obesity and high blood pressure among the older adults was 30.9%, 11.2% and 75.2% respectively. High blood pressure was significantly higher among participants with NCDs (83.7%) compared to those without NCDs (72.2%) (p=0.044). Additionally, being female older adult increases the risk of developing NCDs by 1.8 times (OR: 1.7; 95% CI: 1.1-2.7, p=0.006). Majority of the participants had low serum vitamin C (86.1%) and E (81.3%). Four different dietary patterns were identified, which were mainly from food groups; carbohydrate, protein, fruit and vegetable but no legumes, diary food and nuts and seeds. Older adults with no formal education were less likely to consume vegetables (pattern 2) (OR: 0.3; 95% CI: 0.1-0.8, p=0.015) than those with formal education. Additionally, obese older adults were less likely to consume vegetables (OR: 0.3; 95% CI: 0.1-0.7, p=0.009) and fish (pattern 3) (OR: 2.6; 95% CI: 1.0-6.9, p=0.049) than normal adult. Obesity, high blood pressure was found among the older adults. Older adults had poor serum antioxidant vitamins. Although, dietary pattern of older adults in this study contained carbohydrate, protein, fruit and vegetable, it did not impact their serum antioxidant vitamins. There is the need for nutrition policies and education programmes to assist older people improve upon their nutrition, through consumption of varied foods from all the six food groups.

Keywords: Dietary pattern; Older adults; Serum antioxidant vitamins; Non communicable diseases

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Introduction

Non-communicable diseases (NCDs) including diabetes, cancer and heart disease are increasing in both developed and developing countries. An estimated 36 to 38 million deaths from NCDs occur annually, and Low- and Middle-Income Countries (LMICs) are the most affected by these deaths [1]. The global elderly population is expanding dramatically [2]. Current estimates of 11.7% in 2013 is expected to rise to 21.1% by 2050, when almost 8 out of every 10 older adults will live in less developed regions [2]. The estimated older adults (≥ 60 years) population in Ghana was 5.3% in 2015 and projected to increase to 9.7% by 2050 [3]. Recent studies among older adults in Ghana reported significant levels of chronic conditions, comorbidities, poor utilization of health services [4], which contribute to physical decline and disability in older adults [5,6]. The cost of management of non-communicable diseases, measured by years of life lost, on older people in LMICs is huge as compared to those in high-income countries [7].

Eating unhealthy diets, physical inactivity, excessive alcohol intake and tobacco use among other lifestyles, are modifiable risk factors for non-communicable diseases [8,9]. The nutritional requirement of people aged 60 years and above is not well defined and efforts to provide this age group with adequate nutrition may be faced with challenges. There is decline in lean body mass and basal metabolic rate, as a result, there could be a reduction in energy requirement per kilogram body weight [10]. As a higher risk group for nutrition and health problems, the diet of older people is of interest to those making policy, planning programs and delivering services [11].

Understanding the dietary habits of an individual of any age group is essential to the evaluation of their nutritional status [12]. Studies are therefore, carried out to identify dietary patterns and their possible correlation with health status [12]. In Brazil, a study by Ferreira, Papini [13] involving 355 older adults showed that dietary pattern consisted of snacks, fruits, soft diet and

traditional foods. Dietary pattern is directly related to nutritional status and consequently may result in the occurrence of non-communicable disease, which tend to increase with advancing age [12]. Studies that shows dietary pattern of the older adults are scarce in international literature [14-16]. There is also no literature currently available on patterns of dietary intake in older Ghanaians and how that impact be related with NCDs. Thus, the study aimed at assessing dietary pattern, and associated factors among older Ghanaian adults.

Materials and Methods

Study design and participants

A cross sectional study design was adopted. The study population were older adults aged 60 years and above, who resided in the Sunyani municipality of Ghana. According to the 2010 population and housing census, the population of older people aged 60 years and above in the Sunyani Municipality was 5972 [3]. The study participants were classified into those diagnosed of non-communicable diseases (NCDs) such as diabetes, hypertension and heart conditions, and those without NCDs.

Sample size

Sample size was determined using the [17], formula, $n = \frac{N}{1+N(\alpha^2)}$

Where; n = sample size,

N = total population of older people in the study area according to PHC, 2010 (5972), 'α' is the margin of error at 95% confidence level (0.05).

n= 374.89

n ≃ 375

Data sampling

A two staged sampling procedure (i.e. stratified and simple random sampling) was used. The eight districts in the Municipality were stratified into sampling groups. From each sampling group, a simple random sampling was adopted to select participants from households. A fifth consecutive household along the street was selected after preceding household, in that order. The study protocols were first explained to participants and written consent forms were given before recruitment.

Eligibility

Inclusion and exclusion criteria: All older adults aged 60 years and above and could stand without support were included. All other population groups outside this definition (i.e. could not stand alone, seriously ill, less than age range) were excluded.

Ethics

Ethical approval was obtained from the Committee on Human Research Publication and Ethics at the School of Medical Sciences, KNUST (CHRPE/AP/482/16). In addition, approval letter was obtained from the Brong Ahafo Regional Health Directorate and the Sunyani Municipal Health Directorate before the study was conducted. All participants signed an informed consent form, in accordance with CHRPE regulation, before conducting the study.

Data collection

A questionnaire was used to collect socio-demographic information such as age, gender, dietary habit and health status of participants. The presence and absence of NCD was determined based on the diagnosis by health care profession three months to the study. A standardized food frequency questionnaire adopted from the Harvard Willet Food Frequency questionnaire Harvard [18] with slight modification to suit local context was used to collect dietary patterns of participants.

Anthropometric measurement: Participants height were measured with a portable stadiometer (SECA 213, India), according to standard WHO protocol (in centimetres). A weighing scale (model: DT602, India) was also used to measure the weight of participants, while they were in light clothing (without shoes/footwear), to the nearest 0.1 kg. Body mass index (BMI) was calculated as weight/height^2 (kg/m^2).

Blood pressure measurement: Blood pressure reading was taken by trained personnel using a digital Omron sphygmomanometer (Omron M2 Basic, Omron Healthcare Co. Ltd, Japan). Measurements were taken from the left upper arm after participants had relaxed for about 5-10 minutes. Different cuff sizes were used for different body sizes and placed to cover the left arm at the heart level. Systolic and diastolic blood pressure was taken three times, with at least 2 minutes interval, using a digital sphygmomanometer. The average of the three readings was used for the analysis.

Biochemical analysis of serum vitamin C and E: A 5 ml venous blood sample of each subject was taken by a qualified phlebotomist. Determination of vitamin C in serum sample was done using Sandwich-ELISA method (Human NEXN ELISA kit, Wuhan Fine Biotech Co. Ltd, China). The chemicals used were coated 96- well plates, negative and positive controls provided in test kit, ELISA conjugates, distilled water as wash concentrate and stop solution. In this method, a pre-coated micro-ELISA strip plate with antibody specific to vitamin C standard was used. This was followed by an addition of a Horseradish Peroxidase (HRP)-conjugated antibody, precisely for vitamin C, to micro-ELISA strip plate well and incubated. Free constituents were washed away and the tetra methylbenzidine (TMB) substrate solution was added to each well. Wells which contained vitamin C and the HRP conjugate for vitamin C antibody changed to blue colour in appearance and turned yellow after the stop solution was added. This was followed by measurement of the optical density spectrophotometrically at 450 nm wavelength. The value of the optical density is proportional to the vitamin C concentration. Thus, the concentration of vitamin C was determined by comparing the optical density of samples to a standard curve. Similar protocol was used for the determination of vitamin E concentration in the sample.

Data analysis

Data was analyzed using Statistical Package for Social Sciences version 25 (SPSS Inc Chicago, IL). All categorical variables including; dietary habit, sociodemographic data, BMI status, blood pressure level, serum vitamin C and E status was presented as absolute and relative frequencies. Chi-square cross tabulation was performed to find differences in relative frequencies of study variables. Partial correlation analyses; controlling for age, gender and disease classification was performed on dietary pattern, BMI status, serum vitamin C and E status. Univariate regression analysis was performed to determine association between study variables and dietary patterns. Dietary patterns were generated using principal component analysis (PCA) of the 24 food groups. The number of patterns which best characterised the food intake of the population were selected based on the screen plot as well as the interpretability of the factor loadings for the components (patterns) resulting from the PCA technique. The factor loading is the coefficient that explains the correlation of each food item with a particular pattern. The larger it is, the greater the contribution of that food item with a particular pattern. In the PCA, values below ± 0.3 were considered weak association within the components and were omitted where as those greater than or equal to ± 0.3 were considered strong association. The suitability of the data for factor component analysis was assessed before performing principal component analysis. Labels were given to each component to describe the underlying dietary pattern as much as possible in order for reporting and discussion of the results [19]. All tests were 2-tailed, and p-values <0.05 were considered as statistical significance differences.

Results

Sociodemographic characteristics of participants

A total of 375 participants participated in this study, in which, 66.1% were female and 33.9%, male. The average age of respondents was 69.8 years. Majority (53.9%) of the participants were within 60-69 years of age. Majority (54.4%) of the participants did not have any formal education. A good proportion (34.7%) of the participants had basic education. Majority of the participants (74.4%) were not diagnosed of any NCDs while 25.6% had any of the NCDs including diabetes (15.7%), hypertension (73.9%) and heart conditions (10.4%) (**Table 1**).

Table 2 presents association between sociodemographic, blood pressure level and nutrition status by disease classification. Being female increased the risk of developing NCDs by 1.8 times (OR: 1.7; 95% CI: 1.1-2.7, P= 0.006). The prevalence of overweight and obesity was 30.9% and 11.2% respectively among older adults. Participants with NCDs significantly were more overweight (46.9%) and obese (13.3%) than those without NCDs (overweight: 25.3% Obese: 10.5%, p<0.001). The prevalence of high blood pressure was 75.2%. High blood pressure was significantly higher among NCDs participants (83.7%) compared to those without NCDs (72.2%) (P= 0.044). Majority of the participants had low serum vitamin C (86.1%) and E (81.3%). Serum vitamin C and E, and age group were not significantly associated with disease classification (**Table 2**).

Table 1: Socio-demographic characteristics of Participants.

Variable	Frequency (n=375)	Percentage (%)
Gender		
Female	248	66.1
Male	127	33.9
Age Group		
60-69	202	34.4
70-79	115	19.5
80 and above	58	15.5
Mean age	69.8	
Level of Education		
None	204	53.9
Basic	130	30.6
Secondary	21	5.6
Tertiary	15	4
Other (vocational, technical and non-formal education)	5	1.3
Medical Health status		
With NCDs	96	25.6
Without NCDs	279	74.4
NCDs Diagnosis (N= 96)		
Diabetes	15	15.7
Hypertension	71	73.9
Heart conditions	10	10.4

Dietary habits and patterns of participants

Table 3 presents usual dietary habits of meals consumed daily. For breakfast, majority of participants (52.8%) consumed millet/corn porridge with koose or bread while less than 1% (0.8%) consumed oat porridge and bread. The most consumed lunch meal by participants (27.7%) was cocoyam or plantain ampesi with stew. Most participants (67.2%) ate Fufu with kontomire soup and meat or fish for supper while, 44.3% of the participants consumed fruits for snacks (**Table 3**).

Dietary pattern of food groups consumed by participants is shown in **Table 4**. Four patterns were generated from scree plot after principal component analysis of food frequency data. The principal component analysis revealed four different components with variation in scree plot distance; explained as percentage of variances: 13.3%, 7.8%, 6.6% and 5.4 %. Pattern 1 had the most consumed pattern, followed by pattern 3. Pattern 1 contains most varied foods including carbohydrates, fruits, and plant protein foods and beverage (milo) except animal protein while pattern 2 contains only vegetables, non-carbohydrate and non-fruits foods. Pattern 3 contains animal protein (fish), non-carbohydrate, non-fruit and non-coffee foods. Pattern 4 includes animal protein (meat), vegetables, beverage (coffee), and non-fruit foods (**Table 4**).

Table 2: Association between sociodemographic, blood pressure level and nutrition status by disease classification.

Variables	Total N (%)	With NCDs	Without NCDs	Chi-square	P-value	OR (95% CI)	
	N=375	N=98	N=277			With NCDs	Without NCDs
Gender				7.722	0.006		
Female		76 (77.6)	172 (62.1)			1.7 (1.1-2.7)	0.8 (0.7-0.9)
Male		22 (22.4)	105 (37.9)				
Age group (years)				1.532	0.465		
60-69		58 (59.2)	144 (52.0)				
70-79		27 (27.6)	88 (31.8)				
80 and above		13 (13.3)	45 (16.2)				
BMI (Kg/m^2)				20.164	<0.001		
Underweight	37 (9.9)	4 (4.1)	33 (11.9)				
Normal	180 (48.0)	35 (35.7)	145 (52.3)				
Overweight	116 (30.9)	46 (46.9)	70 (25.3)				
Obesity	42 (11.2)	11 (13.3)	29 (10.5)				
Blood pressure (BP) level (mmHg)				6.268	0.044		
Low BP	7 (1.9)	0 (0.0)	7 (2.5)				
Normal BP	86 (22.9)	16 (16.3)	70 (25.3)				
High BP	282 (75.2)	82 (83.7)	200 (72.2)				
Serum Vitamin C				0.020	0.866	0.9 (0.6-1.5)	1.0 (0.8-1.2)
Low level	323 (86.1)	84 (85.7)	239 (86.3)				
Normal level	52 (13.9)	14 (14.3)	38 (13.7)				
Serum Vitamin E				0.987	0.367	1.3 (0.8-2.0)	0.9 (0.8-1.0)
Low level	305 (81.3)	83 (84.7)	222 (80.1)				
Normal level	70 (18.7)	15 (15.3)	55 (19.9)				

P-value is significant at P<0.05.

Association between BMI, blood pressure, dietary pattern and nutrition status

Table 5 presents correlation between BMI, nutrition status, systolic and diastolic blood pressure, and dietary pattern. There was no significant association between the correlation variables except, consumption of dietary pattern 2 and BMI (r=-0.144, p=0.005), BMI and systolic blood pressure (r=0.121, P=0.019) and diastolic blood pressure (r=0.146, p=0.005) (**Table 5**).

Table 6 presents association between dietary patterns of older adults. Being female increased the risk of developing NCDs by 1.8 times (OR: 1.7; 95% CI: 1.1-2.7, p=0.006). 'Vegetables, non-carbohydrate and non-fruits-based foods' pattern (pattern 2) was significantly associated with older adults with no formal education (OR: 0.3; 95% CI: 0.1-0.8, p=0.015). Additionally, 'vegetables, non-carbohydrate and non-fruits-based foods' pattern (pattern 2) was significantly associated with obese older adults (OR: 0.3; 95% CI: 0.1-0.7, p= 0.009). 'Animal protein (fish), non-carbohydrate, non-fruit, and non-coffee foods' pattern (pattern 3) was significantly associated with obese older adults (OR: 2.6; 95% CI: 1.0-6.9, p= 0.049) (**Table 6**).

Discussion

In the present study, we assessed the dietary habit and pattern, blood pressure level and nutrition status of older adults in Sunyani Municipality of Ghana. A total of 375 participants participated in this study, in which, 66.1% were female and 33.9%, male. Majority of the participants (74.4%) were not diagnosed of any NCDs while 25.6% had any of the NCDs including diabetes (15.7%), hypertension (73.9%) and heart conditions (10.4%).

The findings indicated that majority of older adults had the recommended dietary habit of taking three square meals and a snack. Majority of the older adults consumed Ghanaian staple foods for breakfast to supper and fruit as snack. However, most of the older adults consumed high glycemic index food for breakfast and few consumed fibre-rich foods. Overall, dietary habit of older adults for this study was good, as it had portion from the starches, protein, cereals, fruit, some vegetables but did not contain legumes, dairy products, nuts and seeds. Their dietary habit contained no processed foods; high in sugar, sodium and fat but rather, were staple Ghanaian foods, which provide enough daily calories, some vitamins and minerals.

Four different dietary patterns were identified to be food consumption of the older adults in this study. Except pattern 1 which had varied food groups, the other three patterns had only one particular food group. Comparing to participants' dietary habits, the dietary patterns showed same trend of food groups they were likely to include in their diet and may be similar to the general population. These included carbohydrate, protein, fruits and vegetables and did not contain all food groups. Hence, the dietary pattern of the population might not be balance and lacked variation. A study by Ferreira, Previdelli [12] in Brazil identified three dietary patterns namely; traditional pattern,

Table 3: Usual dietary habits (Meals) consumed by participants.

Type of meal	Frequency (n=375)	Percentage (%)
Breakfast		
Banku with soup and fish or meat	76	20.3
Milo with bread or biscuit	7	1.9
Oats with bread	3	0.8
Millet/corn porridge with *Koose* or bread	198	52.8
Tea or coffee with bread	51	13.6
Tuo zaafi with ayoyo soup and fish or meat	11	2.9
Waakye with stew and fish or meat	29	7.7
Lunch		
Apapransa	21	5.6
Banku with soup and meat or fish	70	18.7
Cocoyam or plantain ampesi with stew	104	27.7
Fufu with kontomire soup and meat or fish	29	7.7
Kenkey with ground pepper or stew and fried fish/meat	61	16.3
Waakye with tomato stew and fried fish/meat	8	2.1
Plain rice with stew and fish/meat	48	12.8
Tuo zaafi with ayoyo soup and fish/meat	34	9.1
Supper		
Cocoyam or plantain ampesi with stew	17	4.5
Banku with soup and meat or fish	49	13.1
Fufu with kontomire soup and meat or fish	252	67.2
Kenkey with ground pepper or stew and fried fish/meat	5	1.3
Rice ball with soup and meat or fish	20	5.3
Tuo zaafi/kokonte with ayoyo/groundnut soup and fish/meat	32	8.5
Snacks		
Alcoholic beverages	7	1.9
Fruits	166	44.3
None	144	38.4
Others (cola nuts and dough nuts)	2	0.5
Roasted yam or plantain with groundnuts	8	2.1
Soft drinks and pastries	48	12.8
Total	375	100

"Pastas, pork and sweets" pattern" and "Coffee with milk and bread and butter".

The prevalence of overweight and obesity among older adults was 30.9% and 11.2% respectively. Also, 7 out of 10 older adults (75.2%) in this study had high blood pressure, which explains the fact that obesity and hypertension is increasingly becoming endemic among the aged population in Ghana, and so needs critical attention by stakeholders to reduce/prevent the menace. Overweight and obesity was found higher among older adults with NCDs (46.9%, 13.3%) compared to older adults without NCDs respectively (25.3%, 10.5%, p <0.01). Also, high blood pressure was significantly higher among NCDs participants (83.7%) compared to those without NCDs (72.2%) (p=0.044). This explains the fact that obesity and high blood pressure are major contributors in the development of non-communicable diseases such as diabetes, hypertension and heart diseases. A study by Biritwum, Mensah [4] found higher prevalence of overweight (53.2) among older adults, whereas, Blankson and Hall [20] found lower prevalence of overweight (15.3%). Additionally, findings revealed that being female older adult increases the risk of developing NCDs by 1.8 times (OR: 1.7; 95% CI: 1.1-2.7, p= 0.006).

Majority of the participants had low serum vitamin C (86.1%) and E (81.3%). Serum vitamin C and E, and age group were not significantly associated with disease classification. A study by Kimokoti and Hamer [21] reported that about 84% of elderly South African men had suboptimal plasma vitamin C concentrations. Deficiency of vitamin C was also found among about 73.9% older people above 60 years, in a 2-centre population-based study by [22]. In New Zealand, a study by Pearson et al. [23], which involved 400 healthy older adults found 62% had sub-optimal vitamin C level. Also, a cross-sectional study by Kim et al. [24] involving 230 elderly people aged 60-79 years in South Korea showed that 13.1% had low serum vitamin C. Poor serum vitamin C and E among vulnerable population may be worrying as these vitamins serve as antioxidant and immunonutrient which protects body against oxidative damage by free radicals, immune attack [22]

Table 4: Dietary patterns consumed by participants.

Dietary Pattern	Pattern 1	Pattern 2	Pattern 3	Pattern 4
% Variance	**13.3%**	**7.8%**	**6.6%**	**5.4%**
	Carbohydrate-based, fruits, milo beverage and plant protein	**Vegetables, non-carbohydrate and non-fruits-based foods**	**Animal protein (fish), non-carbohydrate, non-fruit, and non-coffee foods**	**Animal protein (meat), vegetables, coffee, non-fruits foods**
Starchy and tubers (Carbohydrate)				
Fufu	0.496			
Yam	0.449			
Banku	0.293			
Kenkey	0.341			
Tuo zaafi			-0.313	
Kokonte	0.394			
Plantain	0.38	-0.401		
Animal Protein				
Meat				0.453
Fish			0.628	
Fruits				
Banana	0.513		-0.324	
Avocado pear	0.35	-0.579		
Pawpaw	0.521			-0.379
Mango		-0.53		
Berries			0.392	
Orange	0.6			
Plant protein				
Bambara beans				
Groundnut	0.485			
Beans	0.51			
Beverage				
Milo	0.365			
Coffee			-0.366	0.422
Any vegetable				
Vegetables				
Onion			0.546	
Garlic				0.59
Vegetables		0.598		

and prevent chronic disease [24]. This means the participants are likely to be at risk of any oxidative damage by these free radicals due to poor serum antioxidants levels. The poor serum vitamin C and E among study participants could be due to insufficient consumption of foods rich in vitamin C and E. Also, there was non-significant association between the correlation variables except, consumption of dietary pattern 2 and BMI (r=-0.144, P=0.005), BMI and systolic blood pressure (r=0.121, p=0.019) and diastolic blood pressure (r= 0.146, p=0.005). The correlation was weak and if considered, can be interpreted that consumption of food in pattern 2 (vegetables) by participants which has high fibre may likely influence in BMI reduction. Also, increasing BMI of participants may likely influence higher diastolic and systolic blood pressure.

Findings from regression analyses showed that older adults with no formal education were less likely to consume vegetables in their diet (pattern 2: vegetables, non-carbohydrate and non-fruits-based foods) (OR: 0.3; 95% CI: 0.1-0.8, P=0.015). Additionally, obese older adults were less likely to consume vegetables (OR: 0.3; 95% CI: 0.1-0.7, P=0.009) and fish (pattern 3: Animal protein (fish), non-carbohydrate, non-fruit, and non-coffee foods' pattern) (OR: 2.6; 95% CI: 1.0-6.9, P=0.049) in their diet. Similar study by Ferreira, Previdelli (12) among elderly population in Brazil showed that the "Pastas, pork and sweets" pattern was associated with the male gender (β=0.38, p=0.025) and retired individuals (β=0.55, p=0.017); and the "Coffee with milk and bread and butter" pattern was associated with an age of 80 years or older (β=0.55, p=0.004) and elderly persons who had difficulty chewing (β=0.38, p=0.013).

Overall, obesity and high blood pressure was prevalent in study population, and dietary patterns lacked dietary variation. Participants also had poor serum vitamin C and E levels. Obese older adults were less likely to consume vegetables. There is the need for nutrition policies and education programmes to assist older people to improve upon their nutrition, through consumption of varied foods from all the six food groups.

Table 5: Correlation between study variables.

Variables		Serum vitamin C	Serum Vitamin E	BMI	SBP	DBP
Pattern 1	Correlation	-0.044	-0.076	0.054	-0.014	-0.025
	P-value	0.397	0.144	0.303	0.785	0.630
Pattern 2	Correlation, r	0.014	-0.09	-0.144	0	-0.051
	P-value	0.794	0.084	**0.005**	0.993	0.330
Pattern 3	Correlation	-0.033	0.031	0.055	-0.016	0.028
	P-value	0.520	0.545	0.290	0.762	0.586
Pattern 4	Correlation	-0.006	0.076	0.048	-0.019	-0.008
	P-value	0.908	0.145	0.352	0.71	0.885
Serum vitamin C	Correlation	1	0.275	0.072	-0.021	-0.012
	P-value	.	0	0.169	0.689	0.817
Serum Vitamin E	Correlation	0.275	1	0.028	0.001	0.012
	P-value	0	.	0.588	0.988	0.82
BMI	Correlation	0.072	0.028	1	0.121	0.146
	P-value	0.169	0.588	.	**0.019**	**0.005**
SBP	Correlation	-0.021	0.001	0.121	1	0.742
	P-value	0.689	0.988	0.019	.	0
DBP	Correlation	-0.012	0.012	0.146	0.742	1
	P-value	0.817	0.820	0.005	0	.

P-value is significant at P<0.05.

Table 6: Association between dietary pattern and study variables of older adults.

	Pattern 1			Pattern 2			Pattern 3			Pattern 4		
Variables	**β**	**OR (95% CI)**	**P-value**	**β**	**OR (95% CI)**	**P-value**	**β**	**OR (95% CI)**	**P-value**	**β**	**OR (95% CI)**	**P-value**
Gender												
Female		1.0										
Male	-0.136	0.8 (0.5-1.4)	0.574	-0.307	0.7 (0.4-1.2)	0.211	-0.076	0.9 (0.5-1.5)	0.758	-0.169	0.8 (0.5-1.3)	0.488
Education level												
Tertiary		1.0										
Basic	0.028	1.0 (0.4-2.6)	0.953	-0.855	0.4 (0.1-1.1)	0.096	0.358	1.4 (0.5-3.8)	0.477	0.381	1.4 (0.5-3.8)	0.437
Secondary	-0.193	0.8 (0.2-3.1)	0.779	-0.705	0.5 (0.1-2.0)	0.324	-0.257	0.7 (0.1-3.3)	0.732	0.825	2.3 (0.5-9.0)	0.241
None	-0.188	0.8 (0.3-2.1)	0.692	-1.245	0.3 (0.1-0.8)	**0.015**	0.695	2.0 (0.7-5.3)	0.163	0.239	1.2 (0.5-3.2)	0.622
Disease status												
No NCDs		1.0										
NCDs	-0.229	0.8 (0.5-1.3)	0.360	0.196	1.2 (0.7-2.0)	0.441	-0.117	0.8 (0.5-1.4)	0.648	0.345	1.4 (0.8-2.3)	0.170
BMI												
Underweight		1.0										
Normal	-0.513	0.5 (0.3-1.2)	0.165	-0.204	0.8 (0.4-1.6)	0.579	0.739	2.1 (0.9-4.6)	0.063	0.288	1.3 (0.6-2.7)	0.438
Overweight	-0.404	0.6 (0.3-1.4)	0.307	-0.609	0.5 (0.2-1.2)	0.124	0.536	1.7 (0.7-3.9)	0.204	0.009	1.0 (0.4-2.2)	0.983
Obese	-0.022	0.9 (0.4-2.4)	0.963	-1.272	0.3 (0.1-0.7)	**0.009**	0.972	2.6 (1.0-6.9)	**0.049**	0.396	1.5 (0.6-3.7)	0.400
Serum vitamin C												
Normal		1.0										
Low	-0.366	0.7 (0.3-1.3)	0.258	-0.033	0.9 (0.5-1.8)	0.918	-0.267	0.7 (0.4-1.4)	0.410	0.194	1.2 (0.6-2.2)	0.550
Serum vitamin E												
Normal		1.0										
Low	0.081	1.1 (0.6-1.9)	0.778	-0.240	0.7 (0.4-1.4)	0.406	0.140	1.1 (0.6-2.0)	0.140	-0.384	0.7 (0.4-1.1)	0.180

P-value is significant at P < 0.05.

Limitation

The study is limited to inability to provide nutrients intake of the older adults due to poor reliance of memory to give accurate dietary and portion size estimation. As such, the actual meals consumed daily basis and food frequency questionnaire were used to assess dietary pattern. Nonetheless, this study provided a considerable source of knowledge to the research field especially in the Ghanaian context which creates room for further investigation using more extensive prospective studies.

Conclusion

There was high prevalence of overweight/obesity and high blood pressure among the older adults. High blood pressure was significantly higher among NCDs participants compared to those without NCDs and, being female older adult increases the risk of developing NCDs by 1.8 times (OR: 1.7; 95% CI: 1.1-2.7, P=0.006). Older adults had poor serum antioxidant vitamins (vitamin C and E). Obese older adults were less likely to consume vegetables and fish, whereas, older adults with no formal education were also less likely to consume vegetables. Although, dietary pattern of older adults in this study contained carbohydrate, protein, fruit and vegetable, it did not impact their serum antioxidant vitamins. There is the need for nutrition policies and education programmes to assist older people to improve upon their nutrition (serum antioxidant vitamins), through consumption of varied foods from all the six food groups.

Conflict of Interest

The authors declare no conflict of interest.

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