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Dietary intakes, anthropometric status, and anaemia prevalence among older adults in Effutu Municipality, Ghana

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Abstract.

BACKGROUND: Older adults, both institutionalized and free-living are vulnerable to nutritional deficiencies and poor nutritional status, which affect morbidity and quality of life amongst them. Yet, little attention on nutritional needs is given to this vulnerable group in many developing countries, and very little data exist on the nutritional status of older Ghanaians.

OBJECTIVE: This study assessed dietary intakes, anthropometric status, and anaemia prevalence among older adults in Effutu Municipality, Ghana.

METHODS: Using a cross-sectional design, anthropometry, repeated 24-hour dietary recall, haemoglobin levels were determined among 150 older adults (60–87 years). The Mini Nutritional Assessment (MNA) questionnaire was used to determine malnutrition prevalence among older adults.

RESULTS: None of the older adults met estimated average requirement (EAR) and adequate intake (AI) for vitamin E and calcium respectively, and 72.0%, 71.3%, 99.3%, 98.7%,76.0% had insufficient intake for energy, protein, zinc, folate and vitamin C respectively. Also, 39.3% were anaemic using haemoglobin cut-offs, 12.0% were malnourished based on the MNA tool and 28.0% were underweight based on BMI index. Married older adults (OR = 0.1, $p = 0.005$, 95%CI = 0.1–0.5) had lower odds for anaemia than those who were divorced. Underweight participants had 11.7 increased odds of being anaemic (OR = 11.7, $p = 0.048$, 95% CI = 1.0–135.0) than overweight participants. Those who had adequate vitamin C (OR = 0.3, $p = 0.018$, 95%CI = 0.1–0.8) and folate (OR = 0.2, $p = 0.396$, 95%CI = 0.1–6.7) intakes had lower odds of being anaemic than those with inadequate vitamin C and folate intakes, while those who had adequate iron (OR = 1.4, $p = 0.412$, 95%CI = 0.6–3.2) and vitamin B_{12} (OR = 1.6, $p = 0.473$, 95%CI = 0.5–5.3) intakes were more likely to be anaemic

CONCLUSIONS: Inadequate nutrient intakes, anaemia, underweight and malnutrition prevalence were found among these older adults. Anaemia was associated with being underweight, but not nutrients intake. The nutritional needs of older people should be addressed to reduce risks for disease.

Keywords: Anaemia, dietary intakes, anthropometric status, nutritional status, older adults, Effutu Municipality

1. Introduction

Anaemia and malnutrition persist frequently among older adults due to a decline in physiological and functional status, poor appetite, chronic inflammation, severe comorbidities, and nutritional deficiencies [1–3]. On the other hand, nutrition and health

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status among these population is mostly neglected in developing countries [4]. Undernutrition prevalence among older adults in Ghana was about 48 percent [5], and recent studies had reported malnutrition prevalence among older adults in the Ga West Municipality and Sunyani Municipality [6, 7].

The older adult population (aged ≥60 yrs) is increasingly rising globally and in developing countries [8]. It is projected that the number of older adults (aged ≥60 yrs) will be 1.2 billion in 2025 and 2 billion in 2050, representing 22.0 percent of the world's population [8]. The older adult population in Ghana has increased more rapidly from 327,594 in the 1960's population census and projected to 1,902,200 in 2020 [9, 10]. The increase in the number of aged populations could be attributable to a decline in fertility rates and an increase in life expectancy owing to improvement in health delivery, with the current life expectancy in Ghana being 67 years as of 2018 [8], compared to 45.5 years in the 1960 s [10].

An increase in the population of older adults is attributed to reduced mortality resulting from chronic diseases and a decline in birth rates ratio [11]. Successful aging does not necessarily reflect good nutrition and health status in older adults. Poor lifestyle (including physical inactivity, poor diet, alcohol intake) among older adults directly affects their nutritional status making it suboptimal at certain times [11, 12]. The older adults like any vulnerable population experience reduced food intake, nutrients absorption and utilization, resulting in poor nutritional status, since aging affects physical, emotional, social and biological functions and processes [13–15]. Thus, the provision of adequate and nutritionally-balanced diet is needed to promote good nutritional status among older adults [16]. Nutritional deficiencies, poor nutritional status, and reduced functionality is mostly observed with institutionalized and hospitalized older adults in advanced countries [17–19], however, not much is known about nutrient intakes and nutritional status of older adults in Ghana. De-Graft Aikins & Apt [20] also noted that research on older adults in Ghana has focused on the pattern of aging, socioeconomic status, health status, care, and support for older adults. Yet, few studies have been done on geriatric dietary intakes, nutritional status, and risk of malnutrition using the Mini Nutritional Assessment (MNA) tool. It is essential therefore to routinely assess nutrient intakes, nutritional status of older adults to prevent/reduce the incidence and prevalence of malnutrition (both over and undernutrition) and nutrient deficiencies among these populations. In this study, we assessed dietary intake, anthropometric status, and its bearing on anaemia prevalent among free-living older adults in Effutu Municipality.

2. Methods

2.1. Study design

The study employed a cross-sectional study design.

2.2. Study area

The study area was in the Effutu Municipality. Effutu Municipality is one of the 20 administrative districts in the Central Region of Ghana, and Winneba is its capital. Effutu Municipality in the Central Region of Ghana was selected because few studies on nutrition status among older adults in Ghana have been centered around the Greater Accra, Ashanti regions, Northern and Eastern regions of Ghana [6, 21, 22]. Also, as part of national data on nutrition status and health of older adults, Effutu in the central region was chosen. It is located within the center of the region, though not the regional capital, it is well structured enough, and well populated with older adults who are mostly at home [23].

It is situated between latitudes 5°16' and 20.18"N and longitudes 0°32' and 48.32"W of the eastern part of Central Region. Effutu lies between the Gomoa East District to western, northern, and eastern flanks. On the southern flank is the Gulf of Guinea. The major economic activities in the Municipality are fishing, wholesale/retail trade, services, manufacturing, salt mining (white gold), crop farming, and agro-processing. According to the 2010 Population and Housing Census (PHC), the Municipality had a population of 68,597 which comprises 32,795 males; representing 48 percent and 35,802 females; representing 52 percent. About 4,589 of the population were above 60 years of age [23].

2.3. Study population and data sampling

A total of 150 older adults with no complicated comorbid conditions/diagnoses were selected for this study through the multistage sampling technique. The Effutu community was divided into 4 zones (strata), following the already existing four (4) electoral zones of the community, namely Nsuekyir/Gyahadze, Kojo

Bedu North/ Low cost, South-East Winneba and South-West Winneba zones. Two clusters were randomly selected from each zone to make up 8 clusters. This was to allow equal distribution and representation of different people from different backgrounds and settings. Nineteen (19) older adults were selected, using simple random sampling from seven (7) clusters, and seventeen (17) people were chosen from the last cluster to make up the desired total sample size of 150 participants. In each principal street in the Effutu communities, three house intervals were given for each selected household. For every household visited, the first elderly person reached who met the eligibility criteria was chosen from the study.

2.4. *Ethics*

Approval for the study was given by the Committee on Human Research Publication and Ethics (CHRPE) of the Kwame Nkrumah University of Science and Technology, KNUST, (Kumasi, Ghana) (CHRPE/AP/479/17) as well as the Directorate of Health and Municipal Chief Executive of the Effutu Municipality. Study protocols/aims were first explained to participants in their local language (Fante). Written and signed informed consent was obtained from all participants following CHRPE regulations before participating in the study.

2.5. *Dietary assessment*

A repeated 24-hour dietary recall on two weekdays and one weekend as described by Jackson et al [24], was used to collect dietary intakes of studied older adults. Diet information obtained included all foods, beverages, fruits, and vegetables consumed. Household handy measures of food items were used to help participants estimate the exact quantities of food consumed by participants [25]. Quantities of food consumed by participants were transformed into grams using a standardized excel spreadsheet which has the measuring weight of Ghanaian foods. These grams were further computed into a nutrient analysis Microsoft excel spreadsheet software designed by the University of Ghana, Department of Food Science and Nutrition [26], which included mostly consumed Ghanaian foods. Average mean nutrient intakes of macro-and micronutrients were calculated by the software and compared to estimated average requirement (EAR)/ adequate intake (AI) [27].

2.6. *Anthropometric and nutrition status (Mini nutritional assessment tool)*

Anthropometric measurements of participants taken were weight, height, handgrip strength, and waist circumference. Weight was measured with a weighing scale (model: DT602, India), to the nearest 0.1 kg in light clothes and no shoes whereas, height measurement in centimeter was taken using a portable stadiometer (Secca 213, India), with no shoes on. The values of the weight and height were used to obtain the body mass index (BMI) of the study participants using the formula weight/height (m^2). Waist circumference was measured at the midpoint between the last rib and the iliac crest by using a non-elastic tape measure, with participants standing up straight and weight evenly distributed. When waist circumference values exceeded 102 cm and 88 cm for men and women respectively, participants were considered obese, thus poorly nourished or unhealthy. Right and left handgrip of participants was measured with a handgrip dynamometer, using an acceptable clinical cut off of 30 kg and 20 kg for men and women, respectively. With flexed elbows at an angle of 90 degrees measurement was taken. The participants were made to hold unto the handgrip dynamometer with the left hand first and squeezed with force for a period of five to ten seconds and the figure recorded after which the hands were relaxed for sixty seconds and activity repeated for the same hand and right hand as well. An average of the two measurements was obtained.

Again, the Nestle Mini Nutritional Assessment (MNA) tool was used to assess nutritional status (prevalence of malnutrition) of the older adults. The MNA tool is a well-validated nutritional assessment tool with about 92 percent accuracy when compared with other nutritional assessment tools including anthropometric, dietary intake, and biochemical measurement. The MNA tool has been used in many cross-sectional studies in developing and developed countries to determine the nutritional status of older adults [4, 17, 28]. The 18-items questionnaire was filled by participants and score interpretation was used to identify the malnourished, well-nourished, and the participant at risk of malnutrition. The classification of nutritional status is <17; protein-energy malnutrition/ malnourished, 17–23.5; at risk of malnutrition and ≥ 24; well-nourished. Researchers administered all questionnaires in the Fante, which happens to be the local language of the older adults. (Questionnaire was typed in English and every question translated into Fante language to the participants. The answers obtained from participants were then recorded in English)

2.7. Haematological assessment

Haemoglobin (Hb) levels were used to determine anaemia status of study participants. Three ml venous blood was sampled from all 150 participants and Hb levels determined using a 5-part YUMIZEN H500 Hematology analyzer (HORIBA, France). Anaemia was defined using World Health Organization criteria; haemoglobin concentration less than 13.0 g/dL in men, and less than 12.0 g/dL in women [29].

2.8. Statistics analysis

Data were analysed using IBM Statistical Package for Social Sciences statistics (version 25, SPSS IBM Inc Chicago, USA). Absolute and relative frequencies were determined for sociodemographic variables, nutrients intake, anthropometric, haemoglobin status, and malnutrition status according to the MNA tool. Kolmogorov-Smirnov test of normality was done to determine whether data variables met parametric assumptions. Descriptive statistics (explore test) was performed to determine the median (interquartile) of nutrients intake. Independent *t*-test was performed for non-parametric comparison, while Mann Whitney ‘U’ test and Kruskal Wallis test was performed to determine the non-parametric significant association. A chi-square (Fisher’s exact test) cross tabulation was performed to compare frequencies of sociodemographic variables, nutrients intake, anthropometric by nutrition status (haemoglobin status and malnutrition status according to MNA tool). Independent *t*-test and analysis of variance (ANOVA) was performed to compare mean differences of nutrients intake and anthropometric by nutrition status. Data were presented as mean $\pm$ SD for the continuous variable. All variables that were significant at chi-square (Fisher’s exact test) analysis and dietary iron, folate, and vitamin B_{12} intakes were further analyzed using binary logistic regression to determine predictors of anaemia. The combined effect size of the different significant variables was reported as an odds ratio (95% confidence intervals). All tests were 2-tailed, and *p*-values < 0.05 were termed significant.

3. Results

Table 1 presents sociodemographic variables of study participants characterized by the nutritional status of older adults aged 60–87 years. There were more females (80.7%) than male (19.3%) older adults in this study, confirming the gender ratio distribution of population in Ghana and a recent increase in life expectancy of females (64 years) than males (62 years) [30]. The majority of the older adults had no formal education (59.3%), were widowed (56.0%), and lived with caregivers (72.0%). Some of the older adults had comorbidities including diabetes (5.3%) and hypertension (26.0%). Anaemia prevalent was lower among married older adults (27.5%) compared to widowed (35.7%), and divorced older adults (69.2%) ($p = 0.002$). More male (44.8%) than female (38.0%) older adults were anaemic in this study ($p = 0.530$). Anaemia prevalence and malnutrition status did not vary by education, comorbidities, alcohol intake, and diet supplement ($p > 0.05$).

Table 2 indicates the nutrients intake of the participants. Overall, total mean intakes for energy (1248.9 ± 249.3 Kcal), carbohydrate (204.7 ± 40.9 g), vitamin A ($1193.7 \pm 590.1\mu$g), vitamin B_{12} ($3.2 \pm 1.2\mu$g), iron (8.1 ± 2.0 mg) and selenium (69.1 ± 18.5 mg) were higher than EAR for the nutrients. Contrariwise, the total mean intakes for protein (42.3 ± 10.7 g), vitamins C (63.4 ± 24.5 mg), E (4.0 ± 1.8 mg), folate ($171.9 \pm 72.6\mu$g), zinc (4.5 ± 1.2 mg) were lower than EAR for the nutrients. The total mean fiber (18.2 ± 4.3 g) and calcium (172.4 ± 64.4 mg) intake was also lower than the AI. The mean vitamins A ($p = 0.039$) and C ($p = 0.021$) intakes was significantly higher among anaemic participants ($1324.2 \pm 671.4\mu$g, 69.3 ± 26.5 mg) than non-anaemic ($1108.9 \pm 517.3\mu$g, 59.5 ± 22.5 mg) participants respectively. All other mean nutrients intake did not differ by haemoglobin status and malnutrition status ($p > 0.05$).

Table 3 presents the relationship between nutrients intake, and haemoglobin status and malnutrition status according to the MNA tool. None of the older adults met vitamin E intake (100.0%) when compared to EAR. Majority of the older adults had inadequacies in energy (72.0%) protein (71.3%), vitamin C (76.0%), iron (50,7%), folate (98.7%), and zinc (99.3%) intakes when compared to EAR. None of the older adults met calcium intake (100.0%), while 81.0% of them had inadequate fiber intake when compared to AI. The majority of the older adults (54.0%) had less than 4 inadequacies for combined micronutrient intake. Proportions of adequate and inadequate nutrients intake did not significantly vary by haemoglobin status and malnutrition status ($p > 0.05$), except for inadequate vitamin C intake,

Table 1
Sociodemographic characteristics of study participants

Sociodemographic	n (%)	Haemoglobin status			Malnutrition status by MNA			
		Anaemia	No anaemia	†*P*-value	Well-nourished	Risk of malnutrition	**Malnourished**	†*P*-value
Gender								
Male	29 (19.3)	13 (44.8)	16 (55.2)	0.530‡	4 (13.8)	21 (72.4)	4 (13.8)	0.491¥
Female	121 (80.7)	46 (38.0)	75 (62.0)		29 (24.0)	78 (64.5)	14 (11.6)	
Mean age	69.7 ± 7.2	69.1 ± 7.3	70.1 ± 7.1	0.388deg	68.8 ± 7.2	69.5 ± 7.0	72.3 ± 7.7	0.225¥
Educational status								
None	89 (59.3)	32 (36.0)	57 (64.0)	0.602¥	17 (19.1)	60 (67.4)	12 (13.5)	0.914¥
Primary/JHS	45 (30.0)	20 (44.4)	25 (55.6)		12 (26.7)	29 (64.4)	4 (8.9)	
SHS	13 (8.7)	5 (38.5)	8 (61.5)		3 (23.1)	8 (61.5)	2 (15.4)	
Tertiary	3 (2.0)	2 (66.7)	1 (33.3)		1 (33.3)	2 (66.7)	0 (0.0)	
Marital status								
Widowed	84 (56.0)	30 (35.7)	54 (64.3)	**0.002¥**	23 (27.4)	50 (59.5)	11 (13.1)	0.112¥
Married	40 (26.7)	11 (27.5)	29 (72.5)		9 (22.5)	28 (70.0)	3 (7.5)	
Divorced	26 (17.3)	18 (69.2)	8 (30.8)		1 (3.8)	21 (80.8)	4 (15.4)	
Caregiver								
Yes	108 (72.0)	16 (38.1)	26 (61.9)	1.000†	22 (20.4)	72 (66.6)	14 (13.0)	0.674¥
No	42 (28.0)	43 (39.8)	65 (60.2)		11 (26.2)	27 (64.3)	4 (9.5)	
Co-morbidities								
None	103 (68.7)	45 (43.7)	58 (56.3)	0.258¥	24 (23.3)	67 (65.0)	12 (11.7)	0.523¥
Diabetes	8 (5.3)	2 (25.0)	6 (75.0)		0 (0.0)	6 (75.0)	2 (25.0)	
HPT	39 (26.0)	12 (30.8)	27 (69.2)		9 (23.1)	26 (66.7)	4 (10.3)	
Diet supplement								
Yes	8 (5.3)	4 (50.0)	4 (50.0)	0.712†	2 (25.0)	6 (75.0)	0 (0.0)	0.562¥
No	142 (94.7)	55 (38.7)	87 (61.3)		31 (21.8)	93 (65.5)	18 (12.7)	
Drink alcohol								
Yes	41 (27.3)	17 (41.5)	24 (58.5)	0.851†	4 (9.8)	32 (78.0)	5 (12.2)	0.079¥
No	109 (72.7)	42 (38.5)	67 (61.5)		29 (26.6)	67 (61.5)	13 (11.9)	

Data are presented as frequency (percentage), MNA-Mini Nutritional Assessment, mean ± SD (standard deviation), †Fisher's exact *p* value, ¥Chi-square *p* value, †Independent *t*-test, †Anova test, Bold values are significant at $p < 0.05$. †*P*-value-Significant difference between haemoglobin status and malnutrition status by MNA tool

in which, the higher proportion was found among non-anaemic participants than anaemic participants (66.7% versus 33.3%, $p = 0.011$).

Table 4 indicates anthropometric, MNA malnutrition status, and haemoglobin status. The result showed 28.0% of the older adults were underweight, 11.3%, were overweight. Based on the mini nutritional assessment tool (MNA), malnutrition prevalence was 12.0% among the older adults. Fifty percent of the older adults were classified as centrally obese. Higher proportions of underweight participants (50.0%) were anaemic compared to normal (40.7%) and overweight (5.9%) participants (chi-square = 10.041, $p = 0.007$). Also, 39.3% of the older adults were anaemic using haemoglobin as a marker. Higher proportions of participants who were not centrally obese (50.7%) were anaemic than those who were centrally obese (28.0%) (chi-square = 8.074, $p = 0.007$). The level of malnutrition did not vary by haemoglobin status ($p = 0.284$). Mean handgrip and dietary pattern did not differ by haemoglobin status ($p = 0.176$).

Table 5 indicates the predictors of anaemia from binary logistic regression analysis. Older adults who were either married (OR = 0.1, $p = 0.005$, 95%CI = 0.1–0.5) or widowed (OR = 0.2, $p = 0.008$, 95%CI = 0.1–0.7) were less likely to be anaemic than those who were divorced. Compared with older adults who were overweight, older adults who were underweight were 11.7 increased odds of being anaemic (OR = 11.7, $p = 0.048$, 95%CI = 1.0–135.0). Older adults who had adequate vitamin C intake had lower odds of being anaemic (OR = 0.3, $p = 0.018$, 95%CI = 0.1–0.8) than those who had inadequate vitamin C intake. Compared with older adults who had inadequate folate intake, those with adequate folate intake had lower odds of being anaemic (OR = 0.2, $p = 396$, 95%CI = 0.1–6.7). Older adults who had adequate iron intake were 1.4 increased odds for anaemia (OR = 1.4, $p = 0.412$, 95%CI = 0.6–3.2)

Table 2

Nutrients intake of participants from repeated 24-hour dietary recall

Variable	Cut-off- Male	Cut-off-Female	No anaemia Median (Q1-Q3)	Anaemia Median (Q1-Q3)	‡p-value	Well nourished Median (Q1-Q3)	Risk of malnutrition Median (Q1-Q3)	Malnourished Median (Q1-Q3)	‡p-value
Energy	1800 Kcal/d¥	1300 Kcal/d¥	1252.0 (1074.1–1367.0)	1210.7 (1077.5–1396.4)	0.316	1222.9 (1069.9–138.8)	1241.3 (1077.5–1379.8)	1236.3 (1042.4–1369.8)	0.834
Carbohydrate	100 g/d¥	100 g/d¥	205.8 (180.3–231.8)	198.3 (173.9–225.7)	0.738	201.6 (172.3–228.5)	202.5 (181.4–233.2)	198.8 (170.1–216.1)	0.877
Protein	56 g/d¥	46 g/d¥	42.1 (35.1–51.5)	40.2 (34.2–46.5)	0.504	39.7 (35.0–46.0)	41.9 (34.3–51.0)	41.4 (35.6–47.5)	0.834
Fiber	30 g/d†	21 g/d†	18.1 (15.1–20.2)	17.6 (14.8–21.3)	0.504	18.1 (14.6–20.0)	17.7 (15.0–21.0)	18.2 (14.9–21.4)	0.842
Vitamin A	625µg/d¥	500µg/d¥	997.1 (765.2–1333.9)	1230.4 (897.0–1597.0)	0.095	1053.2 (719.0–1324.5)	1152.2 (586.5–1473.3)	1198.3 (934.8–1378.5)	0.375
Vitamin B_{12}	2.0µg/d¥	2.0µg/d¥	3.2 (2.5–3.8)	3.1 (2.4–3.9)	1.000	3.1 (2.5–3.5)	3.2 (2.4–3.9)	3.5 (2.8–4.0)	0.292
Vitamin C	75 mg/d¥	60 mg/d¥	56.6 (46.4–73.6)	68.0 (50.1–86.1)	0.095	61.0 (46.8–85.0)	59.4 (46.9–73.9)	62.5 (49.4–86.1)	0.980
Vitamin E	12 mg/d¥	12 mg/d¥	3.6 (2.8–5.0)	3.8 (2.3–5.3)	0.504	3.1 (2.3–4.3)	3.8 (2.9–5.1)	4.0 (2.8–5.5)	0.375
Iron	6 mg/d¥	5 mg/d¥	8.0 (6.8–9.4)	7.9 (6.6–9.1)	1.000	7.9 (7.0–9.4)	8.0 (6.7–9.2)	7.6 (6.6–9.1)	0.842
Folate	320µg/d¥	320µg/d¥	159.9 (132.7–20.7)	146.7 (128.0–181.4)	0.504	147.0 (127.5–202.9)	156.3 (131.1–190.4)	155.0 (129.9–170.0)	0.98
Zinc	9.4 mg/d¥	6.8 mg/d¥	4.5 (3.9–5.3)	4.3 (3.5–5.2)	0.316	4.4 (3.8–5.3)	4.5 (3.8–5.3)	4.0 (3.1–5.0)	0.557
Calcium	1200 mg/d†	1200 mg/d†	162.5 (121.9–217.7)	172.7 (125.1–206.2)	0.738	162.8 (122.3–207.5)	162.7 (123.2–206.3)	181.8 (122.2–238.7)	0.603
Selenium	45 mg/d¥	45 mg/d¥	66.4 (58.0–82.3)	67.4 (55.2–78.1)	0.738	64.0 (58.6–77.5)	67.0 (55.8–82.8)	72.3 (58.1–79.3)	0.174

Data are presented as median (interquartile percentiles) Q1-lower quartile, Q3-Upper quartile, ¥EAR- Estimated Average Requirement, †AI-Adequate Intakes, Dietary reference intakes series from National Academy of Sciences, Food and Nutrition Board, Institute of Medicine (2005), MNA-Mini Nutritional Assessment, Bold values are significant at $p < 0.05$, ‡P-value-Significant difference between haemoglobin status and malnutrition status by MNA tool

than those with inadequate iron intake, while older adults who had adequate vitamin B_{12} intake were 1.6 increased odds for anaemia (OR = 1.6, $p = 0.473$, 95%CI = 0.5–5.3) than those with inadequate vitamin B_{12} intake.

4. Discussion

Macro-and micronutrient deficiencies among older adults from developing and developed countries continue to persist, affecting the public health system, and increasing the risk of malnutrition, anaemia, morbidity, and mortality [16, 31]. The present study found that the majority of the older adults deficient of macronutrients; energy, protein, and micronutrients; vitamins C, E, folate, zinc, and their mean intakes for the population were lower than the estimated average requirement (EAR). Inadequate fiber and calcium intake were found among the older adults, and their mean intakes were lower than Adequate Intake (AI). Mean intakes of calcium and protein have been reported to be lower than AI/EAR among older people in Indonesia [32]. Also, other studies have reported inadequate intakes of energy, protein, carbohydrate, vitamins A, C, E, folate, iron, and zinc among institutionalized older adults in Brazil, Ireland, and Turkey [17, 31, 33]. For example, In Brazil, 100% inadequate vitamin E intake was found among older people which is consistent with our findings [33]. Studies have reported that macro-and micronutrient deficiencies among older adults were attributed to poor dietary intake from skipping meals, poor functional ability to shop and prepare food, lack of financial support, and ill-health [4, 16, 34]. Nutrient deficiencies in these older adults are very much worrying as it increases the risk of malnutrition, chronic diseases such as diabetes, hypertension, cardiovascular diseases, and infection which will have negative consequences on the public health system as well as a burden to affected families [4]. Therefore, appropriate nutrition education and intervention that emphasizes access to a balanced diet are needed to decrease nutrients deficiencies among older adults.

Malnutrition is common among older adults due to many reasons including physical and functional changes that take place with age, comorbidities, anaemia, and inadequate access and intake of food [4, 35]. Based on body mass index (BMI) status, 28.0 percent of the participants were undernourished while, 11.0% were overnourished. Undernutrition is the main cause of frailty, increased risk of infection,

Table 3
Relationship between nutrients intake, and haemoglobin and MNA malnutrition status

Nutrients intake	n (%)	Haemoglobin status			Malnutrition status by MNA			
		Anemia	No anemia	†p-value	Well nourished	Risk of malnutrition	Malnourished	†p-value
Energy, Kcal								
Inadequate	108 (72.0)	41 (38.0)	67 (62.0)	0.583†	24 (22.2)	72 (66.7)	12 (11.1)	0.866¥
Adequate	42 (28.0)	18 (42.9)	24 (57.1)		9 (21.4)	27 (64.3)	6 (14.3)	
Carbohydrate								
Inadequate	4 (2.7)	2 (50.0)	2 (50.0)	0.646†	1 (25.0)	2 (50.0)	1 (25.0)	0.686¥
Adequate	146 (97.3)	57 (39.0)	89 (61.0)		32 (21.9)	97 (66.4)	17 (11.6)	
Protein								
Inadequate	107 (71.3)	43 (40.2)	64 (59.8)	0.854†	25 (23.4)	69 (64.5)	13 (12.1)	0.798¥
Adequate	43 (28.7)	16 (37.2)	27 (62.8)		8 (18.6)	30 (69.8)	5 (11.6)	
Fiber								
Inadequate	123 (82.0)	46 (37.4)	77 (62.6)	0.385†	30 (24.4)	80 (65.0)	13 (10.6)	0.219¥
Adequate	27 (18.0)	13 (48.1)	14 (51.9)		3 (11.1)	19 (70.4)	5 (18.5)	
Vitamin A								
Inadequate	24 (16.0)	7 (29.2)	17 (70.8)	0.363†	7 (29.2)	17 (70.8)	0 (0.0)	0.123¥
Adequate	126 (84.0)	52 (41.3)	74 (58.7)		26 (20.6)	82 (65.1)	18 (14.3)	
Vitamin B_{12}								
Inadequate	35 (23.3)	14 (40.0)	21 (60.0)	1.000†	6 (17.1)	26 (74.3)	3 (8.6)	0.494¥
Adequate	115 (76.7)	45 (39.1)	70 (60.9)		27 (23.5)	73 (63.5)	15 (13.0)	
Vitamin C								
Inadequate	114 (76.0)	38 (33.3)	76 (66.7)	**0.011**†	22 (19.3)	78 (68.4)	14 (12.3)	0.363¥
Adequate	36 (24.0)	21 (58.3)	15 (41.7)		11 (30.6)	21 (58.3)	4 (11.1)	
Vitamin E								
Inadequate	150 (100.0)							
Iron								
Inadequate	76 (50.7)	31 (40.8)	45 (59.2)	0.740†	17 (22.4)	49 (64.5)	10 (13.2)	0.889¥
Adequate	74 (49.3)	28 (37.8)	46 (62.2)		16 (21.6)	50 (67.6)	8 (10.8)	
Folate								
Inadequate	148 (98.7)	-	-	-	-	-	-	
Adequate	2 (1.3)							
Zinc								
Inadequate	149 (99.3)	-	-	-	-	-	-	
Adequate	1 (0.7)							
Calcium								
Inadequate	150 (100.0)							
Selenium								
Inadequate	30 (20.0)	14 (46.7)	16 (53.3)	0.406†	5 (16.7)	21 (70.0)	4 (13.3)	0.729¥
Adequate	120 (80.0)	45 (37.5)	75 (62.5)		28 (23.3)	78 (65.0)	14 (11.7)	
All micronutrients								
Inadequate, <4	81 (54.0)	28 (40.6)	41 (59.4)	0.867†	15 (21.7)	46 (66.7)	8 (11.6)	0.985¥
Adequate, 4 and more	69 (46.0)	31 (38.3)	50 (61.7)		18 (22.2)	53 (65.4)	10 (12.3)	

Data are presented as frequency (percentage), MNA- Mini Nutritional Assessment, †Fisher's exact p value, ¥Chi-square p value, Bold values are significant at $p < 0.05$. †P-value-Significant difference between haemoglobin status and malnutrition status by MNA tool

anemia, and mortality in older people [36, 37]. This implies that undernourished study participants might be at risk of infections, increased falls, and anemia. On the other hand, overweight and obesity increased the risk of chronic diseases such as diabetes, cardiovascular diseases, and hypertension [37]. This implies that the double burden of malnutrition was present among the study participant, and put them at greater risk of morbidities and mortality. Underweight and overweight prevalence has been reported among both free-living and institutionalized older adults in Ghana, Ethiopia, and Turkey [7, 17, 38]. Fifty percent of the older adults had abdominal obesity, which is also known as risk factors of diabetes, hypertension, and cardiovascular diseases [37]. Increasing age is associated with loss of muscle mass and increased visceral fat, and this might be the reason, some of the study participants had an increased

Table 4
Anthropometric, MNA malnutrition status, and haemoglobin status of participants

Variable	n (%)	Overall mean	Haemoglobin status		chi-square	Significant difference between haemoglobin status
			Anaemia	No anaemia		
n (%)			59 (39.3)	91 (60.7)		
Mean Haemoglobin, g/dL		12.5 ± 1.7	11.1 ± 1.1	13.4 ± 1.1		**0.001**†
BMI (Kg/m^2)		24.2 ± 5.3	22.3 ± 3.9	25.5 ± 5.8		**<0.001**†
Underweight	42 (28.0)		21 (50.0)	21 (50.0)	10.041	**0.007**‡
Normal	91 (60.7)		37 (40.7)	54 (59.3)		
Overweight	17 (11.3)		1 (5.9)	16 (94.1)		
MNA Malnutrition status		21.4 ± 3.5				
Well nourished	33 (22.0)		11 (33.3)	22 (66.7)	2.520	0.284¥
Risk of malnutrition	99 (66.0)		38 (38.4)	61 (61.6)		
Malnourished	18 (12.0)		10 (55.6)	8 (44.4)		
Male-WC		83.3 ± 12.4				
Female-WC		89.6 ± 14.2				
WC, cm						
Normal	75 (50.0)		38 (50.7)	37 (49.3)	8.074	**0.007**†
High	75 (50.0)		21 (28.0)	54 (72.0)		
Mean hand grip, cm		14.0 ± 5.4	13.3 ± 5.0	14.5 ± 5.7		0.176□

Data are presented as frequency (percentage), MNA-Mini Nutritional Assessment, WC-Waist circumference, BMI-Body mass index mean ± SD (standard deviation), ‡Fisher's exact p value, ¥Chi-square p value, †Mann Whitney test, Bold values are significant at $p < 0.05$.

Table 5
Predictors of anaemia in older adults

Variables	Anaemia			95% Confidence Interval	
	β	OR	p value	lower bound	Upper bound
Marital status					
Widowed	–1.5	0.2	**0.008**	0.1	0.7
Married	–2.0	0.1	**0.005**	0.1	0.5
Divorced		1			
Protein					
Inadequate		1.0			
Adequate	0.2	1.2	0.747	0.4	3.1
Vitamin A					
Inadequate		1.0			
Adequate	–0.9	0.4	0.227	0.1	1.7
vitamin C					
Inadequate		1.0			
Adequate	–1.1	0.3	**0.018**	0.1	0.8
Vitamin B_{12}					
Inadequate		1.0			
Adequate	0.4	1.6	0.473	0.5	5.3
Iron					
Inadequate		1.0			
Adequate	0.3	1.4	0.412	0.6	3.2
Folate					
Inadequate		1.0			
Adequate	–1.5	0.2	0.396	0.1	6.7
BMI status					
Underweight	2.5	11.7	**0.048**	1.0	135.0
Normal	2.3	9.8	0.065	0.9	110.5
Overweight		1.0			

Reference category; no anaemia, OR- Odd ratio, **β** – Slope/ regression co-efficient, Bold values are significant at $p < 0.05$.

central adiposity [4]. A subjective nutritional assessment tool called the mini nutritional assessment tool (MNA), also found 12.0% of the older adults to be malnourished. Changes in lifestyle (such as poor physical activity and alcohol intake) and eating habits from local Ghanaian foods (e.g whole grains, legumes and starchy) to more refined processed foods (e.g canned foods, sugar-sweetened beverages) could have contributed to the cause of abdominal obesity and overweight among older adults [11]. Also, the consumption of a low nutrient-dense diet coupled with physiological changes associated with aging (such as loss of muscle mass and fat mass) could have contributed to malnutrition in these older adults [39]. Previous studies used the MNA tool to report malnutrition among older people in Bangladesh, India, and Turkey [4, 17, 40]. The study also found that nutrients intake and anaemia prevalence did not contribute to malnutrition in older adults, using the MNA tool. This finding was in contrast with a study by Agarwalla et al. [4], which reported that inadequate calorie intake was associated with malnutrition using MNA tool. Malnutrition occurs when there are long term nutritional deficits, and it is likely that their past week nutrients deficiencies reduced body stores of nutrients but not necessarily showing physical manifestation of altered nutritional status [33]. Another possible reason could be a smaller population used in this study and thus, a larger population-based prospective study is required to ascertain these associations.

The study found that 39.3% of the older adults were anaemic. In a study by Lopez-Contreras et al [41], 25.4% of 252 institutionalized elderly people were reported to be anaemic. Anaemia prevalence has also been reported among older people in Taiwan [3]. Several studies have shown that anemia is an independent predictor of mortality in older adults [42, 43], implying that the study participants were at risk of mortality due to low haemoglobin levels. The current study found that anaemia was associated with undernutrition using BMI status but not malnutrition by MNA tool. Participants who were undernourished were more likely to be anaemic ($p = 0.007$). The results imply that undernutrition could have an increased risk of anaemia among the older adults. This is because undernutrition might lead to iron, folate, and vitamin B_{12} deficiency, resulting in the risk of anaemia, and both can have other devastating health consequences [44]. Anemia prevalence did not significantly vary by nutrients intake, except for vitamin C, in which, older adults with adequate intake were more likely to be anaemic. A study by Guralnik et al. [45] showed that deficiencies in iron, folate, and vitamin B_{12} were the cause of anemia in the elderly people. Iron, folate, and vitamin B_{12} are known to contribute to haemoglobin formation in red blood cells [46]. Also, vitamin C is known to increase bioavailability and absorption of non-heme iron which is needed for the production of haemoglobin [47]. Although iron, folate, and vitamin B_{12} intakes were low, they did not influence hemoglobin concentration in older adults.

Our findings from binary regression analysis indicated that underweight was the predictor of anaemia in older adults. Older adults who were underweight ($OR = 11.7, p = 0.048, 95\%CI = 1.0–135.0$) were 11.7 increased odds of being anaemic than those who were overweight. Similar results by Orces [48], in Ecuador found that older men and women who were underweight had increased odds for anaemia than those who were obese. The study also found that older adults who were either married or widowed and those who had adequate vitamin C intake were at lower odds of being anaemic

The study is limited to the inability of the older adults to accurately estimate nutrients intake and food consumption patterns due to poor reliance on memory. The study did not also include smoking habits and dietary patterns of participants to better understand how these variables would affect haemoglobin and nutrition status. Nonetheless, this study has provided a new insight on dietary factors and nutrition status of older people to the scientific community especially in the Ghanaian context which creates room for further investigation using more extensive population-based prospective studies.

In conclusion, inadequate macro-and micronutrient intakes were found among the older adults when compared to EAR and AI. Underweight, overweight and anemia prevalence was common among older adults. Based on the MNA tool, some older adults were found to be malnourished. Underweight was found to be the determinant of anaemia in older adults. Low-cost effective intervention strategies including psychological counseling and nutrition education and family support to improve nutritional needs, and reduce anaemia prevalence in older adults are urgently needed.

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