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THE PREVALENCE AND CORRELATIONS OF ELECTROCARDIOGRAPHIC-LEFT VENTRICULAR HYPERTROPHY IN A RURAL COMMUNITY IN AFRICA.

Alikor Chizindu A, Emem-Chioma Pedro

Department of Medicine, College of Health Sciences,
University of Port Harcourt.

ABSTRACT

INTRODUCTION: Left ventricular hypertrophy (LVH) is a major and independent risk factor for cardiovascular morbidity and mortality irrespective of aetiology. Patients with ECG-LVH from any cause are at a greater risk for major cardiovascular complications including heart failure, cardiac arrhythmias, death following myocardial infarction, decreased left ventricular ejection fraction, sudden cardiac death, aortic root dilation, and stroke. Although echocardiography has become the gold standard for LVH detection in clinical practice, electrocardiography ECG remains widely used due to its simplicity and accessibility. This study is to determine the prevalence and correlations of ECG-LVH among adult population of a rural farming community in Rivers State, Nigeria.

METHODS: A cross-sectional survey involving 539 adults. A questionnaire was administered to elicit socio-demographic data, prior knowledge of blood pressure/blood sugar status and family history of hypertension and diabetes. Anthropometric and blood pressure measurements were done in a standardized manner. Blood samples were taken for blood glucose and uric acid. Twelve lead surface electrocardiograms were recorded on all the subjects using a portable ECG machine. Data obtained was analysed using SPSS version 17. LVH was determined using Sokolow-Lyon voltage criteria $Mv = SV1 + RV5$ (or $V6$ if larger).

RESULTS: The prevalence of ECG-LVH by the Sokolow-Lyon criterion was 16.4% with a significantly higher prevalence in males than females (20.4 % versus 8.2%, $p=0.001$). There was high prevalence rate in the middle age and the elderly age group with the lowest rate seen in the young age group of 18-29 years in both sexes. The male gender, hypertension including both systolic and diastolic blood pressure and cigarette smoking were significantly correlated with LVH.

CONCLUSION: The prevalence of ECG-LVH in this rural community of the study is high. The male gender, hypertension including both systolic and diastolic blood pressure and cigarette smoking are important variables found to be significantly correlated with the development of LVH in this study. This therefore calls for urgent need to tackle these modifiable risk factors amongst others elicited in this study while developing a more comprehensive health package for our rural dwellers.

KEY WORDS: Prevalence, correlations, electrocardiographic-left ventricular hypertrophy, rural community.

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INTRODUCTION

Left ventricular hypertrophy (LVH) which is the response of the heart to chronic pressure or volume overload is a major and independent risk factor for cardiovascular morbidity and mortality irrespective of aetiology.^{1,2} Patients with ECG-LVH from any cause are at a greater risk for major cardiovascular complications including heart failure, cardiac arrhythmias, death following myocardial infarction, decreased left ventricular ejection fraction, sudden cardiac death, aortic root dilation, and stroke.³ The Framingham heart study

showed that LVH was associated with a 15-fold increase in the incidence of heart failure.⁴

Prevalence studies in Nigeria and Africa have shown high and varying ranges of LVH prevalence in the total population depending on the criteria used and show higher prevalence among those with hypertension.⁵⁻⁷ Detection of LVH is therefore of paramount importance particularly in individuals who are hypertensive or have other cardiovascular disease risk factors as prevention or regression of LVH is an important therapeutic goal which may prevent or delay the onset of cardiac events in these individuals. Echocardiography is the gold standard for LVH detection in clinical practice; however ECG remains widely used both in clinical practice and epidemiological studies in

Correspondence to: Emem-Chioma Pedro
Department of Medicine, College of Health Sciences,
University of Port Harcourt.
e-mail: emem.chioma2008@gmail.com

detecting LVH due to its simplicity, accessibility, greater convenience and lower cost.⁸ Available data particularly in Nigeria have shown that most LVH evaluation were hospital and urban-based; hence the need to determine the prevalence of this important and independent risk factor for cardiovascular disease in a rural community setting.

METHOD

This was a cross-sectional study involving adults in a rural farming community in Rivers State of Nigeria.

Questionnaire

A questionnaire was designed to elicit demographic and social information including age, gender, occupation, educational level, cigarette smoking, alcohol consumption and level of physical activity. Medical history such as prior knowledge of blood pressure status and family history of hypertension were all elicited by the questionnaire. Administration of questionnaire was by face-to-face interview by the researcher and field assistants who had been previously trained on this.

Anthropometry

Participants were weighed barefooted using Hanson's weighing scale with readings taken to the nearest 0.1 kg and their heights measured without foot wear and headdress to the nearest 0.1cm. Waist circumference was measured to the nearest centimeter with a flexible tape at the midpoint between the uppermost border of the iliac crest and the lower border of the costal margin (rib cage).⁹ Body mass index (BMI) was calculated as weight in kilogram divided by the square of height in meters. WHO classification of BMI was used in this study to grade BMI.¹⁰ Under weight- < 18.5 Kg/m²; Normal Weight- 18.5 to 24.9 Kg/m²; Overweight- 25 to 29.9 Kg/m²; Obesity- ≥ 30 Kg/m² Waist circumference ≥102cm for males and ≥88cm for females was regarded as abdominal obesity.¹¹

Blood Pressure

Auscultatory method using Mercury Sphygmomanometer and appropriately sized cuff was employed in measuring blood pressure with the participant in a seated position using the subject's left arm positioned at heart level. 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 pressures, respectively.¹² Hypertension was defined using the JNC 7 (Joint National Committee on Prevention, Evaluation, and Treatment report) criteria as blood pressure ≥ 140/90 mmHg or self-reported anti-hypertensive medication use.¹³

Electrocardiography

Twelve lead surface electrocardiograms were recorded on all the subjects after resting for 10 minutes with the patient in a supine position using a portable ECG machine (GE medical system, MAC 1100/1200/1200ST, version 1.2). After explaining the procedure to the subject, the ECG leads were placed according to standard practice. Recordings were made at 25 mm/sec, calibrated at 10 mm/mV and printed onto a graph paper with time represented on the x-axis and voltage represented on the y-axis and a background pattern of 1mm squares, with bold divisions every 5mm in both vertical and horizontal direction. LVH was determined using Sokolow-Lyon voltage criteria $Mv = SV1 + RV5$ (or $V6$ if larger).¹⁴

Blood sample

Venous blood samples were collected and analysed for triglyceride, uric acid and fasting blood sugar.

Ethical consideration

Informed consent was duly obtained from the village Chiefs and all subjects involved in the study. Approval of the Ethics Committee of the University of Port Harcourt Teaching Hospital was also obtained.

Data 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 for categorical variables. Pearson and Spearman rho correlation test were used to detect the relationship between LVH and its possible

risk factors. A p-value of <0.05 was considered statistically significant.

RESULTS

Data collected from five hundred subjects were analyzed. 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 years. The mean age for males was 42.84±17.8 years and that for females was 40.62±16.6 years.

Table 1. Relationship between study variables and the presence of LVH.

Parameter	Percentage (%) with LVH	P-value
Overweight	13.4	0.91
Obese	2.4	
High waist circumference	2.4	0.45
High waist-hip-ratio	17.1	0.38
Hypertension	35.4	<0.001*
Diabetes	3.7	0.47
Hypertriglyceridaemia	6.1	0.6
Gender		
Male	56.1	0.006*
Female	43.9	

Table 2: Prevalence of LVH by age and sex

Variable	ECG-LVH Sokolow-Lyon Criterion %	P-value
MALES		0.0001
18-29 years	4.2	
30-39 years	23.8	
40- 49 years	34.5	
50-59 years	25.0	
60-69 years	22.2	
70 years & above	21.4	
Total	20.4	
FEMALES		
18-29 years	1.4	
30-39 years	3.8	
40-49 years	11.3	
50-59 years	11.1	
60-69 years	16.3	
70 years & above	26.1	
Total	8.2	
Overall prevalence	16.4	

Table 3. Pearson and spearman RHO correlation analysis of LVH and its possible risk factors

Variable	Correlation coefficient	P value
Occupation	0.07	0.87
Education	0.75	0.92
Alcohol consumption	-0.60	0.18
Smoking	-0.94	0.04*
Physical activity	-0.008	0.864
Hypertension	0.162	<0.0001*
Waist circumference	0.023	0.60
Waist-Hip-Ratio	-0.021	0.65
BMI	0.028	0.53
Fasting Blood Sugar	0.012	0.79
Triglyceride	0.002	0.97
Uric Acid	0.031	0.496
Sex	0.121	0.007*
Age	-0.068	0.13

Prevalence of ECG-LVH: The prevalence of ECG-LVH by the Sokolow-Lyon criterion was 16.4% with a significantly higher prevalence in males than females (20.4 % versus 8.2%, p=0.001). There was high prevalence rate in the middle age and the elderly age group with the lowest rate seen in the young age group of 18-29 years in both sexes.

DISCUSSION

Most previous studies on ECG-LVH prevalence were hospital-based urban studies and concentrated more on hypertensive subjects' with a few on individuals diabetes unlike this present study that is a rural-community based, hence the uniqueness of this study.^{15-16,17} The high prevalence (16.4%) of ECG-LVH found in this study using Sokolow-Lyon voltage criterion is similar to the work done by Lutale et al¹⁵ in which he reported an ECG-LVH prevalence of 12.2% using Sokolow-Lyon criterion.

The high prevalence rate of ECG-LVH observed in this rural setting is a clear pointer to the rising burden of the risk factors for LVH even in the rural communities in Africa and perhaps a picture of the need for comprehensive health actions in our rural communities to avert the potential morbidities and mortalities associated thereby. Epidemiological studies in general

East African populations reported ECG-LVH by Sokolow-Lyon voltage criterion in 9.3%¹⁷ of subjects which is lower than what was reported in the present study. However, Dada et al in North-central Nigeria reported a much higher prevalence of 48%¹⁶ using Sokolow-Lyon criterion amongst hypertensives. Using Araoye's criterion, prevalence rates of 37.1% and 51% were found in two different Nigerian studies.⁶⁻⁷ Agomuoh et al⁶ had about one decade ago reported a high prevalence of 37.1% amongst hypertensives in urban population of Rivers State.¹⁷ These wide gaps from the present study are clearly related to the fact that whereas the present study was a rural community-based, cross-sectional study, the comparative studies were hospital-based among patients with hypertension which is a major risk factor for the development of LVH.⁵

It has been reported by previous researchers that gender is an independent determinant of LVH and that males tend to have higher prevalence rates for LVH when compared to the age-matched females.^{7,18, 19, 20} This is in agreement with the findings in this study as ECG-LVH was found to be significantly more prevalent in males than their female counterparts. However, some other studies have shown higher prevalence rates in the female gender necessitating the need for more

community-based cross-sectional studies.²¹⁻²² In both sexes in this study, ECG-LVH was found to be lowest in the young age group of less than 30 years. This may be related to the fact that the possible risk factors (hypertension, obesity, diabetes) for developing LVH were also found to be low in this age group. This is in tandem with various other publications as increasing age has being documented to be significantly associated with the development of LVH.^{23,24,25}

Researchers globally have shown a relationship between high blood pressure and the development of LVH pointing out the importance of blood pressure control in mitigating hypertensive cardiac damage. Both systolic and diastolic blood pressures have being demonstrated as independent predictors of cardiovascular disease, though more with the systolic blood pressure.^{26, 27, 28} This index study demonstrated a significant correlation between LVH and hypertension, both systolic and diastolic blood pressure.

Cigarette smoking is a major modifiable risk factor for cardiovascular diseases including ischaemic heart disease, heart failure, ischaemic stroke and acute myocardial infarction.²⁹⁻³⁰ The risk of cardiovascular disease in smokers is proportional to the number of cigarettes smoked and how deeply the smoker inhales.³¹⁻³² Various mechanisms have linked tobacco smoking to the development of LVH.^{33,34,35} This study have demonstrated a significant association between ECG-LVH and cigarette smoking which is similar to the findings by other authors.^{18,36} There is therefore an urgent need for a more aggressive public health campaign against smoking in sub-Saharan Africa already still currently burdened with infectious disease.

CONCLUSION

The prevalence of ECG-LVH in this rural community of study is high. The male gender, hypertension including both systolic and diastolic blood pressure and cigarette smoking are important variables found to be

significantly correlated with the development of LVH in this study. This therefore calls for urgent need to tackle these modifiable risk factors amongst others elicited in this study while developing a more comprehensive health package for our rural dwellers.

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