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Dietary Patterns and Metabolic Risk Factors for Cardiovascular Disease among University Students in Ghana

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ABSTRACT
Dietary intake is a strong modifiable index for Metabolic Risk Factors (MRF) for atherosclerotic cardiovascular disease. Poor dietary intake has been shown among Ghanaian university students but little is known about how that is related to MRF. This study examined dietary patterns and MRF among KNUST students. Data were collected from 66 randomly selected undergraduate students (31 males and 35 females) from 18-27 years old. Dietary intake was assessed using an 81 item food frequency questionnaire and patterns of dietary intake by K-means cluster analysis. The dietary patterns (clusters) were related to metabolic risk components including fasting blood lipids, fasting blood sugar, blood pressure and waist circumference. In this population, 34.3% of females and 9.7% males had low HDL; 22.9% females and 9.7% males had high LDL; and 11.4% females and 6.5% males had high total cholesterol. Three unique dietary (clusters) patterns were identified, termed: "broad", "convenience" and "ordinary". The "broad" cluster, characterised by a varied dietary intake of most food groups and good intake of fruits and vegetables was associated with more physically active (41.9%) participants than the others. The "ordinary" cluster, characterized by whole grains, meat and dairy products but low intake of fruits and vegetables, had more participants who drank alcohol (38.9%) and ate out (32.9%). The "convenience", characterised by very little to no fruits and vegetables intake, frequent skipping of breakfast (46.2%) and high beverage consumption was associated with higher serum triglyceride ($p = 0.021$) and total cholesterol ($p = 0.005$) among male participants. Between the three, the broad cluster seemed the best regarding types and frequencies of foods consumed and association with MRFs whereas the convenience cluster seemed the worst. In conclusion, our findings showed significant prevalence of MRF for CVDs in this young population and distinct dietary patterns, which were associated with these risk factors.

Key words: Dietary patterns, metabolic risk factors, students, cardiovascular disease

INTRODUCTION
Cardiovascular Disease (CVD), including Coronary Heart Disease (CHD), stroke and heart failure, is associated with 16.7 million deaths in the world every year (Keyhani et al., 2013) with 80% of all CVD deaths occurring in developing countries (WHO, 2012). In 2001, 9.2% of all deaths in Africa were caused by CVD (Abanilla *et al*., 2011) but it is estimated that CVD will cause 23 million deaths in the world by 2030 (WHO, 2012) In Ghana, CVD has been reported to be a leading cause of death in some parts of the country (Aikins, 2007). CVD was the predominant cause

of death in Accra, Ghana, in 1991 and 2001 (Aikins, 2007). Hypertension, heart failure and stroke account for 17.9% of acute medical admissions at Komfo Anokye Teaching Hospital (KATH), a major referral hospital in Ghana (Plange-Rhule *et al.*, 1999). More recently, the national prevalence of hypertension (one of the major causes of CVD in Ghana) has been estimated at 28.7% (Aikins, 2007).

Unhealthy diet, smoking and physical inactivity are among lifestyles that are now known to be major risk factors for CVDs (WHO, 2012; Berg *et al.*, 2008). Stroke, CHD and peripheral artery disease are directly affected by unhealthy diet (Anderson, 2003). These lifestyle factors predispose individuals to metabolic risk, including low serum HDL cholesterol, elevated serum triglyceride, high waist circumference, high blood pressure and high fasting blood glucose which ultimately predispose people to the development of hypertension and atherosclerosis (Afoakwah and Owusu, 2011; Onwuanyi *et al.*, 1998). These Metabolic Risk Factors (MRFs) are now estimated in patients to examine risk of developing diet-related CVDs (Lorenzo *et al.*, 2007).

Generally, dietary patterns characterized by high intake of fatty foods and refined carbohydrates and a low consumption of fruits and vegetables are commonly reported to be the causes of MRFs for CVDs (Berg *et al.*, 2008). In many developing countries, there is currently a shift in patterns of dietary intake towards more westernised foods (Bourne *et al.*, 2002) characterised by increased intake of saturated fat, salt and refined foods and decreased fruits, vegetables and fibre intake ultimately increasing the incidence of diet-related chronic diseases (Slattery *et al.*, 1998; Hu *et al.*, 2000). Increasing consumption of westernized foods high in fats, sugars and salt is a major contributor to the increasing prevalence of CVD in Ghana (Ministry of Health, 2010). In Ghana, the percentage of adults who consume sufficient amounts of fruits and vegetables is less than 5% (Government of Ghana, 2012).

Young Ghanaian university students are not left out in the current observed trend. University students are highly exposed to unhealthy eating habits, because of lack of time for cooking, stress and poor awareness. High consumption of fried foods, eggs sandwich for breakfast and rice for lunch and supper have been reported among students in Ghana (Danquah *et al.*, 2010). Because diet-related chronic diseases begin early in life, their prevention must also begin early (Hong, 2010) and dietary patterns of university-age adults are of great concern to achieve this.

There is a call on governments in Africa to draw effective policies to control the high prevalence of CVD deaths on the continent. The Ghana Health Service in heeding to this call has initiated interventions among school youth in the country with emphasis on healthy dietary behavior, low consumption of energy dense foods, salts, trans fatty acids and sugar to ensure primary prevention of CVD (Government of Ghana, 2012). However, limited data exist on dietary intake among Ghanaian university students and its associated effects to serve as justification for specific interventions. The study sought to characterise the diet and determine the relationship between dietary patterns and metabolic risk factors for CVD among KNUST students.

METHODOLOGY

This study was a cross-sectional study conducted between January and May, 2013 at Kwame Nkrumah University of Science and Technology (KNUST), a tertiary institution with about 20000 under-graduate students located in Kumasi, Ghana. The participants of the study were selected randomly from the University hostel facilities. A total of 66 students gave their consent to participate in the study.

An approved research information leaflet and consent form was provided to prospective participants to decide if they would like to be part of the study. Participants were required to sign the written consent form, which was documented systematically using code numbers. Students aged 18 years and above who gave their consent were eligible for the study. Pregnant female students were excluded from the study.

A detailed questionnaire was then used to collect demographic data of eligible subjects. The questionnaire also captured information about health, lifestyle factors and family history of CVD. All consented participants were invited to the Clinical Analysis Laboratory (CAnLAB) of the Department of Biochemistry and Biotechnology, KNUST the next day for physical examination and donation of fasting blood sample after completion of the health history and dietary questionnaires. This study was approved by the Committee on Human Research Publication and Ethics (CHRPE) of the School of Medical Sciences, KNUST and Komfo Anokye Teaching Hospitals.

Dietary assessment: Information on food intake pattern over a period of three months was assessed with a self-administered Food-Frequency Questionnaire (FFQ) designed to reflect the foods commonly consumed by KNUST students. Food items on the FFQ were obtained from results of a focus group discussion conducted among 10 KNUST students (6 female and 4 male students). The FFQ included a list of 81 food items with 8 frequency categories of intake ranging from “daily” to “never.”

Assessment of metabolic risk factors for CVD: Metabolic risk factors for CVD were characterized by the components of the metabolic syndrome defined by the National Cholesterol Education Program, Adult Treatment Panel III (Lorenzo *et al*., 2007). These components include Waist Circumference (WC), Blood Pressure (BP), High Density Lipoprotein cholesterol (HDL-c), serum triglycerides (TG) and fasting blood glucose (FBS) (Lorenzo *et al*., 2007). Waist circumference (cm) of each subject was measured using a plastic tape measurement at a level just above the navel with participants wearing no shoes. A manual aneroid sphygmomanometer with an appropriate size of cuff was used to take two measurements each of systolic and diastolic blood pressures (at least 20 minutes apart) in mmHg. The average of the two measurements was used for analysis.

Five milliliters of blood sample was collected from each subject by venipuncture after an 8-12 h overnight fast and the serum was separated. The separated serum was analyzed for total cholesterol and triglycerides using enzymatic methods designed by fortress diagnostics Limited, United Kingdom. Serum HDL cholesterol was measured after phosphotungstic acid-magnesium chloride precipitation of LDL and VLDL. The semi-micro assay method was used in the precipitation procedure. The concentration of the HDL cholesterol was determined using the CHOD-PAP (Total cholesterol) method. The concentration of low-density lipoprotein cholesterol (LDL) was calculated using the Friedwald formula. The method was repeated for all samples. Serum samples from specimens in fluoride tubes were also analyzed for glucose using the glucose oxidase method designed by fortress diagnostics Limited, United Kingdom.

Data analysis: Statistical analysis of data was done using SPSS software, version 16.0.1 (SPSS Inc., Chicago IL, USA). Scores were provided from the responses of the FFQ data as follows: never = 1, occasionally = 2, once per month = 3, once per two weeks = 4, once per week = 5, two-three times per week = 6, four-six times per week = 7 and daily = 8. The major food patterns of students were identified using K-means cluster analysis. The criteria below were adopted to categorize metabolic risk factors as follows: Waist Circumference: Men ≥102 cm, Women ≥88 cm; Blood pressure: Systolic ≥130 mmHg, Diastolic ≥85 mmHg, Total Cholesterol: ≥5.2 mmol L^{-1}, HDL cholesterol: Men ≤1.0 mmol L^{-1}, Women ≤1.3 mmol L^{-1}, LDL cholesterol: >2.6 mmol L^{-1}, Serum triglycerides: ≥1.7 mmol L^{-1}; Fasting Blood glucose: ≥6.1 mmol L^{-1}(Lorenzo *et al*., 2007). The ranges above are standards used to determine if the measures are within normal levels or not. Where necessary, analysis was stratified by gender or controlled for possible confounders. One-way ANOVA was used to determine the significance of the mean values of metabolic risk factors between the major dietary patterns. Chi-squared test was used to determine significance of prevalence metabolic risk factors for CVD among the major food clusters.

RESULTS

Descriptive characteristics of study population: Sixty-six participants took part in the study, 31 (47) were males and 35 (53%) were females. Study participants were from 18-27 years old, with mean age of 21 (±2.2) years, whilst the males slightly older than the females (p = 0.171) (Table 1). All participants were non-smokers, 5 (7.6) drank alcohol, 52 (78.8%) participants skipped breakfast frequently and 18 (27.3%) ate at restaurants or fast foods 3 times or more per week. Thirty one (47%) participants engaged in 30 min or more of moderate physical activity on most days of the week; the males had a higher rate than the females (p = 0.007). There was no significant sex difference in the mean DBP but the mean SBP was significantly higher in the males (110 mmHg) than in the female (104 mmHg) students (p = 0.003). The means FBS was 4.67 (±0.84) mmol L^{-1}, serum TC was 3.78 (±0.77) mmol L^{-1}, TG was 0.61 (±0.31) mmol L^{-1}, HDL was 1.53 (±0.38) mmol L^{-1} and LDL was 1.97 (±0.77) mmol L^{-1}. There were no significant differences between males and females.

Prevalence of metabolic risk factors for cardiovascular disease among participants is presented in Table 2. Prevalence of high FBS was 1.5%, high TC was 9.1%, high TG was 1.5% and low HDL was 22.7% Prevalence of high LDL was 16.7%, high DBP 12.1 and high WC being 3%. None of the participants SBP considered high. The frequencies of high FBS, TC, TG, LDL, DBP and WC were not statistically significant by gender but the prevalence of low HDL was significantly (p = 0.017) higher in females (34.3%) than in males (9.7%).

Table 1: Characteristics of participants by sex

Variable	Male	Female	Total	p-value
	----------N (%)----------			
Participants	31(47.0)	35(53.0)	66 (100)	
Exercise	20 (64.5)	11 (31.4)	31 (47.0)	**0.007***
Skip Breakfast	25 (80.6)	27 (77.1)	52 (78.8)	0.72
Drinking	4 (12.9)	1 (2.9)	5 (7.6)	0.18
	----------Mean±SD----------			
Age (years)	21.4±2.35	20.7±1.95	21.0±2.2	0.17
SBP (mmHg)	110±8	104±8	107±9	**0.003***
DBP (mmHg)	77±7	75±7	76±7	0.14
WC (cm)	73.8±5.1	73.4±8.3	73.6±6.9	0.82
FBS (mmol L^{-1})	4.76±0.86	4.59±0.84	4.67±0.84	0.42
TC (mmol L^{-1})	3.60±0.74	3.95±0.76	3.78±0.77	0.07
TG (mmol L^{-1})	0.65±0.34	0.57±0.27	0.61±0.31	0.32
HDL (mmol L^{-1})	1.48±0.35	1.58±0.40	1.53±0.38	0.29
LDL (mmol L^{-1})	1.82±0.67	2.11±0.83	1.97±0.77	0.13

Table 2: Prevalence of metabolic risk factors for CVD by sex

Variable	Male	Female	Total	p-value (χ^2-test)
Participants	31(47)	35(53.0)	66	
FBS ≥6.1 (mmol L^{-1})	0 (0)	1 (2.9)	1 (1.5)	1.00
TC ≥5.0 (mmol L^{-1})	2 (6.5)	4 (11.4)	6 (9.1)	0.67
TG > 1.7 (mmol L^{-1})	1 (3.2)	0 (0)	1 (1.5)	0.47
HDL ≤1.0 (M)	3 (9.7)	12 (34.3)	15 (22.7)	**0.02***
HDL ≤1.3 (F) (mmol L^{-1})				
LDL > 3.0 (mmol L^{-1})	3 (9.7)	8 (22.9)	11 (16.7)	0.15
SBP ≥130 (mmHg)	-	-	-	-
DBP ≥85 (mmHg)	4 (12.9)	4 (11.4)	8 (12.1)	1.00
WC ≥102 (M) (cm)	0 (0)	2 (5.7)	2 (3)	0.49
WC ≥88 (F) (cm)				

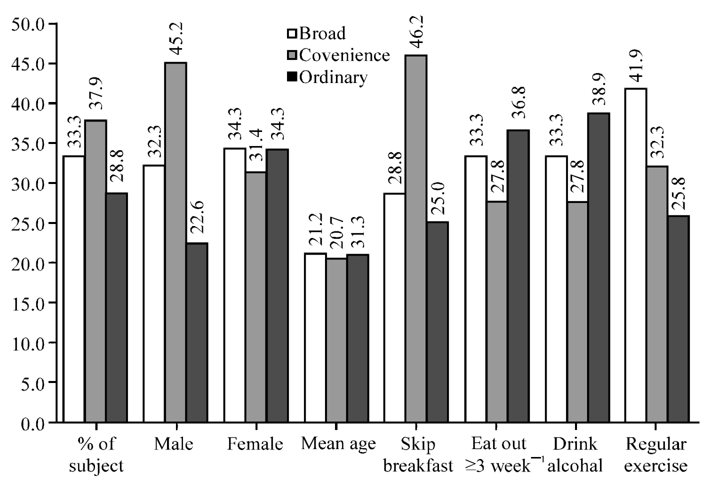

Fig. 1: Relating dietary patterns and some background characteristics

Patterns of dietary intake: Three distinct dietary (clusters) patterns were identified by K-means cluster analysis; “broad”, “convenience” and “ordinary” (Table 3). The food clusters were named according to the types of foods and their frequencies consumed. The broad cluster, on the average, was characterized by consumption of tomatoes stew and cocoa powder drinks (2-3 times per week) and weekly consumption of bread, fried fish, tinned fish, oranges, fried ripe plantain, “jollof” or fried rice, fried and boiled egg, “kenkey” or “banku”, fruit juice and cakes or sweet biscuits consumption. In the convenience cluster, cocoa powder drinks (such as Milo™, Richoco™ and Chocolim™) were the only food items consumed once per week on the average. All other foods were consumed less than once per week. The ordinary cluster was associated with 2-3 times per week consumption of tomatoes stew. Cocoa powder drinks, fried egg, sugar bread, fruit juice, fried chicken, kenkey, jollof/ fried rice, butter bread and fried fish were consumed once a week on the average. All other food items were consumed less than once a week.

Among the three clusters, the broad group was associated with better consumption of varied food groups and fruits and vegetables compared with the others. The ordinary group had fewer foods and food groups where as the convenient group was mainly cocoa drink (Table 3).

Table 3: Food consumption pattern determined by k-cluster analysis

Broad (n = 22)		Convenience (n = 25)		Ordinary (n = 19)	
Food item	Mean±SD	Food item	Mean±SD	Food item	Mean±SD
Fresh or tinned tomatoes stew	6.7±0.9)	Cocoa powder drinks	5.4±2.0	Fresh or tinned tomatoes stew	6.4±1.7
Cocoa powder drinks	6.5±1.5	Fresh or tinned tomatoes stew	4.8±2.2	Fried egg	5.8±1.7
Butter bread	5.9±1.7	Kenkey/banku	4.8±2.1	Sugar bread	5.7±2.3
Fried fish	5.9±1.6	Oranges	4.5±2.2	Fruit juice	5.6±2.0
Tinned fish	5.7±1.6			Fried chicken	5.5±1.5
Oranges	5.5±2.0			Kenkey/banku	5.5±2.0
Fried ripe plantain	5.4±1.3			Jollof/ fried rice	5.4±1.6
Jollof/ fried rice	5.3±1.8			Butter bread	5.3±2.5
Boiled egg	5.3±1.6			Cocoa powder drinks	5.2±2.3
Kenkey/banku	5.2±1.7			Fried fish	5.1±1.9
Tomatoes soup	5.1±2.0			Boiled egg	4.8±1.7
Fried egg	5.1±1.6			Oranges	4.8±2.4
Fruit juice	5.0±2.2			Flavoured milk drinks	4.7±2.5
Cakes/sweet biscuits	5.0±1.9			Boiled, grilled chicken	4.6±2.3
Raw tomatoes	4.8±2.5			Soft drinks	4.6±2.3
Banana	4.8±2.0			Fried yam	4.2±1.7
Wakye (rice and beans)	4.8±1.9			Boiled beef	4.2±2.2
Fried chicken	4.8±1.6			Yogurt	4.1±1.8
Boiled, grilled fish	4.8±2.2			Boiled goat meat	4.0±2.0
Salad	4.7±1.9				
Flavoured milk drinks	4.7±2.3				
Fried yam	4.6±1.7				
Yogurt	4.6±2.0				
Raw carrots	4.5±2.1				
Pasta, noodles	4.5±2.3				
Soft drinks	4.4±1.7				
Roasted ripe plantain	4.3±1.8				
Boiled plantain	4.3±1.7				
Cabbage stew	4.3±1.8				
Raw onions	4.3±2.5				
Meat pies	4.1±1.4				
Fufu	4.2±1.9				
Palm nut soup	4.0±2.3				
Plantain chips	4.0±1.9				
Ice-cream	4.0±1.8				

Association between dietary clusters and lifestyle characteristics: Relating the dietary cluster with some lifestyle factors (Fig. 1), it is shown that the convenient dietary cluster was associated with significantly more males (45.2 versus 32.3 for broad and 22.6% for ordinary), breakfast skippers (46.2 versus 28.8 for broad and 25% for ordinary: $p<0.028$) and more subjects (37.9%) compared with the other clusters. The ordinary cluster was associated with more alcohol drinkers and those who ate outside although these differences were not significant. The broad cluster on the other hand was associated with significantly more participants who exercised regularly (41.9%) compared with the convenient (32.3%) and ordinary cluster (25.8%).

Table 4: Elating dietary patterns by prevalence of the metabolic risk factors for cardiovascular disease

Variable	Broad	Convenience	Ordinary	p-value
High TC	1 (4.5)	4 (16.0)	1 (5.3)	0.31
Low HDL	7 (31.8)	4 (16.0)	4 (21.1)	0.42
High LDL	2 (9.1)	6 (24.0)	3 (15.8)	0.39
High TG	0 (0)	1 (4.0)	0 (0)	0.43
High FBS	1 (4.5)	0 (0)	0 (0)	0.36
High DBP	2 (9.1)	5 (20.0)	1 (5.3)	0.29
High WC	1 (4.5)	0 (0)	1 (5.3)	0.53
Total	14 (63.6)	20 (80)	10 (52.6)	0.15

Table 5: Relating dietary patterns by mean values of metabolic risk factors

Variable	Broad	Convenience	Ordinary	p-value
TC (mmol L^{-1})	3.57	3.92	3.85	0.27
HDL (mmol L^{-1})	1.45	1.56	1.58	0.48
LDL (mmol L^{-1})	1.87	2.02	2.04	0.73
TG (mmol L^{-1})	0.54	0.74	0.51	0.02*
FBS (mmol L^{-1})	4.63	4.80	4.53	0.55
SBP (mmHg)	107	108	105	0.55
DBP (mmHg)	76	77	74	0.34
WC (cm)	73.90	74.35	72.15	0.56

Association between dietary clusters and prevalence of metabolic risk: The prevalence rates of the metabolic risk factors for cardiovascular disease are presented in Table 4. Although, statistically not significant, there were more participants in the convenient cluster who had high LDL (24% convenient versus 15.9% ordinary and 9% broad cluster), high DBP (20% convenient versus 5.3% ordinary and 9.1% broad cluster) and high TC (16 convenient versus 5.3 ordinary and 4.5% broad cluster) than the other clusters. There were also more participants in the broad cluster who had high HDL than the other clusters. The total number of participants who suffered from at least one metabolic risk factor in each cluster was 80% for the "convenience" cluster, 63.6% for the "broad" cluster and 52.6% for the "ordinary" cluster.

Relating dietary clusters by means of metabolic risk indices: There was a significant effect of dietary pattern on triglyceride level for the three clusters [F (2,63) = 4.117, p = 0.021] Table 5. Post hoc comparisons showed that the mean triglyceride value for the "convenience" cluster (0.74±0.40) was significantly higher than the "ordinary" cluster (0.51±0.16) (p = 0.034). However, the "broad" cluster (0.54±0.24) did not differ significantly from the two clusters. There was no significant difference in the HDL cholesterol, LDL cholesterol, fasting blood glucose, systolic blood pressure, diastolic blood pressure and waist circumference between the three dietary patterns.

Relating dietary clusters by means of metabolic risk indices stratified by gender: Dietary pattern had a significant effect on total cholesterol and triglyceride level among males [F (2,28) = 4.078, p = 0.028; F (2, 28) = 6.373, p = 0.005 respectively]. Among the males, mean TG and TC were significantly lower among the broad cluster than the rest (Table 6). Post hoc comparisons showed that the mean total cholesterol for the "convenience" cluster (3.93±0.86) was significantly higher than the "broad" cluster (3.13±0.46) (p = 0.021) but the "ordinary" cluster

Table 6: Relating dietary patterns by mean values of metabolic risk factors, stratified by gender

Variable	Broad	Convenience	Ordinary	p-value
MALE	**N = 10**	**N = 14**	**N = 7**	
TC (mmol L^{-1})	3.13	3.93	3.61	0.028*
HDL (mmol L^{-1})	1.41	1.53	1.49	0.73
LDL (mmol L^{-1})	1.50	2.00	1.93	0.182
Triglycerides (mmol L^{-1})	0.48	0.86	0.47	0.005*
FBS (mmol L^{-1})	4.44	4.95	4.83	0.35
SBP (mmHg)	108	113	108	0.36
DBP (mmHg)	0.79	77	76	0.58
Waist (cm)	73.4	74.25	73.2	0.89
FEMALE	**N = 12**	**N = 11**	**N = 12**	
TC (mmol L^{-1})	3.94	3.92	3.98	0.98
HDL (mmol L^{-1})	1.49	1.61	1.64	0.63
LDL (mmol L^{-1})	2.18	2.05	2.10	0.93
Triglycerides (mmol L^{-1})	0.59	0.59	0.53	0.84
FBS (mmol L^{-1})	4.79	4.62	4.36	0.46
SBP (mmHg)	105	103	104	0.76
DBP (mmHg)	0.74	77	73	0.36
Waist (cm)	74.3	74.5	71.5	0.63

(3.61±0.45) did not differ significantly from the two clusters. Again, post hoc comparison showed that the mean triglyceride level for the "convenience" cluster (0.86±0.37) was significantly higher than both the "broad" cluster (0.48±0.24) ($p = 0.012$) and the "ordinary" cluster (0.47±0.17) ($p = 0.02$). The "ordinary" cluster did not differ significantly from the "broad" cluster. Among the females, there was no statistical difference in the mean values for MRFs between the dietary patterns.

DISCUSSION

In this study, there was as significant prevalence of metabolic risk for cardiovascular disease in this young population and this was higher in females. Close to 10% had high total cholesterol, 16.7% had high LDL and about a quarter had low HDL. It is notable that these parameters are already of concern in this young population. Moreover, prevalence of most of the MRF were higher in females, with low HDL recording significant differences between females and males and this shows that the female had higher risks. Hyperglycaemia, hypertension, abdominal obesity and lipid disorders are generally more common in older people (Nkum and Micah, 2012) and the low prevalence observed in this study could be attributed to the age group studied but we have observed that these problems are occurring in much younger ages now.

Three unique dietary patterns were identified in this study of which no significant difference in the prevalence of metabolic risk factors for CVD were identified. None of the three patterns seemed to meet dietary guidelines, which would help reduce cardiovascular disease risk (Kelly and Stanner, 2003), such as consumption of 5 portions of fruits and vegetables a day, low dietary fat and energy dense food and consumption of unsaturated fatty acids. In this study, fruits and vegetables were consumed less than 2-3 times per week across the three clusters. More than 50% of subjects skipped breakfast regularly, another critical health-promoting recommendation (Ruxton and Kirk, 1997). Our results suggest a generally poor dietary lifestyle and possible dietary inadequacy consistent with other studies among Ghanaian university students (Danquah *et al.*, 2010). The ordinary dietary pattern (cluster) was also comparable to a typical Ghanaian diet, which is characterized by frequent (4.2 days per week) consumption of maize containing foods such as banku and kenkey, wheat/bread (3days), rice (2.8 days) and very low consumption of meat (less than 2 days per week) (Biederlack and Rivers, 2009).

Between the three patterns however, the broad group showed a more varied and balanced diet and was better associated with fruits and vegetables intake than the others. The convenient pattern seemed the worse although more participants followed this pattern. The "convenience" cluster was characterized by very low consumption of whole grain foods such as wheat bread, pasta and rice, fruits and vegetables, fish and meat. Majority of persons (96%) in this cluster also reported to skip breakfast frequently. Consumption of fruits and vegetables and green tea, known to increase the antioxidant status of the body thereby reducing the level of oxidized fats in the blood (Tribble, 1999; Cabrera *et al*., 2006) was more unlikely among consumers of this pattern.

Many studies have found variations in lipid disorders among different dietary patterns (Berg *et al*., 2008; Wirfalt *et al*., 2001). Healthy food patterns are normally associated with low lipid disorders as compared to less healthy dietary patterns (Olinto *et al*., 2012). In the present study, mean triglycerides level was significantly higher in the "convenience" than the "ordinary" cluster ($p = 0.021$). The "broad" cluster did not differ significantly, although the level of triglycerides was lower than the "convenience" cluster. Furthermore, when stratified by gender, total cholesterol and triglyceride levels among males who followed the "convenience" cluster was significantly higher ($p = 0.028$ and $p = 0.005$ respectively) than the other two clusters, indicating that the "convenience" dietary pattern (37.9%) was associated with increased metabolic risks for CVD among males. It seems the broad cluster was not different from the ordinary patterns with regards to association with MRF whereas the convenient pattern was different from both patterns.

Frequent consumption of diets rich in fat, cholesterol and refined carbohydrates are strongly linked to central obesity (Zhao *et al*., 2008). In this study although prevalence of obesity was low, it did seem some of these young university students had lifestyles that put them on the road to development of obesity and its consequences in the future such as low intake of fruits and vegetables, low physical activity and breakfast skipping.

CONCLUSIONS

In conclusion, this study identified siginifant prevalence of MRF for CVDs in this university population. The three unique patterns of dietary intake identified were all associated with inadequate fruits and vegetables intake but the broad category was most optimal compared to the other two. Our study also showed possible association between patterns of dietary intake and MRF, which seem to be apparent in this young population. Further research among other young Ghanaian populations are recommended in order to fully understand what is happening and to intervene early.

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