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The Relationship Between Dietary Intake, Body Composition and Blood Pressure in Male Adult Miners in Ghana

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ABSTRACT
Unhealthy lifestyle and eating habits have been associated with the increasing prevalence of diet-related non- communicable diseases such as cardiovascular disorders and hypertension. The study was a cross-sectional involving 320 underground male miners in the Obuasi municipality. The research was conducted to generate data on the associations between characteristics of underground miners, their nutrition and blood pressure. Cluster and simple random sampling techniques were used to select the respondents from their residential areas. Independent sample t-test and Spearman's correlation (2 tailed) were used to test the significance of associations between selected continuous variables, while Chi-square test was used to test for significance between categorical variables. Logistic regression was used to determine the extent to which significant variables predicted high blood pressure. Results indicated that apart from vehicle ownership ($p = 0.02$) and length of working underground ($p<0.001$). All other socio-economic variables did not indicate any significant association with blood pressure. About 41.6% of the respondents were hypertensive. The prevalence of obesity and overweight cases combined were 62.1%. Potassium intake correlated significantly and positively with systolic ($r = 0.11$, $p = 0.04$) and diastolic blood pressure ($r = 0.13$, $p = 0.02$). The risk of developing hypertension increased with age, with persons within the age categories of 30-39 years, 40-49 years and 50-59 years had odds ratios of 2.55 (95% CI: 1.12-5.81), 3.34 (95% CI: 1.45-7.68) and 7.56 (95% CI: 2.91-19.84), respectively. Nutrient intake and blood pressure monitoring must be part of the day-to-day programmes of the underground male miners.

Key words: High blood pressure, body mass index, percent body fat, waist to hip-ratio, cholesterol, miners

INTRODUCTION
Non-communicable diseases such as obesity, diabetes and cardiovascular disorders have been traditionally associated with developed countries. However, in recent decades the prevalence of these diseases and their antecedent risk factors has rapidly increased in developing countries (Boutayeb and Boutayeb, 2005). These changes are caused to a large extent by dietary changes in relation to socio-economic and living environmental conditions (Svetkey *et al.*, 2001).

Hypertension is a very prevalent condition in industrialized countries and has varied prevalence in developing countries. It is associated with the incidence of some diet-related non-communicable diseases such as stroke and coronary heart diseases (Williams, 1994). Although the actual cause of hypertension is unknown, obesity and genetic factors predispose certain individuals to high blood pressure (Michael, 1997). Dietary approaches to hypertension are under investigation. However, certain dietary alterations lead to a modification of cholesterol levels and a reduction in cardiac risk. The use of a strictly vegetarian and very-low-fat diet reduced serum cholesterol level by 11% and blood pressure by 6% within 12 days (McDougall *et al.*, 1995). Less restrictive diets that contain lean meat, fruits and vegetables and have a high ratio of polyunsaturated fat to saturated fat are beneficial to the control of diet-related non-communicable diseases. Healthy lifestyles, which help to increase an individual sense of well being, can prevent illness (Pickering, 2006). These include eating a balanced diet, regular physical exercise, reducing stress, and avoiding abuse of alcohol and tobacco.

Globally, unhealthy eating habits and physical inactivity are responsible for at least 300,000 deaths each year. For example, 39% of all deaths in 1998 were due to diseases associated with diet. Also, the three most important personal habits that influence health include smoking, alcohol abuse and diet (WHO, 1998). Lifestyle interventions have been identified to reduce the occurrence of hypertension among persons with family history of hypertension and may also reduce the risk of cardiovascular events (Zellner and Sudhir, 1996). Studies have provided evidence of the beneficial effects of lifestyle intervention on blood pressure and serum lipid levels (Elmer *et al.*, 1995). Furthermore, it has been recommended that for the treatment of high blood pressure physicians should encourage patients to make lifestyle changes their priority (Frohlich, 1995). Sedentary lifestyle is strongly associated with increased mortality from coronary artery disease (Yeager *et al.*, 1995) and may be a risk factor for hypertension (Miller *et al.*, 1999). Exercise alone can lower blood pressure, and when combined with weight reduction it reduces blood pressure substantially (Miller *et al.*, 1999).

A relationship has been found between occupational stress and high blood pressure (Ramsay *et al.*, 2006). Studies also showed a reduction of 6 to 26 mm Hg in systolic blood pressure and a reduction of 5 to 15 mm Hg in diastolic blood pressure when stress-management techniques were used. Many people become hypertensive because of excessive alcohol intake. Besides, with a reduction of alcohol intake, 5 mm Hg decline in systolic blood pressure and 3 mmHg decline in diastolic blood pressure have been reported. Moreover, when reduction of alcohol intake is combined with weight loss, blood pressure reduces by up to 10 mmHg in systolic blood pressure and 7.5 mmHg in diastolic pressure (Stevens *et al.*, 2001).

The research was conducted to generate data on the associations between characteristics of underground miners, their nutrition and blood pressure.

MATERIALS AND METHODS

Study design, population and area of study: The study was cross-sectional, involving male miners in the Obuasi municipality in the Ashanti Region of Ghana. The study was conducted between April 2006 and November 2007. There are about 6,474 people employed as underground miners in the municipality. The municipality is noted for mining and trading as the main economic activity. Senior and junior staffs who work underground in the municipality were chosen for the study.

Sample size determination: Using a 95% confidence interval, a prevalence of hypertension (28.7%) in the Ashanti Region of Ghana (Cappuccio *et al.*, 2004; Bahram *et al.*, 2001) percent error (d) of 5% then the required sample size for the study was 314 but was approximated to 320 to improve the precision of the estimates (Appendix 1).

Eligibility criteria: An underground male miner officially registered as an employee of AngloGold Ashanti who is healthy, resides in AngloGold Ashanti residential facility and consented to be part of the study were included.

Sampling technique: The selection of the subjects for the study was done using cluster method. The clusters were divided into senior and junior staff Residential Areas (RA's) respectively. With the help of simple random sampling procedure 16 RA's out of 24 RA's in the Obuasi municipality identified by AngloGold Ashanti estate department as the official RA's of miners were randomly selected. This was done by writing the names of the RA's on pieces of paper using balloting technique. RA's for the study were picked randomly. 7 and 9 RA's were randomly selected for both senior and junior staffs respectively. The RA's where the study was conducted include Anyinam (RA), Bruno (RA), Biney (RA), Dankwa (RA), Monsey Valley (RA), Tiny Rowland (RA) and Rains Hill (RA) for the senior staffs. Those of the junior staff were Anyinam quarters, Bidieso quarters, pompora quarters, Kwabrafoso quarters, wawase, quarters Sam Jonah estate, Biney Security Barracks quarters, ToyTown quarters and Security Barracks quarters.

Weighting technique was also employed for the determination of the number of houses needed in each RA to be selected for the study. This was done to avoid biases during the selection of houses in each RA for the study. Knowing the number of houses needed in each RA, house numbers were written on pieces of paper and then trough the use of lottery technique houses were randomly identified for the interview of house hold index Figures (underground male miners).

Permission for the study: Permission was sought from AngloGold Ashanti, the Municipal assembly and the Municipal Health Directorate of the Ghana Health Service, Obuasi. Furthermore, those who consented to be part of the study signed a consent form (Appendix 2) and those who could not sign thumb printed to show consent.

Pre-testing of questionnaire: Instruments for the study were pre-tested on workers of Mining and Building Contractors (MBC) Obuasi. The workers have similar characteristics as those of the underground male miners at obuasi. This was done purposely to ensure the clarity of the questionnaire and the efficiency of study instruments.

Research instruments: The research instruments used were questionnaire (Appendix 3) electronic digital sphygmomanometer, UNI SECA scale, SECAMicrotoise, tape measure and Harpenden skin fold caliper.

Data collection and measurements: A semi-structured questionnaire was used to obtain information on the demography of the study participants (age, number of years worked at the mine, marital status religion etc.), socio-economic status (income at the end of the month, properties owned by respondents etc.), lifestyle variables (smoking status, alcohol usage, 24 h physical activity questionnaire adopted from (Jimaina and Van, 2001), morbidity of the study participants (hypertension and diabetes) as well as nutritional body composition (Percent Body fat, Skin fold thickness and Body Mass Index etc.) Dietary and eating habits were assessed using food frequency questionnaire and two day 24 h dietary recalls. Descriptive statistics for anthropometric variable are shown in Table 1.

Table 1: Descriptive statistics anthropometry and hypertension status (N=320)

	Hypertensive			Non – hypertensive		
Variables	Minimum	Maximum	Mean±SD	Minimum	Maximum	Mean±SD
Weight (kg)*	54.3	100.4	78.3±10.8	51.8	99.9	72.3±9.7
Height (cm)*	151.2	194.2	167.1±10.8	126	195.3	172.1±10.7
Body Mass Index (kg m^{-2})*	20	40	28.4±4.5	18	40	25.0±4.2
% Body fat*	13.9	45.6	27.7±6.1	10.9	42.2	22.3±6.1
Triceps skin fold thickness (mm)	7.4	18.4	11.2±7.0	6	16.3	9.9±2.4
Biceps skin fold thickness (mm)	3	12.4	5.5±1.8	2	17	6.8±2.2
Sup scapula skin fold thickness (mm)	3	16	8.7±2.4	3.1	19	8.4±2.1
Suprailiac skin fold thickness (mm)	4	18.5	12.8±4.0	3.1	12	11.7±8.6
Waist circumference (cm)*	20	55	35.3±7.1	19	49	31.5±5.8
Hip circumference (cm)	20	46	32.3±5.3	19	48	32.2±5.4
Waist- hip ratio (WHR) *	0.6	1.9	1.1±0.2	0.6	1.9	0.9±0.2
Systolic blood pressure (mmHg)*	110 .0	192	152.8±12.5	100	139	129.6±8.5
Diastolic blood pressure (mmHg)*	60	110	88.7±11.3	60	89	73.6±10.1

*p-value significant at <0.05 (Independent sample t-test) as shown in Table 1 almost all the anthropometric variables showed a significant association between the means of hypertensive and non–hypertensive respondents as well as that of the systolic and diastolic blood pressure

Anthropometric measurement

Height: The height of subjects were taken with SECA microtoise to the nearest 0.1 cm. Measurements were taken with subjects standing upright, bare footed, buttocks, calf, back, head and shoulder blades touching a smooth vertical wall. Subjects were positioned such that Frankfurt plane was observed. Subjects were made to breath-in and the measurement recorded in centimeters.

Weight: Measurements of weight of respondents were taken with respondents standing upright and the eye perpendicular to the height. They were bare-footed, in minimum clothing and without any objects on them UNI SECA Scale calibrated in Kg with a least count of 0.1 kg was used in taking the measurements.

Body mass index: The BMI as a derived quantity of weight and height was determined by dividing weight in kilograms by the height in meters squared.

Skin fold thickness measurement

Triceps: Subjects were made to relax their arm while the arm hangs. The skin and sub-cutaneous tissue were grasped 1 cm above the arms midpoint (between the tip of the acromial process of the scapula and the olecranon process of the ulna). The fold runs parallel to the long axis of the arm while measurements were taken at the posterior midline (Tam *et al*., 1999).

Biceps: The subject's arms were made to hang relaxed at the side. The anterior aspects of the upper arm skin fold were lifted directly above the centers of the cubital fossa. Measurements were taken at the same level as that of the triceps skin fold (Tam *et al*., 1999).

Sub scapular: With the shoulder and the arm relaxed 1 cm of the skin was lifted under the inferior angle of the scapular. The fold runs parallel to the natural cleavage lines of the skin before measurements were made (Tam *et al*., 1999).

Suprailiac: About 2 cm of the skin fold of the subjects were lifted above the iliac crest in the midaxillary line. Measurements were then taken. All the measurements were in duplicate and the average value taken as the skin fold measure. Using harpenden skin fold caliper measurements were taken to the nearest 0.2 mm on the left side of the body (Tam *et al.*, 1999).

Waist-to-Hip Ratio (WHR): Waist and Hip circumference were measured with subjects standing with feet together and in gentle expiration (WHO, 1995). Waist circumference was measured with a tape measure encircling the body horizontally at the umbilicus. The hip circumference was also measured at the level of maximal circumference in the hip region while they stood erect and with feet together. The waist-to-hip ratio was calculated by dividing the waist circumference by the hip circumference (Seidell *et al.*, 2001).

Dietary intake assessment

Food frequency questionnaire: Structured questionnaire with the list of Ghanaian foods were used to determine the frequency with which the study participants consume them. Subjects were made to tell the number of times they have eaten any of the food prepared from the Ghanaian food groups within the past week.

24 h dietary recall: Two day twenty-four hour dietary recalls (one week day and one weekend) were performed. The subjects were made to recall all foods and beverages consumed during the previous day noting the nature and amount of each item. Serving sizes were estimated with standard sized cups, bowls and spoons. Simple food models in pictorial form were used to quantify the reported food intake (Williams, 1994).

Blood pressure determination: Electronic digital sphygmomanometer was used to measure the blood pressure of the subjects on their left arm. Two blood pressure measurements were taken first before the questionnaire administration and other study measurements. The mean of the two blood pressure readings were recorded and taken as the blood pressure values for each study participants after they have rested for at least 5 min time interval before the second pressure measurements.

Data analysis: The data were entered and analyzed using Statistical Package for Social Sciences (SPSS version, 13.0). ESHA version 6.02 nutrient database was also used to analyze nutrient content of estimated food intake for the 24 h recall dietary survey. Means standard deviation and ranges were calculated for continuous variables while proportions were presented for categorical variables. Chi-square, independent sample t-test, correlation were used to determine the association between blood pressure, background characteristics, anthropometric indicators and lifestyle variables. Logistic regression was used to determine the extent to which significant variables predicted high blood pressure

RESULTS AND DISCUSSION

Body composition and blood pressure: As shown in Table 2, 127; 39.7% of the respondents had BMI within the range 25.0-29.9 kg m^{-2}. A total of 198; 61.9% overweight and obese cases were identified. About 122; 38.1% normal BMI respondents were observed. About 150; 46.9% of the respondents had a WHR $\geq$ 1.0 and 170; 53.1% had WHR <1.0. About 170; 53.1% of the respondents had their percent body fat within the normal range of 10-25%. Body mass index, waist-to-hip ratio and percent body fat were significant with blood pressure ($p<0.05$).

Table 2: Body composition in relation to blood pressure (N=320)

Variables	Normotensive N (%)	Prehypertensive N (%)	Hypertensive stage[1] N (%)	Hypertensive stage[2] N (%)	Total N (%)	p-value
BMI (kg m^{-2})[1]						
Normal	14 (4.4)	84 (26.3)	15 (4.7)	9 (2.8)	122 (38.1)	
Overweight	4 (1.3)	61 (19.1)	38 (11.9)	24 (7.5)	127 (39.7)	<0.001
Obese	2 (0.6)	22 (6.9)	28 (8.8)	19 (5.9)	71 (22.2)	
Total	20 (6.3)	167 (52.2)	81 (25.3)	52 (16.3)	320 (100.0)	
WHR[2]						
Normal	1 6 (5.0)	110 (34.4)	28 (8.8)	16 (5.0)	170 (53.1)	
Above normal	4 (1.3)	57 (17.8)	53 (16.6)	36 (11.3)	150 (46.9)	<0.001
Total	20 (6.3)	167 (52.2)	81 (25.3)	52 (16.3)	320 (100.0)	
%Body fat [3]						
Normal	17 (5.3)	110 (34.4)	28 (8.8)	16 (5.0)	170 (53.1)	
Above normal	3 (0.9)	57 (17.8)	53 (16.6)	36 (11.3)	149 (46.9)	<0.001
Total	20 (6.3)	167 (52.2)	81 (25.3)	52 (16.3)	320 (100.0)	

p-value significant at <0.05 (Chi-square test); [1]Body Mass Index (kg m^{-2}); <18.5 thin, 18.5-24.9 normal, 25.0-29.9 overweight; [2]WHR (Waist Hip Ratio) Male (<1.0 normal, ≥ 1.0 above normal) , [3]Normal body fat (%): 10-25%

There was an association existed between body mass index, waist-hip circumference ratio and percentage body fat. This confirms a study conducted by Jimaina and Van (2001) where similar findings were recorded in a cross-sectional study. In addition being obese or overweight had about 3-4 times risk for developing hypertension as compared to having normal body weight. This finding is consistent with Ramsay *et al.* (2006) where body mass index, waist circumference and fat mass index were associated with the prevalence of cardiovascular disease among 4,252 British men in a cross-sectional study.

A total of 61.9% overweight and obese cases were found in this study. This high prevalence of obesity and overweight cases recorded suggests the lack of nutritional awareness and understanding among the respondents. It also implies that, the majority of people still accept the notion that big is beautiful, which emphasizes hierarchy and status in communities (Jimaina and Van, 2001). The prevalence of obesity and overweight and its corresponding high hypertensive cases can be linked to overweight and obesity being associated with hypertension, metabolic syndrome, elevated blood lipid, diabetes mellitus and dyslipidemia (Harris *et al.*, 2000; Doll *et al.*, 2002). The high rate of central obesity (46.9%) and percent body fat (46.9%) recorded in this study suggests a potentially high risk for the development of diabetes, heart disease and hyperlipedemia (Doll *et al.*, 2002).

Nutrient intake and blood pressure: Correlation matrix analysis was conducted to evaluate the relationship between blood pressure and nutrient intake (Table 4). The study indicated that only potassium correlated significantly with both systolic and diastolic blood pressure. This finding is in agreement with Vogt *et al.* (1999) meta-analysis that suggested that, potassium lowers systolic and diastolic pressure particularly among people with high sodium intake. Also, according to LaRosa *et al.* (1999) diet rich in low fat and high in potassium, magnesium and calcium decreases blood pressure substantially and has a greater effect than reductions in sodium intake; but in this study, only potassium intake supported LaRosa *et al.* (1999) findings, this is likely to be attributed to the study being cross-sectional and again, the possibility that, the intakes of

Table 3: Average nutrient intakes of hypertensive and non-hypertensive

	Range for					
	Hypertensive		Non-hypertensive		Total	
Variables	Min.-Max.	Mean±SD	Mini.-Max.	Mean±SD	Min.-Max.	Mean±SD
Calories (kcal)	681.0-5507	2698.0±889.7	600.0-4881	2680.0±933	600.0-5507	2687.5±913.8
Protein (g)	18.7-515	110.1±59.2	16.4-802	103.3±65	16.4-802	106.2±63.2
Carbohydrate (g)	93.4-556	287.6±87.4	76.1-584	293.7±88	76.1-584	291.6±87.9
Total fat (g)	5.0-299	106.7±60.0	1.4-697	104.06±72	1.4-697	105.1±67.1
Dietary fiber (g)	5.0-299	106.7±60.0	0.9-79	20.6±11	0.9-122	20.7±12.2
Vitamin C (mg)	17.6-403	90.7±50.4	9.6-223	84.1±37	9.6-403	86.8±43.2
Calcium (mg)	13.2-4028	1141.9±851.6	3.9-3077	1049.0±976	3.9-4028	1087.8±926.2
Magnesium (mg)	0.03-569	68.5±80.9	0.03-573	59.2±72	0.03-573	63.1±75.9
Potassium (mg)	0.05-3813	540.5±556.9	0.03-573	59.2±72	0.02-3813	490.2±515.4
Sodium (mg)	0.03-355	335.3±553.2	0.03-133	298.2±370	0.03-355	313.6±454.9

Independent t-test (p = 0.05) shows no significant difference in the mean nutrient intake of hypertensive and non-hypertensive. However, the mean intakes of nutrients among the hypertensive were higher than that of the non- hypertensive

magnesium and calcium as a mineral nutrients by the study subjects not being enough to correlate with systolic and diastolic blood pressure discovered that, fiber intake failed to correlate significantly with systolic and diastolic blood pressure. This finding is consistent with other studies conducted to determine the effect of dietary fiber on blood pressure where inconsistent results were obtained (Vogt *et al.*, 1999).

Independent sample t-test was used to evaluate the differences between the means of nutrient intakes of hypertensive and non-hypertensive subjects (Table 3) but it was realized that, no significant association were obtained between the nutrient intakes in the two groups. This result demonstrates the fact that the nutrients consumed by the two groups are completely different with regards to their average nutrient intakes, with hypertensive consuming higher average nutrients. This finding indicates lack of knowledge on the health consequences associated with excessive nutrient intake among the study subjects.

Age and blood pressure: The research showed a significant association between age (years) and blood pressure. Besides, from the logistic regression analysis (Table 5) it was evident that, the risk of developing hypertension increased as the age of the respondents increased.

Respondents aged 50-59 years had about 8 times risk of developing hypertension compared to those aged 20-29 years. This confirms the Framingham study that found that, blood pressure rises as one ages (Steven and James, 1988). Also, according to Steven and James (1988) diastolic blood pressure peaks and falls as one ages, but systolic blood pressure tend to rise linearly with age throughout adult life.

The results support Steven and James (1988) study that showed that, for all men, the prevalence rate of hypertension doubles from 28.4% in the 35-44 year range to 60.2% in the 65-74 year range. This finding can be as a result of the fact that, as one ages there is a decrease in compliance and an increase in rigidity of the aorta and its major tributaries. The aorta becomes increasingly rigid with thickening of the arterial intima and media. These layers of the vessel become laden with calcium, collagen, elastin and glycosaminoglycans which results in a progressive decrease in elasticity and compliance thereby impeding the flow of blood supply to vital body tissues and cells (Steven and James, 1988).

Table 4: Correlation matrix of nutrient intake and blood pressure

	SBP (mm Hg)[1]	DBP (mm Hg)[2]	Calories (kcal)	Protein (g)	Carbohydrate (g)	Total fat (g)	Dietary fiber (g)	Vit C (mg)	Ca (mg)	Mg (mg)	K (mg)	Na (mg)
SBP (mmHg)[1]												
DSP (mmHg)[2]	20.48											
	<0.00											
Calories (kcal)	-0.02	0.04										
	0.70	0.45										
Proteins	0.08	0.09	0.32									
	0.11	0.11	<0.00									
Carbohydrates (g)	-0.09	-0.01	0. 43	0.24								
	0.09	0.77	<0.00	<0.00								
Total fat (g)	0.01	0.05	0.69	0.13*	0.20							
	0.84	0.37	<0.00	0.02	<0.00							
Dietary fiber (g)	-0.01	0.03	0.33	0.13*	0.40	0.08						
	0.77	0.52	<0.00	0.01	<0.00	0.12						
Vitamin C	0.04	0.01	0.43	0.24	0.39	0.14*	0.51					
(Vit C) (mg)	0.48	0.78	0.00	<0.00	<0.00	0.01	<0.00					
Calcium (Ca) (mg)	0.02	0.03	0.35	0.45	0.25	0.19	0.08	0.26				
	0.66	0.52	<0.00	<0.00	<0.00	0.00	0.16	<0.00				
Magnesium (Mg)	0.03	0.06	0.08	0.17	0.17	-0.02	0.01	0.07	-0.00			
(mg)	0.57	0.30	0.16	0.00	0.00	0.63	0.76	0.20	0.97			
Potassium (K) (mg)	0.11*	0.13*	0.14*	0.25	0.19	0.04	0.06	0.17	0.00	0.60		
	0.04	0.02	0.01	<0.00	0.00	0.42	0.27	0.00	0.98	<0.00		
Sodium (Na) (mg)	0.03	0.05	0.13*	0.07	0.09	0.10	0.01	0.05	-0.00	0.26	0.28	
	0.59	0.32	0.01	0.17	0.09	0.06	0.79	0.35	0.92	<0.00	<0.00	

*Correlation significant at the 0.05 level (2-tailed); [1]Systolic Blood Pressure; [2]Diastolic Blood Pressure; The Correlation matrix analysis shown above indicated that, only potassium intake correlated significantly with both systolic and diastolic blood pressure

Table 5: Odds ratios with 95% confidence interval for potential predictors of high blood pressure

Variables	Odds ratio (95% C.I.)
Age (years)[1]	1.00
Age 20-29	2.55 (1.12-5.81)
Age 30-39	3.34 (1.45-7.68)
Age 40- 49	7.56 (2.91-19.84)
Age 50- 59	
Waist-Hip ratio[2]	
Normal (<1.0)	1.00
Above normal (>1.0)	2.50 (1.45-4.29)
Body Mass Index[3]	
Normal (18.5-24.9)	1.00
Overweight (25.0-29.9)	2.98 (1.63-5.45)
Obese (> 30)	3.99 (1.90-8.37)

The regression coefficient for the entire model; $R^2 = 0.224$, [1]: Adjusted for age (years); years of work, income levels, marital status, educational status, staff categories, waist-hip ratio, body mass index, percentage body fat, diabetes status, hypertension status, special diet intake and property owning (car) were included in the regression model, [2]: Adjusted for waist-hip ratio; years of work, income levels, marital status, educational status, staff categories, body mass index, percentage body fat, diabetes status, hypertension status, special diet intake and property owning (car) were included in the regression model, [3]: adjusted for body mass index; years of work, income levels, marital status, educational status, staff categories, percentage body fat, diabetes status, hypertension status, special diet intake and property owning (car) were included in the regression model

CONCLUSIONS

The prevalence of obesity and overweight cases combined was very high (62.1%) with Body Mass Index, Waist-Hip Ratio and percentage body fat found to be factors that predispose the respondents to high blood pressure. The risk of developing hypertension increased with age with persons within the ages categories 30-39 years, 40-49 years and 50-59 years having odds ratio of 2.55 (95% CI: 1.12 -5.81), 3.34 (95% CI: 1.45-7.68) and 7.56 (95% CI: 2.91-19.84), respectively. Potassium intake correlated significantly and positively with both systolic ($r = 0.115$, $p= 0.04$) and diastolic blood pressures ($r = 0.133$, $p =0.02$).

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APPENDIX 1

Determination of sample size: The sample size calculation was done using:

$$n = Z^2_{1-\alpha/2}\ P\ (1\text{-}P)\ /d^2$$ (Bahram *et al.*, 2001)

where, n is the sample size, Z is the 95% confidence interval (CI), P is the prevalence of hypertension in the Ashanti Region and d is the percent

APPENDIX 2

Title of study: The Relationship between Dietary Intake, Body Composition and Blood Pressure in Male Adult Miners in Ghana.

As part of the activities in Nutrition and Food Science Department this year, we have decided to conduct a study on the relationship between Dietary Intake, Body Composition and blood pressure among underground male miners in the Obuasi Municipality.

The purpose is to generate information on these because of the unique nature of miners. The study will involve participants providing information about their socio-economic background and the kind of activities they engage in. Another component will involve you being measured (Weight, Height, Waist circumference, Hip circumference, Skin fold measurements and Blood pressure). All these procedures are non-invasive and have no identified risk to your health. We are by this letter informing you and seeking your consent to be part of the study.

I ……………………………………………………………………wish to participate [ ].

…………………………………… Date………………………………

Signature/Thumbprint of
Research Participant

……………………………………. Date………………………………

Signature of Investigator

APPENDIX 3

Questionnaire for the study of the Relationship between Dietary Intake, Body Composition and Blood Pressure in Male Adult Miners in Ghana

DEMOGRAPHY

a. Area of residence………………………………. b. House No…… c 1. ID...
c 2. Department……………………………. d. Age (years)…………………
e. How many years or months have you worked underground? ………………………
f. What is your tribe?
i. Akan [ ] ii. Ewe [ ] iii. Ga [ ] iv. Dagomba [ ] v. Other [ ] (Specify)………
g. What is your religion?
i. Christian [ ] ii. Moslem [ ] iii. Traditional [ ] iv. Others [ ] (Specify)……………
h. What is your level of education?
i. Primary [ ] ii. Middle/JSS iii. Secondary [ ] iv. Technical [ ] v. Tertiary [ ]
i. What is your marital status now?
i. Married [ ] ii. Single [ ] iii. Divorced [ ] iv. Widowed [ ] v. Separated [ ] vi. Other [ ] (Specify)…………

MORBIDITY
Hypertension

a. Are you hypertensive? i. Yes [ ] ii. No [ ]
b. If yes, for how long have you been suffering from hypertension?........................
c. Has any of your relatives ever suffered from hypertension?
i. Yes [ ] ii. No [ ].
d. If yes , specify
i. Father [ ] ii. Mother [ ] iii. Sister [ ] iv. Brother [ ]
v. Uncle [ ] vi. Auntie [ ] vii. Grandparents [ ] viii Other [ ] (Specify)……………
e. Are you on any special diet? i. Yes [ ] ii. No [ ]
f. If Yes, name it..
g. Are you on any hypertensive drug? i. Yes [ ] ii. No [ ] g. If Yes, which drug?...

ASSESSMENT OF BODY COMPOSITION

a. Weight (kg)……………………… b. Height (cm) …………………………
c. BMI (kg/m^2)… ………… d. % Fat……………………

F. Skin Fold Thickness Measurements (SFTM)

	Measurement 1 (mm)	Measurement 2 (mm)	Mean
Triceps SFTM			
Biceps SFTM			
Sub scapular SFTM			
Suprailiac SFTM			

G. Waist and Hip Circumference Measurements

	Measurement 1(cm)	Measurement 2 (cm)	Mean
Waist circumference			
Hip circumference			
WHR			

BLOOD PRESSURE DETERMINATION

Blood Pressure (mmHg)	Systolic B.P	Diastolic B.P	Time
1st reading			
2nd reading			
Mean			

ASSESSMENT OF EATING HABITS/DIETARY PATTERN
a. Food Frequency Questionnaire

Tell me how many times you have eaten any of these foods within the past one week

	1	2	3	4	5	9	CODE
Cereals, starchy roots and tubers							
Maize	0x	1x	2-4x	5-9x	10+	NK	MAIZE
Potatoes	0x	1x	2-4x	5-9x	10+	NK	POTAT
Millet	0x	1x	2-4x	5-9x	10+	NK	MILET
Rice	0x	1x	2-4x	5-9x	10+	NK	RICE
Plantain	0x	1x	2-4x	5-9x	10+	NK	PLANT
Yam	0x	1x	2-4x	5-9x	10+	NK	YAM
Cocoyam	0x	1x	2-4x	5-9x	10+	NK	COYAM
Cassava	0x	1x	2-4x	5-9x	10+	NK	CASSAV
Meat and egg products							
Beef	0x	1x	2-4x	5-9x	10+	NK	BEEF
Fish	0x	1x	2-4x	5-9x	10+	NK	FISH
Poultry	0x	1x	2-4x	5-9x	10+	NK	POULT
Egg	0x	1x	2-4x	5-9x	10+	NK	EGG
Milk	0x	1x	2-4x	5-9x	10+	NK	MILK
Mutton	0x	1x	2-4x	5-9x	10+	NK	MUTTON
Vegetable Foods							
Tomatoes	0x	1x	2-4x	5-9x	10+	NK	TOMAT
Carrot	0x	1x	2-4x	5-9x	10+	NK	CARROT
Green Leafy (e.g. kontomire)	0x	1x	2-4x	5-9x	10+	NK	GLVRG
Fruits							
Water melon	0x	1x	2-4x	5-9x	10+	NK	WMELON
Oranges	0x	1x	2-4x	5-9x	10+	NK	ORANGE
Banana	0x	1x	2-4x	5-9x	10+	NK	BANANA
Pineapple	0x	1x	2-4x	5-9x	10+	NK	PINEPLE

24-Hour Dietary Recall

Day	Time	Meal	Amount Eating
1	Breakfast		
	Lunch		
	Supper		
	Snack		
2	Breakfast		
	Lunch		
	Supper		

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