Nigerian Journal of Biochemistry and Molecular Biology
Volume 26, No. 1, 2011. pp. 39-43 (Printed in Nigeria)
0189-4757/96 $3.0 + 0.00

NJBMB/012/11

Relationship between cholesterol, blood pressure and body mass index of young adults volunteers residing in Minna, Niger State, Nigeria

Gbodi, T. A., *Makun, H. A., Suleiman, Z. H. and Esan, V. O.
Department of Biochemistry, Federal University of Technology, Minna, Niger State.

ABSTRACT:
Despite a growing burden of obesity and hypertension in developing countries, there is limited information on the contribution of body mass index (BMI) to blood pressure (BP) in these populations. The anatomical distribution of blood cholesterol has also been shown to be a factor in determining which people are more susceptible to coronary heart disease and thus at risk of developing cardiovascular diseases. This study investigated the relationship between cholesterol level and body mass index (BMI); and blood pressure and body mass index (BMI) of Nigerians aged 18-29 years. The study employed a cross-sectional survey of individuals living in Minna Local Government Area of Niger State, Nigeria. One hundred and fifty two male and female individuals were sampled using a non-probability sampling technique. Measurements taken include subjects' systolic and diastolic blood pressures, height and weight. Data on BMI, BP, blood cholesterol level and other background characteristics of study participants were generated using the World Health Organization STEPwise approach. The results revealed that BMI, systolic and diastolic pressures and cholesterol had a non-significant positive relationship. A non-linear relationship was also found for systolic pressure, diastolic pressure and cholesterol level with BMI in the study population.

Keywords: Cholesterol level, Blood pressure, Body Mass Index.

INTRODUCTION

The relationship between excess weight and diseases has been recognized overtime (Visscher *et al*., 2001; Cameron *et al*., 2003). Obesity has a strong relationship with cardiovascular diseases like hypertension, coronary heart disease and diabetes (Stevens *et al*., 1998; Cameron *et al*., 2003). This is because increased body fat is accompanied by profound changes in the physiological and metabolic functions of the body, which are directly dependent on the degree of excess weight and its distribution around the body.

The prevalence of obesity is rising in developed and developing nation, and it is cited as an important risk factor for early mortality (WHO, 1998). A number of clinical measurements for obesity have been used to determine susceptibility to cardiovascular diseases (Cameron *et al*., 2003). These include anthropometric indices such as body mass index (BMI) and cholesterol level.

Body mass index has been identified by the World Health Organization as the most useful epidemiological measure for obesity. It is nevertheless a crude index that does not take into account the distribution of body fat, resulting in variability in different individuals and population (WHO, 2000). In the assessment of obesity, the central distribution of body fat cannot be overlooked, hence, the use of cholesterol level and body mass index. Excess body weight leads to the development of atherosclerosis which is characterized by a process that gradually clog arteries through cholesterol deposit that build up on the inner walls of the arteries (Maden, 2004). The risk of atherosclerosis (coronary artery) is measured by the level of cholesterol in the blood (Bloom and Warren, 1998).

Blood cholesterol level has been shown to be a better and simpler indicator of coronary artery disease, than BMI (Bloom and Warren, 1998). It is less dependent on the body size and height. Several studies

***Corresponding Author**
Tel.: **Tel**: +2348035882233;
E-mail:hussainimakun@yahoo.com

have shown consistent independent association between excess body weight and cholesterol level (Maden, 2004). Although some significant correlation between weight and total cholesterol were also observed in other studies (Denke *et al*., 1993).

Cardiovascular diseases (CVDs) are one of the leading causes of death in both male and female in most western countries (Padwal *et al*., 2001). From ages 35-60 years, the systolic and diastolic blood pressure increases at an average of 20/10mmHg, however, the systolic blood pressure is the most consistent and significant risk factor for CVDs compared to the diastolic blood pressure (Neaton and Wentworth, 1992).

Several studies showing the relationship of blood cholesterol level, BMI and blood pressure have been carried out (Maden, 2004). In Caucasian populations, a strong association has been reported between BMI and mortality (Hofmans *et al*., 1988; Stevens *et al*., 1998). A similar association has also been demonstrated among Asian population (Bei-Fan, 2002; Ni Mhurchu *et al*., 2004; Weng *et al*., 2006). Some studies have documented a consistent, but modest association between BMI and BP, whereas other suggested BMI threshold at which level the relationship with BP begins (Dyer and Elliot, 1989). Correlations between BMI and BP in very lean populations in Africa and Asia have also been reported in earlier studies (Swai *et al*., 1993; Gupter, 1995). However, there is a dearth of information on this type of study on Africans, particularly in Nigeria.

This study was therefore designed to investigate the association of cholesterol level and blood pressure to BMI of male and female aged 18-29 years in a Nigerian population. In this study, BMI and blood cholesterol level were used to assess body fat distribution. BMI is more accurate in assessing excess weight than the measurement of weight alone, due to its accessibility and reproducibility (WHO, 2000).

MATERIALS AND METHODS

Study areas and participants

The participants in this study were from designated centres within Minna Local Government Area of Niger State. They were from Federal University of Technology, Minna; College of Education, Minna; Government Secondary School, Minna; as well as from Primary Health Centres in Minna. Selection was by a sample of convenience based on the cooperation of the Vice Chancellor, Provost, and Principal of the schools, the management of the Primary Health Care Centres as well as the readiness of the participants after their informed consent. Male and female participants who met the inclusion criteria for the study were selected using a non- probability sampling technique.

Cholesterol assay kit

The cholesterol enzymatic kit (catalogue number 200) was a product of Randox Ltd., Co-Antrim, UK.

Determination of anthropometric indices

Prior to the commencement of the study, ethical approval was obtained from the Federal University of Technology, Minna/ University Health Service, FUT, Minna Review Board. The rationale behind the study, including the procedures was explained to the participants. The participants' weight (kg) and height (m) were measured and used to calculate the BMI. 3.0 ml of venous blood was drawn from the vein of the upper arm of the participants by tying a tourniquet round the arm. The blood was allowed to clot and then centrifuged at 2,400 rpm. The serum was carefully separated from the blood cells. The samples were kept in the freezer and analyzed within four days of collection. Blood pressure measurement was taken by wrapping an inflatable cuff around the arm. The systolic pressure was determined by allowing the pressure to fall to the pressure at which the radial pulse first became palpable while the diastolic pressure was determined when the sound disappeared.

Determination of cholesterol concentration
The cholesterol content in the serum of the voluteers was determined by following the procedures in the Instruction manual contained in the assay kit.

Statistical analysis
The mean and standard deviation were calculated for all parameters, while independent t-test was used to compare values obtained for male and female participants. Pearson product moment correlation was used to investigate the degree of relationship between BMI and blood pressure, BMI and blood cholesterol level. Linear regression method was used to estimate the slope of blood pressure with BMI and cholesterol. All analysis was conducted using Minitab statistical software.

RESULTS
The study population consisted of 152 individuals (both male and female) with ages ranging from 18-29 years. This consisted of students, teachers, civil servants and artisans. 11% of the subjects were under weighed, 71.7% were normal, 13.8% were overweighed and 2.8% were obese. The mean value of cholesterol level for the 101 participants fell below the range for hypercholesterolemia. The BMI for all the participants was within the range 18.5-34.0 kg/m^2.

There was a significant relationship between the systolic blood pressure (113±14.63) as well as diastolic blood pressure (86±14.5), and the indices of adiposity of all the participants ($p<0.05$) (Figure 1).

There was no significant difference between the BMI (22.0±3.6) and blood cholesterol (110±32.5) level of the participants (Figure 2). The linear slope for pressure and BMI, cholesterol level and BMI has positive slope estimates at $p>0.05$ level within the sample size. The slopes for systolic blood pressure (SBP), diastolic blood pressure (DBP) and cholesterol level were 0.08, 0.12 and 0.13 respectively. The coefficient of determination were respectively equal to 0.032, 0.014 and 0.17 for SBP, DBP and cholesterol.

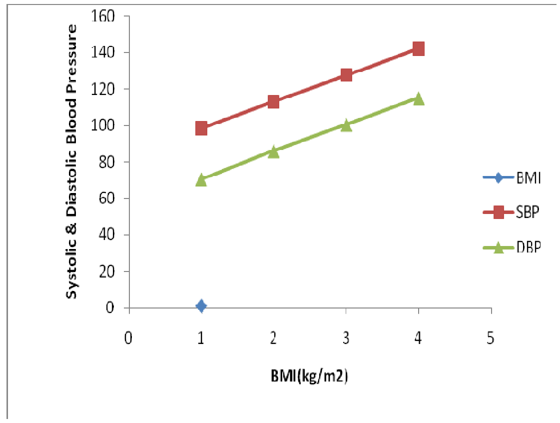

Fig. 1: Blood pressure (systolic and diastolic) of the participants

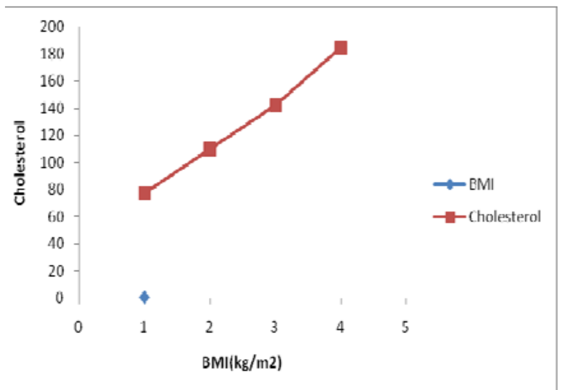

Fig.2: BMI range and serum cholesterol level of the participants

DISCUSSION
In this study, the distribution of body mass index among the subjects shows that the mean value for BMI falls within the normal weight range of 18.5-24.9. This range is associated with low mortality rates. Their fat can be expressed as percentage body weight with a fat and fat free mass of 75% and 25% respectively. The participants are at a lower risk of diseases associated with excess body weight, which include hypertension, type two diabetes mellitus, hyperglycemia and various endocrine dysfunctions (Murray *et al*., 2003).

A positive association was found between body mass index and cholesterol level of the participants. This result is similar to that of Denke et al (1993). Only about 2% of the alterations in cholesterol level could be due to changes in the body mass index of the participants thus a non-linearity in the relationship between cholesterol and BMI. It was also observed that BMI was positively related to systolic and diastolic pressures in participants. This association was relatively straight forward on a descriptive level, its interpretation is less so. These findings agree with those of Kaufman et al (1997) where they reported that there was a non- linear relationship between BMI and blood pressure in lean population. The small changes in the systolic and the diastolic pressures could be due to changes in relative weight but the pathophysiological significance of relative weight has never been well defined.

In conclusion, the results of this study revealed that a non-linear relationship of cholesterol level and blood pressure to body mass index in the study population. While further research is needed to shed light on the underlying pathophysiological mechanisms, the pattern of association seen in the present study supports the hypothesis that the association of cholesterol level and blood pressure to body mass index is a non linear one.

REFERENCES

Bei-Fan, Z. (2002). Predictive values of body mass index and waist circumference for risk factors of certain related diseases in Chinese adults: study on optimal cut-off points of body mass index and waist circumference in Chinese adults. Asia Pac. J. Clin. Nutr. 8(suppl): S685-S693.

Bloom, R. B. and Warren, S. B. (1998). Lipid abnormality in current medical diagnosis and treatment of Stanford CT. Appleton and Large. p. 1-4.

Cameron, A. J., Welborn, T. A. and Zimmet, P. Z. (2003). Overweight and obesity in Australia: The 1999-2000 Australia Diabetes, Obesity and Lifestyle Study. Medical J. Aust., 178: 427-432.

Denke, M., Senpoc, C. and Grundy, S. (1993). Excess body weight under recognized contribution to high blood pressure, cholesterol level in white America men. Arch. Internal Med., 53:1093-1103.

Dyer, A. R. and Elliot, T. (1989). For the intersalt cooperative research group. The intersalt study: relations of body mass index to blood pressure. J. Hum. Hypertension, 3: 299-308.

Gupter, R., Guptha, S., Gupta, V. P. and Prakash, H. (1995). Prevalence and determinants of hypertension in urban population of Jaipur in Western India. J. Hypertension, 13: 1193-1200.

Hofmans, M. D., Kromhout, D. and de Lezenne-Coulander, C. (1988). The impact of body mass index of 78612 18-year-old dutch men on 32-year mortality from all causes. J. Clin. Epidemiol., 41:749-756.

Kaufman, S. J., Asuzu, C. M., Murfunda, J., Forester, T. S., Wilk, R., Luke, A., Long, E. A. and Copper, S. A. (1997). Relationship of body mass index and blood pressure in lean population. Hypertension 30:1511-1516.

Maden, R. (2004). Risk factors of cardiovascular diseases. Research for National Health and Nutrition Examination Survey (NAHNES). Canbrra, US: Media and Publishing Unit.

Murray, R. R., Granner, K. D., Mayers, A. P. and Rodewel, W. V. (2003). Harper's Illustrated Biochemistry 3rd edn., United States of America: World Publisher. p. 799-814.

Neaton, J. D. and Wentworth, D. (1992). Serum cholesterol, blood pressure, cigarette smoking and death from coronary heart disease. Overall findings and differences by age for 316, 099 white men, multiple risk factor intervention trial research group. Arch. Internal Med., 152: 56-64.

Ni Mhurchu, C., Rodger, A., Pan, W. H., Gu, D. F. and Woodward, M. (2004). Asia pacific cohort studies collaboration. Body mass index and cardiovascular disease in the Asia-Pacific Region: an overview of 33 cohort involving 310000 participants. Int. J. Epidemiol. 33: 751-758.

Padwal, R., Sraus, S. E. and McAlister, E. A. (2001). How do cardiovascular risk affect whether we recommended therapy for hypertension? Brit Medical J., 5: 44.

Stevens, J., Cai, J. and Pamuk, E. R. (1998). The effect of age on the association between body mass index and mortality. New Engl. J. Med., 338: 1-7.

Swai, A.B, McLarty, D. G., Kitange, H. M., Kilima, P. M., Tatalla, S., Keen, N., Chuwa, L. M. and Alberti, K. G. (1993). Low prevalence of risk factors for coronary heart

disease in rural Tanzania. Int. J. Epidemiol., 22: 651-659.
Visscher, T. L. and Seidell, J. C. (2001). The public health impact of obesity. Ann. Rev. Public Health, 22: 335-375.
Weng, X., Liu, Y., Ma, J., Wang, W., Yang, G. and Caballero, B. (2006). Use of body mass index to identify obesity-related metabolic disorder in the Chinese population. Eur. J. Clin. Nutr., 60:931-937.
World Health Organization (1998). Obesity: preventing and managing the global epidermic. Report of a WHO consultation on obesity.
World Health Organization (2000). Obesity: preventing and managing the global epidemic. Geneva (WHO Technical Report Series, No 894). http://whqlibdoc.who.int/trs/WHO_TRS_894.pdf.