Original Research Article

Clustering of cardiovascular disease risk factors in a rural adult population in Nigeria

Chizindu Akubudike Alikor*, Pedro Emem-Chioma

Department of Medicine, University of Port Harcourt, Rivers State, Nigeria

*Correspondence:
Dr. Chizindu Akubudike Alikor,
E-mail: alikorchizindu@yahoo.com

ABSTRACT

Background: Cardiovascular disease (CVD) is responsible for one third of global deaths and is the leading contributor to global disease burden. A non-communicable disease survey done in Nigeria helped determine the prevalence of major CVD risk factors in the country and showed a rising trend in the prevalence. This study aims to determine the proportion of adults in a rural farming community in the Niger Delta region of Nigeria with clustering of the following CVD risk factors: hypertension, diabetes, obesity, dyslipidaemia, hyperuricaemia, ECG-LVH, smoking, heavy alcohol consumption and physical inactivity.
Methods: Descriptive cross-sectional survey carried out in a rural farming community in the Niger Delta region of Nigeria. Stratified sampling method was used to recruit study subjects aged 18 years and above and a total of 500 subjects completed the survey. Socio-demographic information, anthropometric, blood pressure and ECG measurements were obtained. Venous samples were collected and analyzed.
Results: Five hundred subjects participated. There were 156 males and 344 females with male to female ratio of 1:2.3. The overall mean age was 41.32±17.0 with range of 18 years to 95 years. The mean age for males was 42.84±17.8 and females 40.62±16.6. Overall, 38.2%, of subjects had 2 or more risk factors. Additionally, 42.1% of males and 31.4% of females had ≥2 of these risk factors. Multivariate logistic regression showed higher clustering of risk factors with increasing age, male gender, Government staff and higher educational attainment.
Conclusions: Clustering of CVD risk factors is high in this rural community of Nigeria and requires integrated approach to its prevention, detection and treatment.

Keywords: Clustering, Cardiovascular disease, Risk factors

INTRODUCTION

Cardiovascular disease (CVD) is responsible for one third of global deaths and is the leading and increasing contributor to global disease burden.[1] It was responsible for global mortality of 17.5 million individuals in the year 2005 with the rising trend prevalent in the low and middle income countries.[2] In industrialised countries, cardiovascular disease (CVD) is a major cause of morbidity and mortality.[3] With increasing urbanisation and westernisation of lifestyles in sub-Saharan Africa,

reported prevalence of cardiovascular diseases have risen and cardiovascular diseases are increasingly being recognised as a significant cause of morbidity and mortality in sub-Saharan Africa (SSA).[3] In Nigeria, as a result of increasing rural-urban drift and socio-economic changes, there is a rising trend in cardiovascular disease burden.[4] With an increasingly high emergence of ischaemic heart disease as an important cause of morbidity and mortality in the population.[5] A non-communicable disease (NCD) survey carried out in Nigeria between 1990-1995 helped to determine the

prevalence of major cardiovascular disease risk factors in the country.[6] Over the years, there is a rising prevalence of the different cardiovascular disease risk factors with increasing incidence of metabolic syndrome in the Nigeria community.[6] The presence of multiple risk factors plays a significant role in the development of cardiovascular diseases.[7] This brings to light the importance of a multi-factorial approach to risk assessment and intervention. Rural sub-Saharan Africa is at an early stage of economic and health transition but there is currently very little published information on the prevalence of cardiovascular disease clustering, although such data will be essential in planning future health services.[8] Most of the published works were concentrated in the urban areas and mainly Hospital based.

The goal of this study was to determine the proportion of adults in a rural farming community in the Niger Delta region of Nigeria who had 1, 2 or ≥3 of the following CVD risk factors: hypertension, diabetes, obesity, dyslipidaemia, hyperuricaemia, ECG-LVH, smoking, heavy alcohol consumption and physical inactivity.

METHODS

This was a descriptive cross-sectional survey carried out in a rural farming community in the Niger Delta region of Nigeria. The vast majority of the population in the community were involved in subsistence farming which involved use of manual farming implements and trekking of long distances to farm. Stratified sampling method was used to recruit study subjects aged 18 years and above and a total of Six hundred and four persons were recruited from five primary sampling units. A total of five hundred subjects completed the survey and examination with a response rate of 82.8%.

Data collection

The sessions were held in the various selected churches and primary schools which reflected the divisions of the community into villages. The questionnaire which was administered through face-to-face method by trained research staff was designed to elicit demographic and social information including age, gender, occupation, educational level, cigarette smoking, alcohol consumption and previous diagnosis and treatment of hypertension and diabetes. Physical activity was assessed using questionnaire designed to fit into the activities peculiar to the rural community where this study was done.

Arthropometric measurement

The anthropometric indices were measured following a standard prototocol. Participants were weighed barefooted and wearing light clothing with the aid of a weighing scale and weight reading was taken to the nearest 0.1kg. Height was measured standing and the examiner read the measurement to the nearest 0.1cm.

Body mass index was calculated from weight (kilogrammes) divided by height squared.

Blood pressure measurement

Auscultatory method was used in checking subject's blood pressure. Sitting blood pressure was measured after subject had been comfortably seated for five minutes and the back and arm supported, such that the middle of the cuff on the upper arm was at the level of the right atrium (the mid-point of the sternum) and the legs uncrossed.[9] The upper arm was bare without constrictive clothing. The blood pressure was read to the nearest 2mmHg with the first (korotkoff phase I) and last (korotkoff phase V) audible sounds taken as systolic and diastolic pressure.[10]

ECG measurement

Twelve lead surface electrocardiograms were recorded on all the subjects after resting for 10 minutes using a portable ECG machine according to standard protocol.[11,12]

Laboratory measurement

Venous samples were obtained from the subjects to measure serum lipids, uric acid and plasma glucose after 10-12 hours of overnight fast. Plasma samples were conveyed to the Chemical department laboratory of University of Port Harcourt Teaching Hospital, centrifuged and subsequently analysed. Plasma total cholesterol, HDL andtriglycerides were determined by the Colorimetric enzymatic methods.[13] Low density lipoprotein (LDL cholesterol) was estimated according to the formula LDL cholesterol = total cholesterol-HDL cholesterol-triglycerides/2.2. Uric acid was also analysed while venous blood glucose was measured by the glucose oxidase method.[14]

Definitions of risk factors

For the purpose of this study, the following parameters were defined as follows: Heavy alcohol consumption was consumption of >21 units per week.[15] Physical inactivity was defined as: I activity at work or leisure that is not vigorous or moderate in intensity for at least 10 minutes continuously for ≥3 days in a week or II not commuting by foot or use of bicycle (cycling) for at least 10 minutes continuously for ≥3 days in a week. Obesity was defined with the BMI using the WHO classification.[16]

Hypertension was defined using the JNC 7 (Joint National Committee on Prevention, Evaluation, and Treatment report) criteria of blood pressure ≥140/90 mmHg or self-reported anti-hypertensive medication use while diabetes mellitus was defined using fasting plasma glucose (FPG) ≥7.0 mmol/l (126 mg/dl) and individuals who were previously known to have diabetes based on history of drug medication.[6,17] Total cholesterol of > 6mmol/L, TG >1.8mmol/L, HDL-C <1.0mmol/L and

LDL-C ≥3mmol/L were taken as abnormal values. Hyperuricemia was defined as ≥420mmol/L for males and ≥360 mmol/L for females.[18] LVH was determined using either of Sokolow-Lyon voltage criteria Mv= SV1+RV5 (or V6 if larger) or Araoye's criteria SV2 +RV6 >4.0Mv (Male); >3.5mV (female).[19,20]

Statistical analysis

Statistical analysis was done using Statistical Package for Social Sciences (SPSS Inc, Chicago, IL) version 17. Results were expressed as either mean values (standard deviation) or proportions. Comparison for statistical significance was by student's t-test for continuous variables and chi-square analysis for categorical variables. Multivariate logistic regression was also done A p-value of <0.05 was considered statistically significant.

RESULTS

Five hundred subjects participated in the study. There were 156 males and 344 females with male to female ratio of 1:2.3. The overall mean age was 41.32±17.0 with

a range of 18 years to 95 years. The mean age for males was 42.84±17.8 and that for females was 40.62±16.6.

Prevalence of CVD risk factors

In this community, the prevalence of the cardiovascular disease risk factors screened for was as follows: Cigarette smoking 6.6% (males 21.2%, females 0%, p<0.001); heavy alcohol consumption 4.6% (males 7.9%, females 1.7%, p<0.001); physical inactivity 2.6% (males 2.6% to 3.9%, females 2.6 to 8.1%,p= 0.86); generalized obesity 2.6% (males 0%, females 3.8%, p=0.15); abdominal obesity 3.4% (males 0%, females 4.9%, p=0.002); hypertension 20.4% (males 20.5%, females 20.1%, p=0.72); diabetes mellitus 2.2% (males 2.6%, females 2.2%, p= 0.84); hypercholesterolaemia 0.2% (males 0%, females 0.3%, p=0.75); hypertriglyceridaemia 6.2% (males 5.8%, females 6.4%, p=1.00); low HDL-Cholesterol 29.4% (males 28.9%, females 29.7%, p=0.42); high LDL-Cholesterol 31.8% (males 21.9%, females 36.3%, p=0.02); hyperuricemia 17.2% (males 25.0%, females 13.7%, p=0.006); Electrocardiography-left ventricular hypertrophy 12.2% (males 18.6%, females 9.3%).

Table 1: Prevalence of measured cardiovascular disease risk factors by gender.

| Cardiovascular risk factor	Males n (%)	Females n (%)	X^2	p value
Smoking	33 (21.2)	0 (0.0)	77.69	<0.001*
Heavy alcohol consumption	08 (7.9)	02 (1.7)	21.21	<0.001*
Physical inactivity	04 (2.6)	09 (2.6)	0.03	0.86
Gen obesity	0 (0.0)	13 (3.7)	9.29	0.03*
Hypertension	32 (20.5)	69 (20.1)	0.20	0.72
Diabetes	04 (2.6)	07 (2.0)	0.35	0.84
Hypercholesterolaemia	0 (0.0)	01 (0.3)	0.59	0.75
Hypertriglyceridaemia	09 (5.8)	22 (6.4)	0.004	1.00
Low HDL-C	45 (28.9)	102 (29.7)	0.63	0.42
High LDL-C	34 (21.9)	125 (36.3)	6.09	0.02*
Hyperuricaemia	39 (25.0)	47 (13.7)	7.75	0.006*
ECG-LVH by either Sokolow-Lyon or Araoye's criteria	29 (18.6)	32 (9.3)	11.19	0.001*
ECG-LVH by Sokolow-lyon criterion	28 (18.0)	31 (9.0)	13.13	<0.001*
ECG-LVH by Araoye's criterion	14 (9.0)	13 (3.8)	9.09	0.004*
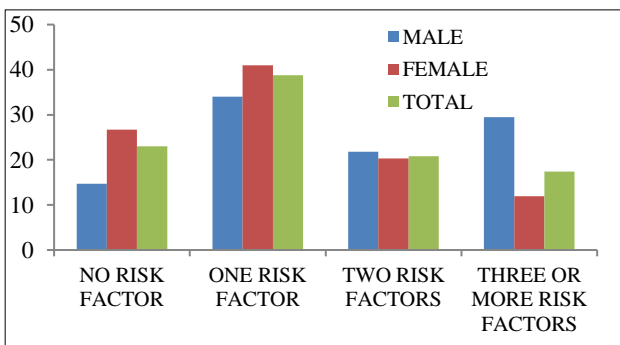
Figure 1: Clustering of cardiovascular risk factors by gender.

Clustering of cardiovascular disease risk factors by gender

From Figure 1 below, 77% of the subjects had 1 or more CVD risk factors with only 23.0% of the study subjects with no risk factor. On the Overall, 38.8%, of study subjects had 1risk factor, while 20.8% and 17.4% of study subjects had 2 and ≥3 of these risk factors respectively. Figure 1 also shows that 14.7% of males and 26.7% of females had no clustering of risks factors while 34% of males and 41.0% of females had only 1 risks factor. Among males, 21.8% and 20.3% had 2, and ≥3 of these risk factors, respectively. However, 19.5%

and 11.9% of females had 2, and ≥3 of these risk factors, respectively.

Cardiovascular disease clustering by age group

From Figure 2 below, the prevalence of cardiovascular disease clustering for subjects with 2 and ≥3 risk factors showed increasing trend with increasing age with the highest prevalence in the elderly age group of ≥70 years unlike subjects with 0 and 1 risk factor which showed higher prevalence in the younger age groups.
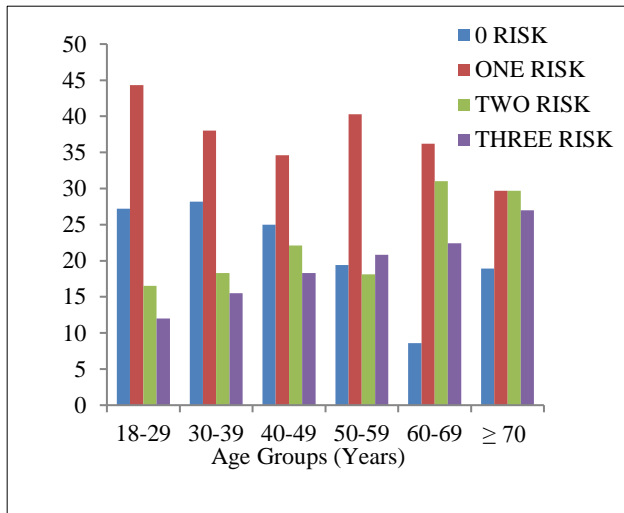

Figure 2: Cardiovascular disease clustering by age group.

Prevalence of zero risk factor by age and gender

According to Figure 3 below, there is a decreasing pattern with increasing age among subjects with no cardiovascular disease risk factor clustering. More females than males had no risk factor.
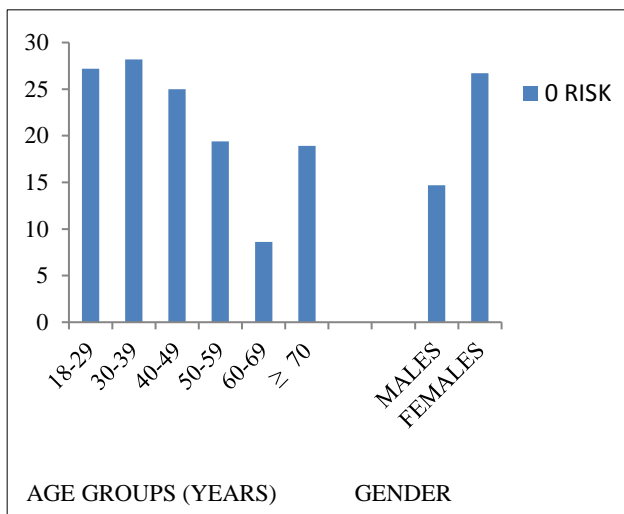

Figure 3: Prevalence of zero risk factor by age and gender.

Prevalence of one risk factor by age and gender

Figure 4 below shows that the older age group of seventy years and above had the least prevalence (29.7%) among subjects with only one risk factor with the younger age group of 18 to 29 years having highest prevalence (44.3%). More females (41%) than males (34%) had one risk factor only.
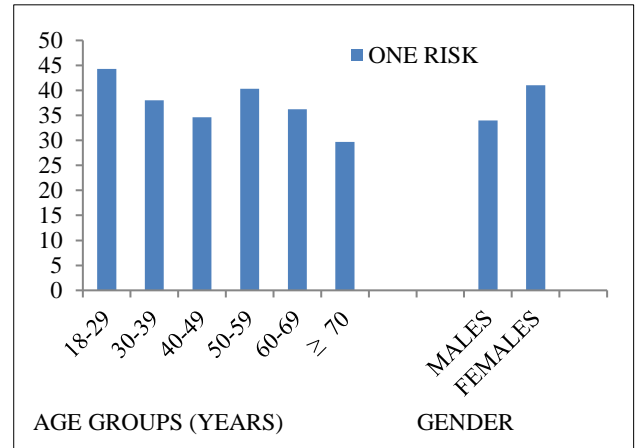

Figure 4: Prevalence of zero risk factor by age and gender.

Prevalence of two risk factors by age and gender

As depicted in Figure 5 below, the prevalence of having two risk factors increased progressively with increasing age peaking in 60-69 years age group (31.0%). More males than females had two risk factors (males 21.8%; females 20.4%).
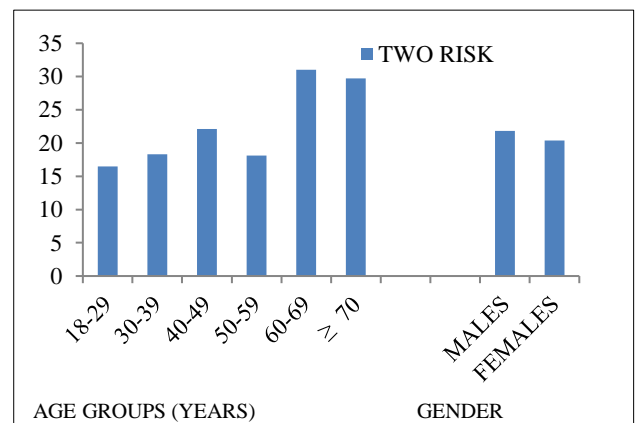

Figure 5: Prevalence of two risk factors by age and gender.

Prevalence of three or more risk factors by age and gender

The prevalence of having three or more risk factors increased progressively with increasing age. Males had a higher prevalence of three or more risk factors than females (males 30%; females 11.9%).
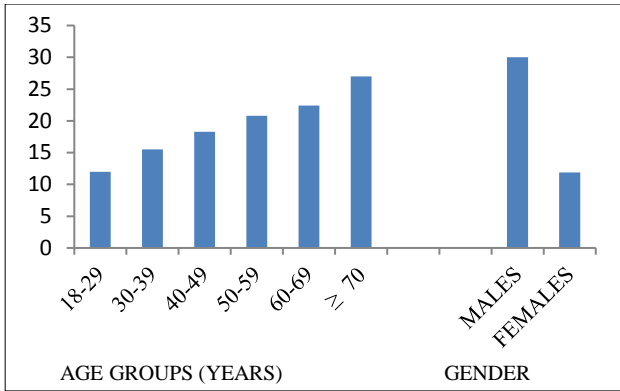
Figure 6: Prevalence of three or more risk factors by age and gender.

Effect of age, gender and educational level on CVD risk factor clustering by multivariate logistic regression analysis

Table 2 below presents results of multivariate logistic regression analysis of predictors of risk factor clustering among the study subjects. The probability increased significantly with increasing age with peak in the 60-69 years age-group. It is also shown that males had higher probability of CVD clustering in this study compared to females. Among those who had attained some educational status, the higher the educational level, the greater the probability of risk factor clustering. However, those with no educational attainment, also had a high risk of CVD clustering.

Table 2.: Multivariate logistic regression analysis of CVD risk factor clustering with age group, gender and educational level of study subjects.

Variable	EXP (B)	95% confidence interval		P value
		Lower bound	**Upper bound**	
Age group (years)				
18-29	0.62	0.44	0.89	
30-39	0.68	0.46	1.01	
40-49	0.77	0.53	1.11	
50-59	0.82	0.56	1.22	<0.001
60-69	1.07	0.71	1.61	
≥70	1.00	1.00	1.00	
Gender				
Male	1.62	1.34	1.97	<0.001
Female	1.00	1.00	1.00	
Educational level				
No education	1.00	0.64	1.56	
Primary education	0.71	0.52	0.97	<0.001
Secondary education	0.72	0.53	1.67	
Tertiary education	1.00	1.00	1.00	

Table 3. Multivariate logistic regression analysis of CVD risk factor clustering with occupation.

Variables	EXP(B)	95%CI lower bound	95 %CI upper bound	p value
Occupation				
Farmer	0.97	0.78	1.20	
Government staff	1.19	0.77	1.86	
Student	0.85	0.65	1.12	<0.001*
Trader	1.18	0.72	1.93	
Other	1.00	1.00	1.00	

Effect of occupation of study subjects on CVD risk factor clustering by multivariate logistic regression

According to Table 3 below, the probability of CVD risk factor clustering was highest among the government staff and traders compared to students and farmers who had a lower probability of clustering of CVD risk factors. Study subjects who are married had the highest probability of risk factor clustering in this study.

DISCUSSION

Clustering of cardiovascular disease risk factors increases the risk of cardiovascular morbidity and mortality. Hence

it is important not just to study the individual risk factors but to explore the presence and degree of clustering of these risk factors. The present study indicates that 77% of the study subjects had at least 1 of the studied CVD risk factors with 38.2 % of study subjects having a clustering of 2 or more risk factors. This is lower than the 63.6% and 86% prevalence of clustering of risk factors reported by Puepet et al and Ogbera respectively in two different Nigerian studies.[21,22] These remarkable differences may be as a result of several factors which may include the fact that the present study was a rural community study amongst apparently healthy population while the comparative studies were both urban and hospital-based studies amongst diabetics which on itself is a risk factor for CVD and predisposes to other cardiovascular risk factors. The clustering of CVD risk factors reported in this study is however higher than the 21.7% clustering reported in a study on clustering of cardiovascular risk factors among a rural adult population in India.[23] While both studies are rural community based, the Indian study however evaluated for fewer CVD risk factors than the present study which can possibly explain the reason for the lower prevalence of clustering found in the Indian study.

In our study, 17.4% of study subjects had clustering of 3 or more risk factors with 20.8% of study subjects having a clustering of only 2 risk factors which is contrary to the findings by Osuji et al in Enugu, Nigeria who reported a 31.2% of clustering of three or more risk factors and 40.4% of clustering of two risk factors.[24] The work by Osuji et.al was however amongst hypertensive in a tertiary hospital which may account for the higher values reported. In a rural study on the prevalence of metabolic syndrome, Gyakobo et al reported a prevalence of 15% using IDF criteria which is similar with the outcome in this study.[25] It is however important to state that our study evaluated more risk factors (including ECG-LVH) than the comparative studies. In a study conducted in both a rural and urban setting in China, a higher prevalence of clustering of CVD risk factors were reported compared to our study.[25] These differences may be related to the fact that whereas this present study was limited to a rural settlement, the Chinese study involved both the rural and urban communities.

This present study showed that clustering of two or ≥3 risk factors was more amongst males than their female counterparts similar to the findings by Balaji et al in a rural Indian community.[23] This higher prevalence of risk factors in men compared with women may be due to the fact that more of the individual risk factors evaluated in this study were commoner in males than in females. This is similar to the findings in previous studies but not so with the work by other authors.[24-28] This present study also showed a progressively increasing prevalence of 2 or ≥3 risk factor clustering with increasing age similar to the findings of other workers.[24-26] However, the work by Osuji et al, showed a declining pattern of clustering after the age of 50 years.

Clustering of risk factors is associated with occurrence of the major CVDs.[6,8] It becomes necessary to identify the groups at higher risk in order to design appropriate intervention measures. This study revealed through a multivariate logistic regression that clustering of risk factors was associated with age, gender, occupation and educational attainment. The finding that the risk factors cluster as age advances is not surprising, as some of the individual risk factors showed similar pattern and the age-related biological risks (e.g. hypertension) are super-imposed upon the cumulative life-style behavioural risk factors (e.g. physical inactivity). These are consistent with the observation that the prevalence of chronic diseases increases with age.[28] The male gender had a greater risk of clustering similar to the outcome of many other studies.[28-30]

This study also showed a relationship between increasing level of educational achievement and greater probability of clustering of risk factors in tandem with the finding by Gyakobo et al in a rural community in Ghana.[25] This may be related to the fact that increasing education comes with increasing income and hence more access to tobacco, alcohol, and diets rich in fats, salt and sugar. The Government staff and traders had greater risk of cluster which may be related to the fact that they are likely to spend most of their work hours sedentary unlike the farmers who had a lower risk of clustering of risk factors comparatively.

CONCLUSION

Clustering of CVD risk factors is high in this rural community of the Niger Delta region of Nigeria and integrated approach should be developed towards its prevention, detection and treatment in a cost effective way.

REFERENCES

1. WHO. World Health Report 2002: reducing risks, promoting healthy life. Geneva. Available at www.who.int/whr/2002/.
2. WHO. Preventing Chronic Diseases 2005: a vital investment. Geneva. Available at www.who.int/chp/chronic_disease_report/contents/en/.
3. World Bank. World Development Report 1993. Investing in Health. Oxford University Press for the World Bank, 1993; New York. Available at https://openknowledge.worldbank.org/handle/10986/5976.
4. Osuntokun BO. Stroke in Africans, Africa J Med Sci. 1997;6:39-55.

5. Sani MU, Adamu B, Mijinyawa MS, Abdu A, Karaye KM, Maiyaki MB, et al. Ischaemic heart disease in Aminu Kano Teaching Hospital, Kano, Nigeria: a 5-year review. Niger J Med. 2006;15(2):128-31.

6. Akinkugbe OO, Akinyanju OO. Non-communicable diseases in Nigeria-final report of a national survey. Lagos: Federal Ministry of Health-National Expert Committee on Non-Communicable Diseases. 1997:1-2.

7. Jackson, R, Lawes, CM, Bennett, DA. Treatment with drugs to lower blood pressure and blood cholesterol based on an individual's absolute cardiovascular risk. Lancet. 2005;365:434.

8. Yusuf S, Reddy S, Stephanie O, Sonia A. Global Burden of Cardiovascular Diseases Part I: General Considerations, The Epidemiologic Transition, Risk Factors, and the Impact of Urbanization. Circulation. 2001;104:2746-22753.

9. Cushman WC, Cooper KM, Horne RA, Meydrech EF. Effect of back support and stethoscope head on seated blood pressure determinations. Am J Hypertens. 1990;3:240-1.

10. Perloff D, Grim C, Flack J, Frohlich ED, Hill M, McDonald M, et al. Human blood pressure determination by sphygmomanometry. Circulation. 1993;88:2460-70.

11. "Limb Leads - ECG Lead Placement - Normal Function of the Heart - Cardiology Teaching Package Practice Learning - Division of Nursing - The University of Nottingham". http://www.nottingham.ac.uk/nursing/practice/resources/cardiology/function/limb_leads.php. Accessed at 15 Aug 2009.

12. Lesson 1: The Standard 12 Lead ECG, 2009. Available at http://library.med.utah.edu/kw/ecg/ecg_outline/Lesson1/index.html#orientation. Accessed at 15 Aug 2009.

13. Tietz NW. Clinical Guide to Laboratory Tests, Second Edition W.B Saunders Company, Philadelphia, USA;1990:554-6.

14. Trinder P. Determination of blood glucose using 4-aminophenazone as oxygen acceptor. J Clin Path. 1969;22:246.

15. Obembe A, Sijuwola AO, Ayuba LN. Excessive alcohol consumption, risk of death and liver disease. A 5-year hospital review at Jos, Medical Practitioner. 1993(26); 61-4.

16. Eknoyan G. Adolphe Quetelet (1796-1874)-the average man and indices of obesity. 2008;23(1):47-51.

17. Joint National Committee on Detection. Evaluation, and Treatment of High Blood Pressure (JNC-The seventh report of the Joint National Committee. Arch Intern Med. 1993;153:154-83.

18. Nakagawa T, Tuttle KR, Short RA, Johnson RJ. Fructose-induced hyperuricemia as a casual mechanism for the epidemic of the metabolic syndrome. Nat Clin Pract Nephrol. 2005;1:80-86.

19. Sokolow M, Lyon TP. The ventricular complex in left ventricular hypertrophy as obtained by unipolar precordial and limb leads. Am Heart. 1949;37:161-86.

20. Araoye MA. Left Ventricular hypertrophy by electrocardiography; A code system applicable to Negroes. Niger Postgrad Med J. 1996;3:92-7.

21. Puepet FH, Uloko A, Akogu IY, Aniekwensi E. Prevalence of the metabolic syndrome among patients with Type 2 Diabetes mellitus in urban North-Central Nigeria. Afr J Endocrinol Meta. 2009;8:10-12.

22. Ogbera AO. Prevalence and gender distribution of the metabolic syndrome. Diabetology Metabolic Syndrome. 2010;2(1):1.

23. Balaji R, Logaraj M, John KR. A study on clustering of cardiovascular risk factors among a rural adult population in Tamil Nadu. J Cardiovasc Dis Res. 2015;6:85-90.

24. Osuji CU, Omejua EG. Prevalence and characteristics of the metabolic syndrome among newly diagnosed hypertensive patients. Ind J Endocrinology Meta. 2012;16(Suppl1):S104.

25. Gyakobo M, Amoah AG, Martey-Marbell DA, Snow RC. Prevalence of the metabolic syndrome in a rural population in Ghana. BMC endocrine disorders. 2012;12(1):25.

26. Gu D, Gupta A, Muntner P, Hu S, Duan X, Chen J, et al. Prevalence of cardiovascular disease risk factor clustering among the adult population of China: results from the International Collaborative Study of Cardiovascular Disease in Asia (InterAsia). Circulation. 2005;112(5):658-65.

27. Alegria E, Cordero A, Laclaustra M, Grima A, Leon M, Casasnovas JA et al. Prevalence of metabolic syndrome in the Spanish working population: MESYAS registry. Rev Esp Cardiol. 2005;58(7):797-806.

28. Ajayi EA, Ajayi OA, Adeoti OA. Metabolic syndrome: prevalence and association with electrocardiographic abnormalities in Nigerian hypertensive patients. Metabolic syndrome and related disorders. 2014;12(8):437-42.

29. Ezenwaka EC, AkanjiAO, Akanji BO, Unwin NC, Adejuwon CA. The prevalence of insulin resistance and other cardiovascular disease risk factors in healthy elderly southwestern nigerians Atherosclerosis. 1997;128(2):201-11.

30. Okesina AB, Oparinde DP, Akindoyin KA, Erasmus RT. Prevalence of some risk factors of coronary heart disease in a rural Nigerian population. East Afr Med J. 1999;76:212-6.