Lipid and Lipoprotein Cardiovascular Risk Factor Responses to Episodic Academic Stress

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Substantial evidence indicates that mental stress has adverse effects on serum lipid levels and cardiovascular health. This study examined the effects of final medical degree examinations (mental stress) on serum lipid and lipoprotein cardiovascular risk factors in African medical students. Twenty-seven healthy male and female medical students had lipids, lipoproteins, urea and uric acid assessments before and during final year examination. The results showed that black African medical students had adverse lipoprotein changes characterized by reduction in the levels of high density lipoprotein-cholesterol (HDLC) and HDLC/total cholesterol (TC) ratio [coronary heart disease (CHD) risk predictor index] during examinations, while mean urea level decreased from the baseline. These findings provide an opportunity for better planning of the nutritional requirements (vis-à-vis increase in protein intake) for medical students during examinations. They will also guide academic curriculum planners on how to work out strategies to reduce mental stress and its associated metabolic disturbances among the students during examinations, throughout the period of their medical training. In all, these findings will add to our knowledge of the numerous factors that may affect lipid and lipoprotein changes in African subjects.

Key words —— lipids, lipoprotein, cardiovascular risk factor, mental stress

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INTRODUCTION

Coronary heart disease (CHD) is invariably the most frequent cause of death in all the developed Western nations.[1)] Atherosclerosis which is the most common form of CHD is caused by a gradual deposition of fats and lipids in muscular arteries.[2)] Numerous prospective studies have shown that increases in the levels of cholesterol in plasma are a risk factor for the development of CHD.[3)] On the other hand, mental and psychological stress have been reported to exert adverse effects on cardiovascular health.[4)] Substantial evidence indicates that mental stress is associated with elevations in serum lipid concentration,[4)] and increases in cholesterol levels following academic examinations have been documented.[5–8)] The majority of the previous studies measured only cholesterol levels, while some also showed that the levels of other lipids and lipoprotein were affected.[4,8)]

Most of the reported studies were conducted in the Caucasian population. This present study was conducted in the black African population, in whom coronary heart diseases were known to be low[9–10)]; recently, however, high cholesterol levels have been reported in apparently healthy businessmen in a certain community in Nigeria.[11)] This study therefore examined the effects of final medical degree examinations on the serum lipids, lipoproteins, urea and uric acid profiles in medical students. These results will better our understanding and knowledge of the disorders of lipid and lipoprotein metabolism, as well as allowing us to speculate on the cardiovascular risk factor implications of final year medical degree examinations in African medical students.

MATERIALS AND METHODS

Subjects —— Twenty seven apparently healthy final year medical students of the College of Health Sciences, Nnamdi Azikiwe University Nnewi Campus, Nigeria volunteered for this study. Before embarking on the study, the entire procedure was explained to all the students and they gave their consent. The group was composed of 5 females and 22 males with mean age 26.78 ± 3.02 years (S.D.); none was obese and the female students were neither pregnant nor lactating mothers nor on oral contraceptives (see Table 1). Six of the male students were occasional smokers and ten of the males and one female were occasional consumers of alcohol drink-

Table 1. Demographic Profile of Medical Student Subjects

Variable	Males	Females
Number of subjects	22	5
Age (years)	27.61 ± 1.5	25.95 ± 1.52
Obesity (kg/m^2)	nil	nil
Smoking habit	6	nil
Alcohol intake	10	1
Oral contraceptives	—	nil

Age in years expressed as mean ± S.D.

ing a bottle of beer about once or twice a week. No student had any history of hypertension, diabetes mellitus, renal disease or other diseases known to affect lipids and lipoprotein metabolism and/or urea and uric acid levels. The students lived their normal life throughout the study period.

Sampling Procedure and Laboratory Assays —— We believed that the beginning of the second semester in the final year class (approximately 3 months before the final examination) would be a time the students would feel least stressed, since they were not involved in any serious academic work or examinations or continuous assessments. Ten milliliters of venous blood was withdrawn from each individual after an overnight fast into a sterile container, allowed to clot, and the serum was separated and stored at –20°C before analysis. During the final year degree examinations, especially during clinical/oral examinations (a period we believe is usually accompanied by a great deal of tension when stress is usually at its peak), we withdrew the second 10 ml of venous blood from the same students. All of them were maintained on the same diet before and during examinations, as documented by the nutritionist based on the nutritional contents of their diet which consisted of high amounts of carbohydrates, protein (plant and animal protein), with low fat and vegetable levels. The serum samples collected from the students before and during the examination periods were analyzed at the same time in order to minimize inter and intra-batch errors. Total cholesterol (TC), high density lipoprotein-cholesterol (HDLC), triglycerides, uric acid and urea levels were determined by enzymatic methods (Bayer Diagnostic sera pack testing kits, UNICHEM Nig., Ltd., Nigeria). Low density lipoprotein-cholesterol (LDLC) and very low density lipoprotein-cholesterol (VLDLC) levels were calculated using the Friedewald formula.[12] The coronary heart disease risk predictor index HDLC/TC was also calculated.

Data Analysis —— The changes in the measured variables before and during examination were evaluated by paired *t*-test. The relationships between the CHD risk predictor index and other variables were explored using the Spearman correlation.

RESULTS

As shown in Table 2, the mean values of HDL-cholesterol and CHD risk predictor index HDLC/TC were significantly decreased ($p < 0.05$); mean urea level was also decreased ($p < 0.001$) in the medical students during final year examinations. The mean values of the other lipids, lipoproteins and uric acid did not show any significant difference from their baseline values during this examination period. The positive correlation between HDLC/TC and HDLC level was not statistically significant.

DISCUSSION

The observed significant reductions in the mean values of HDLC and CHD risk predictor index HDLC/TC during final year examinations in the medical students strongly suggest an adverse lipoprotein profile in these individuals during mental stress; and the risk of cardiovascular disease associated with these metabolic changes is a matter of concern. The mean TC, triglycerides, LDLC and VLDLC levels for those students also fluctuated during the final year examinations, but the differences were not substantial when compared with their baseline values. Increases in serum lipid concentrations following mental or psychological stress have been reported by others[3,13-14] in different populations, while Niaura *et al.*[15] observed that commonly occurring stressful situations do not produce significant changes in plasma lipid and lipoprotein levels. Increments in lipids, lipoproteins and other biologic variables have been associated with hemoconcentration elicited by mental or psychological stress.[4] This suggestion may not account for the adverse lipoprotein changes observed in our medical students during examinations, because if hemoconcentration were responsible for the lipoprotein changes, the levels of all the lipids, lipoproteins and other biochemical macromolecules (by-products) including urea and uric acid would be increased. But our study showed remarkable reductions in HDLC and urea levels for the medical students during the final year examinations. Their regular diet was the same be-

Table 2. Lipids, Lipoproteins and Other Cardiovascular Risk Factor Variables as Measured in Medical Students before (Baseline) and during Final Year Examination

Variable	Before examination (N = 27)	During Examination (N = 27)	*p* Value
Total cholesterol (mmol/l)	4.66 ± 1.15	4.48 ± 1.37	0.51 NS
HDLC (mmol/l)	1.45 ± 0.33	1.17 ± 0.39	0.008* S
LDLC (mmol/l)	3.07 ± 0.88	3.16 ± 1.23	0.71 NS
Triglycerides (mmol/l)	0.65 ± 0.25	0.74 ± 0.31	0.21 NS
VLDLC	0.13 ± 0.05	0.15 ± 0.06	0.20 NS
HDLC/TC	0.32 ± 0.05	0.27 ± 0.06	0.008* S
Uric Acid (μmol/l)	300 ± 201.4	293 ± 148.3	0.90 NS
Urea (mmol/l)	9.37 ± 3.59	6.50 ± 2.98	0.001** S

Values are expressed as mean ± S.D. S, significant *$p<0.05$; **$p<0.001$. NS, not significant. N, number of subjects.

fore and during these examinations, as documented in the nutritional records of the food served the medical students in the cafeteria. The food they consumed was quite similar to the diet of typical Nnewi residents.[11)]

Our data also showed that certain variables known to influence HDLC levels, such as physical exercise, smoking and drinking habits of the medical students did not differ before and during the examination. It is therefore likely that the mental stress during the final year examination, is responsible for the decreases in HDLC level and HDLC/TC ratio compared with the value observed before examination. The high urea levels before students took the examination reflected the nature of food (as indicated above) they consumed throughout the entire study. These levels, however, decreased during the examination which indicates that a higher protein diet many have been required by the students during the final year examination period in order to cope with the mental stress. The mean uric acid level was also lower during the examination, but the difference from mean baseline value was not remarkable.

In conclusion, these results show that our black African medical students have adverse lipoprotein changes characterized by reductions in the levels of HDLC and CHD risk predictor ratio HDLC/TC during periods of mental stress. These reductions may be a consequence of the increase in mental stress during the examination period. The exact mechanism by which mental stress influences HDLC metabolism is not known, and further studies are encouraged. These results will also provide an opportunity for better planning of the nutritional requirements (vis-à-vis increase in the amount of protein intake) for the medical students during the period of examinations. These findings will guide academic curriculum planners on optimal strategies to reduce mental stress among students during examinations throughout the period of their medical training. Overall, these results will add to our knowledge of the numerous factors that may bring about lipid and lipoprotein changes in African subjects.

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