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Full Length Research Paper

The influence of dietary intake on the serum lipid profile, body mass index and risk of cardiovascular diseases in adults on the Niger Delta region

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This study is designed to assess some of the risk factors for cardiovascular diseases (CVD) in healthy adult subjects in the Niger Delta region of Nigeria, in relation to their dietary intake habits. 131 male and female adults aged 20 - 40 years were assessed. Anthropometric measurements, blood pressure, serum lipid profile and electrolytes among two populations were estimated. Diet history recall questionnaire, food sample analysis and food composition tables were used to compute energy and nutrients intake. In Delta State subjects, the body mass index (BMI) was significantly different from those of Cross River State. There was a significantly higher intake in energy and protein and a lower fibre and ash intake by the participants from Delta State. Total serum cholesterol (TC), high density lipoprotein-cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C), triacylglycerides (TG) and TC/HDL-C ratio, were also higher in Delta State participants. In conclusion, we inferred that 22, 15 and 35% of the participants from Delta State were at risk of CVD compared to 5, 6 and 10% from Cross River based on the respective BMI, blood pressure and TC/HDL-C ratio values.

Key words: Body mass index, cardiovascular diseases, dietary intakes, serum lipids.

INTRODUCTION

Cardiovascular disease is the primary cause of mortality in developed countries and the leading cause of death in developing countries as well (Minh et al., 2003). Prospective and retrospective studies have shown that cardiovascular risk factors, namely: Obesity, lipid profile, unhealthy diet and sedentary lifestyle, have their roots in childhood and tend to track into adulthood (Ericksson et al., 2001).

The continuous modernization and technological advancement of the developing world has brought rapid lifestyle changes which result to the consumption of fast-food, caloric dense diets and sedentary lifestyle, which are known to have a major impact in the development of cardiovascular diseases and chronic diseases (Callabero, 2001). Many investigators have pointed out that excessive intake of dietary saturated fat and especially cholesterol increases the serum cholesterol, thus leading to a high risk of cardiovascular diseases (Ye and Kwiterovich, 2000). Food sources containing saturated fats and those derived from animal sources such as milk fat, lard and tallow, has been a major cause of health hazard in populations that depends mainly on animal food source (Ye and Kwiterovich, 2000). However, all saturated fats, whether animal or vegetable in origin, have been discredited because they cling to the wall of blood vessels, thereby forming plague and obstructing the normal flow of blood (Witztum and Steinberg, 1991).

The tropical oils such as palm oil, palm kernel oil and coconut oil, sunflower oil, corn oil, olive oil, hard nut oil, etc, have been major targets of health campaigns against the wider consumption of saturated fats (Ng et al., 1992). Interestingly, researches have shown that ingestion of fibre sources containing a greater proportion of soluble components of dietary fibre, such as oat-bran, dried

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beans and pectin are effective in lowering plasma cholesterol concentration whereas sources with little soluble fibre such as wheat bran are ineffective hypocholesterolaemic agents (Ericksson et al., 2001; Ye and Kwiterovich, 2000).

There are, however, multiple genetic influences on lipoprotein metabolism that may render certain individuals in the same population as either “dietary responsive” or “dietary non-responsive” to fat intake (Ye and Kwiterovich, 2000). These influences have been widely studied in children and adults in the western world and intervention programmes aimed at reducing the risk of cardiovascular diseases in children and adolescence in the last two decades have been initiated in the Third World countries (Ford et al., 2004), Nigeria inclusive. The rationale for this preventive approach is based on extensive evidence from research, that early lesions of coronary atherosclerosis begins in childhood are associated with serum cholesterol concentrations (Berenson et al., 1992). In Southern Region of Nigeria, habitual meals and soups are mainly prepared using palm oil and to a lesser extent, other vegetable oils. These soups were served along with tropical roots tubers and root food products. These foods contain high caloric value and fibre content. However, the dietary intake pattern varies from one ethnic group to another within these regions. This may be due to specific cultural food regimens.

The present study is aimed at investigating the serum profile of apparently healthy adults between 20 - 40 years of age on the Niger Delta region of Nigeria, in relation to their dietary intakes and possible risk of cardiovascular diseases.

MATERIALS AND METHODS

Selection of subjects

One hundred and thirty-one (131) adults, both males and females between 20 - 40 years of age from Delta and Cross River States were used to represent the cross-section of the inhabitants of the Niger Delta Regions. The target population was drawn from two local government areas in each State: Ethiope East and Aniocha South in Delta State and, Calabar and Odukpani local governments in Cross-River State, respectively.

Evaluations of the diet and measurement of body mass index

Diet history recall questionnaire, food frequency lists, food record and observation of food intake was done according to the method of Derelian (1988). The body mass index was done according to the method of Keys et al. (1972).

Collection procedure of blood samples

Whole blood specimen of the subjects was collected by venepuncture techniques using a 5 ml disposable syringe with a needle. The whole blood was allowed to cloth and then centrifuged at 3,500 rpm for 5 min at 25°C. The resulting supernatant (serum) was collected into sterile sample screw capped bottle and stored frozen until needed.

Biochemical analysis

The enzymatic end point method of Richmond (1973) was used to estimate total cholesterol (TC). Triacylglycerides was determined by the method of the Study Group of Atherosclerosis Society (1987).

Serum sodium was determined by the method of Gulder et al. (1982), while the estimation of total potassium was determined by the method of Tietz (1982). High density lipoprotein cholesterol (HDL-C) was estimated according to the method of the National Cholesterol Education Programme (NCEP, 2001). Low density lipoprotein cholesterol (LDL-C) concentration in the serum was calculated directly from values obtained from total cholesterol (TC), HDL-C and triacylglycerides (TG), using Friedewald et al. (1972).

Chemical determination of food composition

Proximate analysis of food composition of the participants was determined by the method of the Association of Official Analytical Chemist (AOAC, 1980).

Statistical analysis

The data obtained were analyzed using the analysis of variance (ANOVA) and the values expressed in mean ± standard error of mean (SEM), except otherwise stated.

RESULTS AND DISCUSSION

In Southern Region of Nigeria, especially the Niger Delta Region, habitual meals and soups are mainly prepared using palm oil and to a lesser extent, other vegetable oils. These soups were served along with tropical roots tubers and root food products. The foods contain high caloric value and fibre content (Oguntona and Akinyele, 1995). However, the dietary intake pattern varies from one ethnic group to another within these regions. This may be due to specific cultural food regimens.

The results of the proximate analysis of foods consumed by participants in the Niger Delta Region of Nigeria (Table 1) revealed that Oghwo soup, which is more frequently and culturally consumed by participants from the Delta State region, contains the highest lipid content (57.5 g/ 100 g of food) among the food samples analyzed. However, the lipid content of Abak soup (25.5 g/ 100 g of food), the highest lipid-containing soup more frequently consumed by Cross-River State participates, is approximately 2.25 times lesser than that of the Oghwo soup. This connotes a higher risk of contracting cardiovascular diseases among the participants from Delta State than Cross-River.

Table 2 shows the mean weight, height and body mass index (BMI) of participants from Delta and Cross-River States, whereas Table 3 shows the daily energy

Table 1. Proximate analysis of foods consumed by participants.

Food samples (local names of mixtures)	Moisture	Ash	Fibre	Protein	Lipids	Carbohydrate	Energy (kcal/100 g of food)
	g / 100 g of food						
Banga soup	32	8.3	10.3	13.2	24.5	11.7	66.0
Oghwo soup	21	1.3	0.3	9.1	57.5	10.8	245.4
Vegetable soup	33	7.4	2.5	17.5	19.0	20.6	537.4
Melon plain soup	65	2.5	1.4	10.8	10.5	10.1	209.1
Etok meal	47	4.3	1.9	8.2	9.0	30.6	115.1
Afang soup	24	10.8	13.2	26.5	15.5	9.5	56.8
Abak soup	35	8.0	3.2	15.3	25.5	13.0	175.5
Ekpankukwo soup	32	4.2	3.6	5.9	11.5	42.0	257.8
Affiaefere soup	63	3.4	2.2	7.9	9.0	14.5	152.5
Garri	60	1.5	9.4	2.1	-	27.0	40.4
Fu-Fu	27	1.0	6.0	1.4	-	64.6	29.1

Table 2. Mean weight, height and body mass index of participants from Delta and Cross-River States.

Variables	Delta State (n = 69)	Cross-River (n = 62)
Weight (kg)	74.7 ± 1.14a	70.8 ± 1.04b
Height (m)	1.77 ± 0.01a	1.78 ± 0.01a
Body Mass Index (Kg/m^2)	24 ± 0.04a	22.2 ± 0.28b

Values expressed in mean ± SEM. n = number of participants. Values with different small letters in the same line are significantly different at the level of 0.05 ($P < 0.05$).

Table 3. Daily energy and nutrient intake of participants from Delta and Cross-River States.

Variables	Delta State (n = 16)	Cross River (n = 17)
Energy (Kcal)	3727.2 ± 253.93a	31206 ± 236.80b
Carbohydrate (g)	431.8 ± 34.40a	485.2±33.73a
Protein (g)	249.7 ± 12.91a	163.3 ± 11.20b
Fibre (g)	61.2 ± 7.58a	78.1 ± 8.30b
Total lipids (g)	117. 0 ± 13.90a	108.7 ± 8.30a
Ash (g)	29.8 ± 3.20a	63.3 ± 5.62b

Values given as mean ± SEM. Using food composition of Oguntona and Akinyele (1955). n = number of participants. Values with different small letters in the same line are significantly different at the level of 0.05 ($P < 0.05$).

and nutrient intakes of participants from Delta and Cross-River States. There was a significant difference in blood lipids in relation to body mass index (BMI) and nutritional habits of the population studied. These findings agree with epidemiological surveys in developing countries which reports on the distribution and positive profile association of blood lipids profile, BMI and dietary habits factors as related to cardiovascular risk (Kuzawa et al., 2003).The nutritional status of the individual in the groups studied might be the possible determinant of the body mass and serum lipid levels. Delta State participants, with a higher nutritional status, had a higher mean body mass index value and higher serum lipid profile compared to those of the Cross-River participants (Table 4). Blood lipids, especially cholesterol, increased with changes in body weight from the normal weight level. Hallak and Nomani (1958) first noted an increase in blood cholesterol level with weight loss or gain during and after fasting month of Ramadan. However, few of the participants in this study were underweight, with body mass index less than 9.0 and therefore variation of serum lipid could not be accounted for in this body mass index zone.

The total lipid intake of the two population groups was compared. In spite of the fact that palm oil is a major constituent of food intakes among the inhabitant of the two states, blood cholesterol levels and other serum lipid were within the normal reference range (cholesterol, 140 - 200 mg/dl). Although statistical differences exist between the two groups (Table 4), these “within the range” normal cholesterolaemic values noted may have been caused by the hypocholesterolaemic effect of palm oil on total cholesterol (TC), low density lipoprotein cholesterol (LDL-C) and triacylglycerides (TG), plus its hypercholesterolaemic effect on high density lipoprotein cholesterol (HDL-C) (Herber et al., 1992). The hypocholesterolaemic property of palm oil is attributable to the presence of palm olein, a major fraction in the oil. The higher serum lipid profile of the Delta state participates over those of the Cross-River state could, however, possibly be due to their lower dietary fibre intakes as compared with those of Cross-River State and hence its reduced mopping action of dietary cholesterol in the gastrointestinal tract. There is possibility that some of the ingredients used in the preparation of food also have direct blood cholesterol lowering effect by directly affecting pathways that regulate whole-

Table 4. Mean serum lipid profile of participants from Delta and Cross-River states.

Variable	Delta State (n = 67)	Cross River (n = 59)
Total cholesterol (mg/dl)	179.6 ± 2.33a	161.9 ± 2.79b
HDL-C (mg /dl)	41.9 ± 0.75a	45.0 ± 1.13b
LDL-C (mg /dl)	113.8 ± 2.63a	94.7 ± 2.11b
TAG (mg/dl)	118.9 ± 3.20a	109.3 ± 4.73b
TC: HDL-C ratio	4.33 ± 0.11a	3.61 ± 0.09b

Table 5. The mean serum sodium, potassium, systolic and diastolic blood pressure of participants from Delta and Cross-River States.

Variables	Delta State	Cross River
Na (mmol/L)	137.9 ± 0.83 (n = 69)a	136.8 ± 0.85 (n = 44)a
K (mmol/L)	3.51 ± 0.07 (n = 69)a	3.43 ± 0.10 (n = 44)a
SBP (mmHg)	124.9 ± 1.12 (n = 69)a	118.4 ± 1.03 (n = 61)b
DBP (mmHg)	90.3 ± 1.66 (n = 69)a	80.12 ± 1.57 (n = 61)b

Values given as mean ± SEM. SBP = systolic blood pressure; DPB = diastolic blood pressure.
Values with different small letters in the same line are significantly different at the level of 0.05 (P<0.05).

body cholesterol metabolism. Dietary fibre, Soy protein, plants sterol, rice oil, oryzanol and other ingredients in traditional diets have a positive association for regulating whole-body metabolism. The constituents of these ingredients have been shown to inhibit hydroxymethylglutaryl-CoA reductase (HMG-CoA), to possess higher activities of LDL-receptors and also able to lower plasma LDL-cholesterol concentration (Couch et al., 2000).

The result presented in Table 5 shows mean serum sodium and potassium levels, as well as the systolic and diastolic blood pressures of participants from Delta State and Cross River States. Both the systolic blood pressure (SBP) and diastolic blood pressure (DBP) of Delta State participants were significantly higher than Cross-River State participants, with 35 and 15% of their respective population hypertensive (That is BP = 135/85 mmHg or more). Serum sodium and potassium levels were not significantly different in the two groups. Their mean values were comparable and also within the reference range (135 -150 mmol/l Na and 2 - 7 mmol/l K). Therefore, it is possible that higher blood pressure observed in the group from Delta State is not due to sodium and potassium levels in the blood. However, increase in dietary sodium and potassium have been reported to have a significant positive and negative relationship with systolic and diastolic blood pressures, respectively (Medeiros and Borgman, 1982, 1984).

The ratio of the total cholesterol (TC) to HDL-C has been used by some investigators to assess the relative risk of individual to cardiovascular diseases (Kocaoghe et al., 2005). With an average TC/HDL-C ratio of 4.33 ± 0.11 to 3.61 ± 0.09, Delta state participants appear to have a higher number of individuals at risk of cardiovascular diseases (35%) compared with Cross-River state participants (10%) (Table 4). Therefore, the significant difference ($P < 0.05$) in total cholesterol/HDLC ratios between the two groups may provide some indications that higher number of participants from Delta State are not only overweight and hypertensive, but also have a greater health risk of cardiovascular diseases.

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