Am J Cardiovasc Dis 2021;11(3):300-315
www.AJCD.us /ISSN:2160-200X/AJCD0133208

Original Article

Cardiovascular event risk estimation among residents of a rural setting in Bayelsa state, Nigeria

Tamaraemumoemi Emmanuella Okoro*, Johnbull Jumbo*

Department of Internal Medicine, Niger Delta University Teaching Hospital, Okolobiri, Bayelsa State, Nigeria.
**Equal contributors.*

Received March 16, 2021; Accepted May 11, 2021; Epub June 15, 2021; Published June 30, 2021

Abstract: Cardiovascular diseases (CVD) are a leading cause of death worldwide. There is a rising prevalence of CVDs in Nigeria, including in rural communities. The present study assessed the total CVD risk among two rural communities in Bayelsa State, South-south Nigeria. Adults aged ≥ 40 years in 264 randomly selected households in two rural communities in Bayelsa State were interviewed in this descriptive cross-sectional survey. Using a structured questionnaire, data on socio-demographic characteristics, anthropometry, blood pressure (BP) and random blood sugar measurements were obtained. The WHO/ISH risk assessment chart for the African sub-region was used to estimate the 10-year total risk of fatal or non-fatal CVD events using five predictor variables: age, gender, smoking, systolic BP, and coexistence of diabetes mellitus (DM). Of the 264 participants, majority was men (70.1%) and married (93.2%). Mean age was 50.9±8.1 years. Most participants were overweight (53.4%), add salt to food on table (97.0%), lead a sedentary lifestyle (79.2%) and greater than a third of participants (36.7%) were known hypertensive patients. Using the WHO/ISH risk prediction chart for Africa, 90.0% and 10.0% of the study population had low and moderate risk, respectively of developing cardiovascular events in 10 years. As the age of participants increases, the 10-year risk of a cardiovascular event increased (X^2-48.9; P-0.001). History of hypertension (X^2-20.0; P-0.001), DM (X^2-5.87; P-0.016) and smoking (X^2-23.42; P-0.001) were significantly related to the level of 10-year cardiovascular event risk. Sex showed no significant relationship. There is a high prevalence of several cardiovascular risk factors in this rural population, though the 10-year risk of CV event is still low. CVD risk in rural communities requires awareness, monitoring and an integrated approach in their prevention, detection, and treatment.

Keywords: Cardiovascular diseases, WHO/ISH risk prediction chart, risk categories, 10-year total risk of fatal or non-fatal CVD events, rural communities

Introduction

Cardiovascular diseases (CVDs) make up nearly a half of all non-communicable disease (NCD) related deaths [1, 2]. Over three quarters (79%) of the global disease burden attributed to cardiovascular disease affect people less than 70 years of age and a substantial portion of CVD deaths (46%) are of people less than 70 years of age [3]. CVDs such as stroke, hypertensive heart disease, and ischemic heart disease are leading causes of Disability Adjusted Life Years (DALYs) globally and constitute a major barrier to sustainable human development [4, 5].

The 2015 Global Burden of Disease (GBD) study estimated 422.7 million prevalent cases of CVD [4]. Several countries including Nigeria, Angola, and Côte d'Ivoire suffer more premature mortality from non-communicable diseases than other African countries [4]. In 2016, the World Health Organization (WHO) revealed that NCDs account for 29% of all deaths in Nigeria, with CVDs accounting for 11% [6]. CVDs like hypertension, stroke, and heart failure have been on the increase in Nigeria, over the past 20 years [6]. Between 1990 and 2015, all high-income and some middle-income countries had significant declines in the age-standardized death rate due to CVD but no significant changes were detected over the same time period for most of sub-Saharan Africa [4].

Access to effective health care interventions and variations in exposure to modifiable risk factors such as obesity, dyslipidaemia, hypertension, alcohol abuse and cigarette smoking account for regional differences in CVD [7-12]. Cardiovascular diseases have a tremendous impact on healthcare spending in both developed and developing countries, costing the USA health care system $214 billion per year with additional $138 billion in lost job productivity [13]. CVD places a significant economic burden on low- and middle-income countries which have limited resources for its management given competing health priorities [14]. In Nigeria, an assessment of the costs of cardiovascular disease (CVD) prevention care in a rural setting, assessed using international guidelines, found the individual costs of CVD prevention care was $144 per year. The major contributory factors were drugs ($39) and diagnostic tests ($36). The cost of hypertension care was $118 and that of diabetes care $263 per patient per year [15].

Regular physical activity, a healthy diet and smoking cessation are appropriate and effective measures for preventing CVD events in both younger individuals and the elderly. Detection and treatment of raised blood pressure, abnormal blood lipids and blood glucose reduce risk of CVD events [16]. Reductions of CVD morbidity and premature deaths can be achieved through several strategies, including; targeting reduction in risk factors at the population level, primary prevention strategies that are individual based (to prevent onset of CVD) and finally prevention of disease progression in persons who already have CVDs, through secondary prevention and treatment strategies [17].

Given the interplay of multiple risk factors in the aetiology of CVDs, using a single risk factor in predicting cardiovascular risk would be insufficient [18]. Adopting risk charts that consider several probable determinants in assessing total cardiovascular risks would be a more holistic approach [19-24]. Total CVD risk is defined as the probability of an individual's experiencing a CVD event (e.g., stroke or acute myocardial infarction) over a time period, for example 10 years [25]. Total CVD risk is dependent on an individual's CVD risk factor profile, age and sex. It will therefore be higher for older persons with several coexisting risk factors than younger individuals with fewer risk factors [25]. Several studies suggest that adopting treatment strategies based on assessment of total CVD risk, offers considerable financial savings compared to treating each risk factor as a single entity [26, 27].

The total risk approach has been implemented in both developed and developing countries (after some adjustments for developing countries) [21-23]. CVD risk scores are useful clinical tools for quick and consistent estimation of individuals' total CVD risk and can also be used to estimate and monitor population distribution of CVD risk [17, 26-35]. Several risk charts for CVD risk assessment of individual patients have been described [36-39].

The World Health Organization (WHO) and the International Society of Hypertension (ISH) have developed CVS risk prediction charts based on the Framingham equations for regional use, using the best of available risk factors and mortality data of low- and middle-income country (LMIC) populations [20, 24]. They were developed for use in LMICs including Nigeria that do not have refined risk prediction charts. The predictor variables of age, gender, smoking, systolic blood pressure, plus or minus cholesterol and coexistence of diabetes mellitus are used to categorize participants into different CVD risk groups using the charts. These charts are cost-effective and can be applied in low resource-settings to predict a ten-year risk of major cardiovascular outcomes. Using the chart, a primary health care worker in a LMIC can identify persons at high CVD risk and refer if necessary for appropriate treatment to the next level of care. This way, the WHO/ISH risk prediction charts and accompanying guidelines can improve the effectiveness of cardiovascular risk management, even in resource settings that lack cardiologists and sophisticated technology. The WHO/ISH charts are designed to assist physicians in timely preventive measures and reduce the burden of CVDs on healthcare systems of LMIC countries [24, 25, 27]. WHO/ISH risk score can be calculated using either of two sets of risk prediction charts (plus and minus blood cholesterol) [20, 24, 25]. The categorization by the chart with or without cholesterol estimation has been shown to be similar in predicting the risk of fatal events for women and men [40]. The risk categories of the 10-year total risk of fatal or non-fatal CVD events include: "low risk" < 10%, "moderate risk" 10 -

< 20%, "high risk" 20 - < 30% and "very high risk" ≥ 30% [25, 41].

The practice notes which accompanied the WHO/ISH risk score charts are also used to further adjust and fully categorize each participant and are meant to aid clinicians in interpreting and adjusting individuals' risk when there are other CVD risk factors present which are not included in the risk score calculations. These notes state persons with persistent blood pressure ≥ 160/100 mm/Hg or with blood cholesterol levels ≥ 8.0 mmol/l should be considered in the high-risk category regardless of risk calculations using the charts. Also, "CVD risk may be higher than what is indicated by the charts" in persons with ages or blood pressures approaching the next chart category, persons currently on antihypertensive therapy, obesity, sedentary lifestyle, low socioeconomic status, premature menopause, close family history of CVD or stroke, raised pulse rate, raised triglyceride or low HDL cholesterol levels and a range of other biochemical markers. The WHO/ISH risk prediction charts can be used by health care professionals to match the intensity of CVD risk factors management with the likelihood of CVD events. The charts may motivate patients to change their behaviour if used to explain the likely impact of interventions on the patient's risk of developing CVD [25].

Cardiovascular risk factors have been thought to be less common in rural communities compared to urban areas because of their traditional lifestyle compared to the western lifestyle of urban dwellers. However, a rising trend of cardiovascular disease risk factors including hypertension and obesity has been observed in rural communities [42, 43]. Using WHO/ISH risk prediction chart as an easy and inexpensive screening tool in predicting cardiovascular events, total cardiovascular risk can be estimated in rural communities. Several studies have found these charts useful in quantifying individual's 10 years risk of developing CVDs [26, 44].

A cross-sectional study involving two rural communities in India revealed a high burden of CVD risk as assessed by WHO/ISH risk prediction charts' [44]. Their study assessed the prevalence of CVD risk factors and estimated the cardiovascular risk among adults aged > 40 years. They found seventeen percent of the rural populations studied had moderate to high risk for cardiovascular events using WHO/ISH risk prediction charts. Also, CVD risk factors such as smoking, alcohol, low levels of High-Density Lipoprotein (HDL) cholesterol were found in 32%, 53%, 56.3%, and 61.5% of the study participants, respectively. A similar study in Nepal revealed a large proportion of Nepalese rural population were at moderate and high 10 years CVD risk [44, 45]. Most studies in Nigeria have focused on assessments of the prevalence of CVD risk factors but not the risk of future cardiovascular events [46, 47]. However, information gathered on prevalence of CVD risk factors alone is not adequate in providing needed knowledge on the risk of future cardiovascular events. Also, in order to implement cost-effective methods to prevent CVDs, information is needed on the proportion of persons in low, intermediate or high cardiovascular risk strata. This stratification would afford the health care workers especially in low resource settings like ours, the opportunity of prioritizing interventions by allocating available resources to persons with high total cardiovascular risk. Presently, there is scarcity of data on cardiovascular event risk estimation in Nigeria. Therefore, this study assessed the total CVD risk among two rural communities in Bayelsa State, South-south Nigeria in the Niger Delta region of Nigeria, with a view to identifying patients who may be asymptomatic but at different levels of risk of developing CVDs using the WHO/ISH risk prediction charts.

Materials & methods

Study area

Bayelsa state is one of the six states in the oil rich Niger Delta region, created in the year 1996 from Rivers State, in the south-southern region of Nigeria. It is bounded by Delta state on the north, Rivers state on the east and the Atlantic Ocean on the western and southern parts. There are 8 local government areas (LGA) in the state of which Yenagoa LGA accommodates the state's administrative headquarters. Yenagoa LGA has an area of 706 km^2 and a population of 353,344 comprising of 187,791 male and 165,553 females with an estimated annual exponential growth rate of 2.9 as at the 2006 National Census [48]. Most of its communities are surrounded by water, making them inaccessible by road [49]. The state is mainly inhabited by the Ijaw tribe but is also home to other Nigerians and foreigners. The major crafts in the communities are canoe building, pottery, fish net and fish traps making, basket and mat making, fishing, and farming while some work in the government civil service mainly as clerical staff and other administrative positions depending on their level of education. The study was carried out at Okolobiri and Obunagha communities, both of which are oil producing communities and engage in fishing and farming as a source of livelihood in the Yenagoa LGA of Bayelsa state.

Study design

The study was a descriptive cross-sectional study estimating population total CVD risk in two rural communities in Bayelsa State, using the WHO/ISH risk prediction charts.

Study population

The study population comprised all aged 40 years above in households in the selected communities.

Sample size

We calculated sample size using the formula for estimation of single proportion in a population greater than 10,000 [50] stated below:

$$N = \frac{Z^2 PQ}{d^2} \times DEFF$$

Where N = number of participants, Z = 1.96, P = prevalence (11% or 0.11), Q = 1-P, d = 0.05, *DEFF* is the design effect to account for the clustering effect that is usually associated with community surveys. A design effect of 1.5 was employed in the sample size estimation. Using a prevalence of 11% for CVD in Nigeria as reported by WHO [6], a minimum sample size of 225 participants was obtained. Adjusting for non-response with a non-response rate of 10%, sample size was further increased to 248 participants. However, we eventually sampled a total of 264 persons aged 40 years and above.

Sampling technique

Yenagoa LGA is made up of 15 administrative wards, 6 wards are considered urban, while the other 9 wards are made up of rural communities. Of the 9 rural wards, one ward (Okolobiri) was selected by simple random sampling (balloting). Okolobiri ward is made up of four communities out of which 2 communities (Okolobiri and Obunagha) were selected for the study by simple random sampling (balloting). After a house mapping exercise in the selected communities a systematic random sampling was employed in selecting houses/households for the study in the 2 communities. Appropriate intervals were determined in both communities to ensure 124 houses were selected from each community. Some houses were inhabited by more than one household, households for the study in such houses were selected by balloting. One adult aged 40 years and above was chosen in each household. In situations where selected participants were unwilling to participate or no eligible adult in the household, the selection criteria is applied in the next house before returning the sequence of the systematic sampling.

Study instrument (questionnaire)

The study used an interviewer-administered questionnaire developed by the researchers using the WHO STEP wise approach to surveillance guidelines [17, 51] which has been used in studies of total CVD risk in several populations. This was used to gather information on selected demographic characteristics including gender, age, dietary intake, physical activity, tobacco and alcohol use, systolic and diastolic blood pressures, and presence or absence of diabetes mellitus.

Study procedures

Using an information sheet and consent form prepared for the study, the objectives, procedure, and benefits of the study were explained to participants and written informed consent was obtained. Thereafter the questionnaire was administered, participants were examined, and blood samples taken for laboratory investigation by trained research assistants. Research assistants (RAs) were 3 house officers and a resident doctor trained by the investigators on how to obtain the required measurements. Training of RAs was for two days and lasted 3 hours daily, during which the objectives of the study were emphasized, and they were taught how to take the required measurements in the study, in a consistently accurate manner. Training ended with a field trial where RAs were watched and corrected to ensure compliance to study procedure. The data collection exercise was done over a period of 3 months between October and December 2020.

Physical examination included measurements of height and weight, waist circumference, blood pressure, and collection of blood samples for random blood sugar using standard protocols [51-54]. Height was measured with each participant standing with his/her feet together, no shoes on, and with their back to a rigid tape measure, head held high, looking straight on at a spot on the opposite wall. A flat rule was placed on the participant's head to flatten any hairs present. The measurement was taken to the nearest centimeter, at the point where the flat rule touched the rigid tape. Body weight was measured in kilograms (kg) using a standardized weight scale, while the participants wore only light clothing.

Waist circumference (WC) was measured to the nearest 0.1 centimeter, using a non-stretch linear tape which was applied approximately midway between the lower margin of the last palpable rib and the top of the iliac crest [53]. Hip circumference (HC) was measured across the widest diameter of the hips over the greater trochanters, also to the nearest centimeter.

An Accoson mercury sphygmomanometer was used for the measurement of the brachial artery systolic and diastolic blood pressures at Korotkoff 1 and 5 respectively, with participants seated, after resting for 5 minutes [55, 56]. Two BP recordings were taken from the right arm of patients, with measurements taken at 5-minute intervals. The average of two measurements was then used for the analysis [55, 56].

Random blood glucose levels were determined before participant's lunch using an Accucheck glucometer. Additional risk factors such as persons on anti-hypertensive medication(s), obesity (BMI > 30 Kg/m^2, WC > 94 cm in men or > 90 cm in women), raised resting pulse rate > 90 bpm [57-59], sedentary lifestyle defined by less than 30-45 minutes brisk walking for up to 3-5 times a week [60-62], that may put individuals at greater total CVD risk than indicated by the charts were also considered.

Data analysis

Data collected was checked for completeness at the end of every research day and entered into into Microsoft Excel sheet for cleaning. This was then imported into SPSS version 23 for analysis. Continuous variables were summarized as mean, standard deviation and range while categorical variables were presented as frequencies and proportions. The body mass index (BMI) was calculated as weight divided by the square of the height in metres (kg/m^2). Using WHO guidelines, obesity was defined as a BMI of ≥ 30 kg/m^2 [1, 52]. BMIs of < 18.5 kg/m^2, 18.5-24.9 kg/m^2 and 25-29.9 kg/m^2 was characterized as underweight, normal and overweight respectively [51, 52]. Abdominal obesity was defined using the WC cut-off of 94 cm for men and 80 cm for women, waist-to-hip ratio (WC divided by HC) > 0.90 in males and > 0.85 in females and waist-to-height ratio (WHtR) of ≥ 0.5 [53, 54]. Diabetes mellitus and impaired glucose tolerance will be defined by random blood glucose of ≥ 11.1 and ≥ 7.8 mmol/L, respectively or if there was a prior diagnosis of DM with use of insulin or oral hypoglycemic drugs. Hypertension was defined according to World Health Organization/International Society of Hypertension guidelines (WHO/ISH) as systolic blood pressure reading (SBP) ≥ 140 mmHg and/or diastolic blood pressure reading (DBP) ≥ 90 mmHg [55, 56]. Significant alcohol intake was defined as 21 units for men and 14 units for women.

The proportion of participants in the different CVD risk categories was obtained and the relationship of sociodemographic, clinical, and medical factors was explored using a Chi-square test of proportion. Level of Significance was set at *p* Value < 0.05.

Ethical issues

The study was conducted in accordance with the Helsinki declaration [63], and ethical clearance (application form no NDUTH REC/2020/10256) was obtained from the Research and Ethics committee of the Niger Delta University Teaching Hospital. Voluntary written informed consent was obtained from the study participants. All data was handled with strict confidentiality.

Table 1. Sociodemographic information of Study participants

Characteristics	Frequency (N = 264)	Percent (%)
Sex of Respondents		
Male	185	70.1
Female	79	29.9
Age of Respondents		
40-49 years	118	44.7
50-59 years	99	37.5
60-69 years	42	15.9
70-79 years	5	1.9
Mean (SD) age in years	50.9 (8.1)	
Marital Status		
Single	18	6.8
Married	246	93.2

Results

Sociodemographic characteristics

A total of two hundred and ninety-three were assessed for eligibility to participate in the study, however, only two hundred and sixty four persons consented and fully participated in the study, giving a participation rate of 90%. Nineteen persons (6.5%) considered eligible for the study declined participation while 10 persons (3.5%) who commenced the study stopped at the point of examination and blood sample collection.

Of the two hundred and sixty four participants, **Table 1** revealed that majority were men (70.1%) and 29.9% were women. Most participants were in the 4th and 5th decades of life (44.7% and 37.5% respectively) and married (93.2%).

Anthropometric measures, clinical features, and Social factors among participants

Tables 2 and **3** summarizes the anthropometric measures, clinical features, and social factors among the study participants. The mean body mass index and waist circumference was 26.6 kg/m^2 and 90.0 cm with standard deviations of 3.4 kg/m^2 and 12.2 cm, respectively (**Table 2**). **Table 2** further reveals systolic and diastolic blood pressure ranged between 90-180 mmHg and 50-110 mmHg, respectively. Among the 33 participants (12.5%) that smoke cigarettes, the mean quantity was 5.1±3.8 pack years and out of the one hundred participants who drank alcohol, the mean alcohol consumption was 28.7±2.1 units (**Table 2**). Greater than a third of participants (36.7%) were known hypertensive patients, while only 1 of every twenty participants were known diabetic (5.3%) prior to this study (**Table 3**). Also, **Table 3** shows that most participants were overweight (53.4%), add moderate salt to food on table (65.9%) and perceive their level of stress as 'moderate' (76.5%). Slightly above half (56.8%) and about a third of participants (29.9%) had family history of hypertension and Diabetes mellitus, respectively.

Risk of cardiovascular event in 10 years among participants

Using the WHO/ISH risk prediction chart for Africa, 90.0% of the study population has low risk (< 10%) of developing cardiovascular events in 10 years while 10.0% of the study population has a moderate risk (10-19%) of a 10 year cardiovascular event development (**Figure 1**). High risk (≥ 20%) was not found in participants at the time of this study.

Relationship between risk of CV event and sociodemographic features and clinical factors

As the age of participants increased, the 10-year risk of a cardiovascular event increased (X^2-48.9; P-0.001) while sex showed no significant relationship with the level of cardiovascular risk in this study. History of hypertension (X^2-20.0; P-0.001), diabetes mellitus (X^2-5.87; P-0.016) and smoking (X^2-23.42; P-0.001) were significantly related to the level of 10-year CV event risk (**Tables 4** and **5**).

Discussion

We found a high prevalence of several cardiovascular risk factors in this population of rural men and women. The prevalence of hypertension in our study is 56.4% (149) out of which only 97 (36.7%) are aware, so 52 persons (19.7%) were newly diagnosed hypertensives in this study. Hypertension is a major risk factor for cardiovascular diseases and contributes greatly to cardiovascular morbidity and mortality in Africa, with Nigeria as the most populous country in the continent, contributing hugely to this burden [64]. Prevalence of hypertension in Nigeria is among the highest in Africa [65].

Table 2. Anthropometric measures, Clinical features, and Social factors among participants

Characteristics	Number	Mean (SD)	Range
Anthropometric measurements			
Weight	264	80.6 (12.5)	51.7-119.9
Height	264	1.74 (0.08)	1.52-1.98
Body mass index (in kg/m^2)	264	26.6 (3.4)	19.2-37.8
Waist circumference (in cm)	264	90.0 (12.2)	68.0-130.0
Waist-to-hip ratio	264	0.91 (0.08)	0.67-1.27
Waist-to-height ratio	264	0.53 (0.07)	0.40-0.74
Clinical features			
Pulse (beats per minutes) - median	264	78.6 (8.9)	60.0-112.0
Systolic blood Pressure (in mmHg)	264	130.4 (15.8)	90.0-180.0
Diastolic blood pressure (in mmHg)	264	83.4 (9.9)	50.0-110.0
Random blood sugar	264	5.3 (1.2)	3.2-9.6
Social factors			
Quantity of water intake (in litres/day)	264	2.9 (0.6)	1.0-4.0
Quantity of Cigarette (in pack years)	33	5.1 (3.8)	1.0-20.0
Quantity of Alcohol intake (in Units)	100	28.7 (21.1)	1.0-70.0

Table 3. Clinical and Social risk factors for cardiovascular events among participants

Characteristics	Frequency (N = 264)	Percent (%)
Clinical Features		
BMI Categories		
Underweight	2	.8
Normal Weight	76	28.8
Overweight	141	53.4
Obese	45	17.0
History of Hypertension		
Present	97	36.7
Absent	167	63.3
History of Diabetes		
Present	14	5.3
Absent	250	94.7
Social Factors		
Smoking		
Yes	33	12.5
No	231	87.5
History of Alcohol intake		
No history of intake	163	61.7
Insignificant Intake	28	10.6
Significant Intake	73	27.7
Daily Fruit Intake		
Yes	52	19.7
No	212	80.3
Exercise		
Yes	55	20.8
No	209	79.2

Data from a recent nationwide survey showed an overall age-standardized prevalence of hypertension of 38.1% with prevalence rates ranging from 20.9% in the North-Central to 52.8% in the South-East region [65]. However, prevalence rates in their study did not differ significantly (P > 0.05) among rural and urban dwellers; 39.2% versus 37.5% respectively [65]. The finding of a high prevalence of hypertension in our study agrees with findings of a growing trend of hypertension in rural dwellers and a closing up of the rural-urban gap of hypertension prevalence [42, 43, 65]. The adoption of lifestyles that fuel hypertension may be responsible for the narrowing urban-rural gap in prevalence of hypertension [66, 67]. Our study also showed most participants were overweight (53.4%), add salt to food on table (97%), and most had a sedentary lifestyle (79.2%), all of which are established risk factors for developing hypertension [68-73]. The population of Nigeria has been growing at a steady rate [74], resulting in dwindling availability of farm land and this combined with the pollution of streams and rivers [75] encourage rural dwellers to divert to more non-farming and non-fishing occupation for their livelihood [76, 77]. These less manual labour driven activities encourage sedentary life style and consumption of processed salt-rich food [65, 78].

Intake of Extra salt (adding salt on Table)		
None	8	3.0
Little	79	29.9
Moderate	174	65.9
A lot	3	1.1
Perception of stress level		
Mild	28	10.6
Moderate	202	76.5
Severe	34	12.9
Family History of Hypertension		
Yes	150	56.8
No	114	43.2
Family history of Diabetes mellitus		
Yes	79	29.9
No	185	70.1

*BMI means Body mass index.

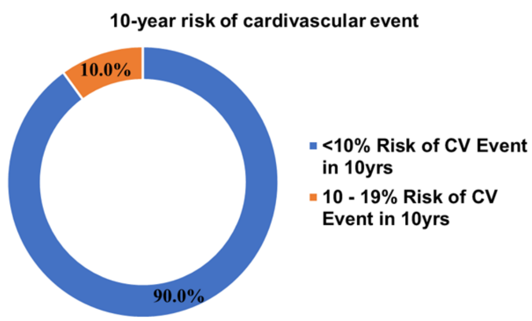

Figure 1. 10-year cardiovascular event risk among study participants.

Previous studies have shown that although hypertension is as common in rural areas as urban areas [43, 65], there is better awareness of hypertension in urban than rural areas [65]. In our study, almost one fifth of the participants (19.7%) that were discovered to be hypertensive were not aware of their hypertensive status prior to the study. Furthermore, of the 97 that were aware of their hypertension only 15 (5.7% of the study population) have their BP well controlled during the survey. Detection and treatment rates of hypertension remain low in sub-Saharan Africa because of poor awareness and a highly deficient, underfunded health system [79]. The challenges of low awareness of hypertension include a high rate of unmet needs in hypertension care, low rates of treatment and BP control [80]. Factors responsible for low rates of awareness of BP status and treatment include poor access to health care, poor health seeking behaviour, poorly managed health systems and patients' non-adherence to prescribed therapies [81, 82].

In our study, slightly above half (56.8%) and about a third of participants (29.9%) had family history of hypertension and diabetes mellitus, respectively. Our finding agrees with previous studies which have shown an increased prevalence of hypertension amongst first-degree relatives of hypertensive patients [83-85]. A positive family history of hypertension is a risk factor for hypertension, dyslipidemia, Type 2 diabetes mellitus, obesity, and CVDs [83-85]. A positive family history of Type 2 diabetes mellitus may increase the risk of a person becoming diabetic by up to 40% [86].

Using the WHO/ISH risk prediction chart for Africa, 90.0% of our study population had low risk, that is < 10% risk of developing cardiovascular events in 10 years while 10.0% of the study population has a moderate risk of developing a cardiovascular event in 10 years. Our study agrees with findings using WHO/ISH risk prediction charts in three developing countries Cambodia, Malaysia, Mongolia that showed the majority of people in all three countries had low risk of a 10-year CV event ranging from 89.6% in Mongolia, to 97% in Cambodia. This is similar to our findings of 90.0% having low risk of 10-year CVD risk [17]. Cardiovascular disease risk is typically lower in rural areas because of their traditional lifestyles, eating habits, physically tasking work and cultural practices, but the trend is changing with adoption of western lifestyles and urbanization of some of our rural communities [18, 65-67].

Our study also showed 10.0% of the study population had a moderate risk of a 10-year cardiovascular event, however, high risks (≥20% risk) were not found in participants in the current study at the time of this study. Prevalence of high total CVD risk has been estimated to be less than 10% in people aged 40 or over in several LMIC countries including China 1.1%, Cuba 2.8%, Iran 1.7%, Georgia 9.6%, Nigeria 5.0%, Pakistan 10.0% and Sri Lanka, 2.2% [26]. It is

Table 4. Relationship between risk of CV event, sociodemographic features, and family history of medical conditions

Characteristics	Total N = 264	Risk of CV event		X^2	df	*P* Value
		Low Freq (%)	Moderate Freq (%)			
Sex of Respondents						
Male	185	163 (88.1)	22 (11.9)	2.91	1	0.088
Female	79	75 (94.9)	4 (5.1)			
Age of Respondents						
40-49 years	118	115 (97.5)	3 (2.5)	48.9	3	0.001*
50-59 years	99	93 (93.9)	6 (6.1)			
60-69 years	42	28 (66.7)	14 (33.3)			
70-79 years	5	2 (40.0)	3 (60.0)			
Marital Status						
Single	18	17 (94.4)	1 (5.6)	0.40	1	0.527
Married	246	221 (89.8)	25 (10.2)			
Family History of Hypertension						
Yes	150	134 (89.3)	16 (10.7)			
No	114	104 (91.2)	10 (8.8)	0.26	1	0.609
Family history of Diabetes mellitus						
Yes	79	68 (86.1)	11 (13.9)	2.11	1	0.146
No	185	170 (91.9)	15 (8.1)			

*Statistically significant at p<0.05. CV event means cardiovascular event.

Table 5. Relationship between Risk of CV event and clinical factors

Characteristics	Total N = 264	Risk of CV event		X^2	df	*p* Value
		Low Freq (%)	Moderate Freq (%)			
Body mass index						
Underweight	2	1 (50.0)	1 (50.0)	4.25	3	0.236
Normal weight	75	68 (90.7)	7 (9.3)			
Overweight	141	126 (89.4)	15 (10.6)			
Obese	46	42 (93.3)	4 (6.7)			
History of Hypertension						
Yes	97	77 (79.4)	20 (20.6)	20.03	1	0.001*
No	167	161 (96.4)	6 (3.6)			
History of Diabetes						
Yes	14	10 (71.4)	4 (28.6)	5.87	1	0.016*
No	250	228 (91.2)	22 (8.8)			
Smoking History						
Yes	33	22 (66.7)	11 (33.3)	23.42	1	0.001*
No	231	216 (93.5)	15 (6.5)			
History of Alcohol intake						
No history of intake	163	149 (91.4)	14 (8.6)	2.32	2	0.314
Insignificant Intake	28	23 (82.1)	5 (17.9)			
Significant Intake	73	66 (90.4)	7 (9.6)			
Daily Fruit Intake						
Yes	52	49 (94.2)	3 (5.8)	1.21	1	0.271
No	212	189 (89.2)	23 (10.8)			
Exercise						
Yes	55	51 (92.7)	4 (7.3)	0.52	1	0.471
No	209	187 (89.5)	22 (10.5)			

Intake of Extra salt (adding salt on Table)						
None	8	8 (100.0)	0 (0.0)	4.38	3	0.224
Little	79	67 (84.8)	12 (15.2)			
Moderate	174	160 (92.0)	14 (8.0)			
A lot	3	3 (100.0)	0 (0.0)			
Perception of stress level						
Mild	29	26 (89.7)	3 (10.3)	0.05	2	0.975
Moderate	201	181 (90.0)	20 (10.0)			
Severe	34	31 (91.2)	3 (8.8)			

*Statistically significant; CV - Cardiovascular.

therefore not surprising that none of our study participants had a high risk of 10-year CV event in the population which had a predominant age group of 40-49 years.

Our study found as the age of participants increased, the 10-year risk of a cardiovascular event also increased (X^2-48.9; P-0.001) while sex showed no significant relationship with the level of cardiovascular risk in this study. This is in keeping with previous studies showing increasing age as an important risk factor for CVD event risk [87, 88]. Prioritizing screening of CVD risk factors and possibly pharmacological interventions may reduce risk of CVD events in middle aged and elderly persons. The lack of significant sex difference in the 10-year risk of CVD in this population is similar to the findings by Otgontuya et al [17] in assessment of total CVD risk in three LMICs. They found that although a higher proportion of men had moderate to high total CVD risk than women, the differences were not statistically significant, and the risk among both women and men increased significantly with age just as was found in our study. Cardiovascular disease (CVD) has remained one of the most common causes of death in both men and women in the developed world. Women account for over half of the nearly 1 million deaths annually that is caused by CVD in the United States [89]. However, historically, CVD risk factors in women have been insufficiently recognized and diagnosed, and less aggressively treated [90-92]. A five-year retrospective study in Nigeria has shown a rising trend of CVD among Nigerian women [93]. A survey of prevalence of cardiovascular risk factors among Nigerian adults found no gender differences in prevalence of CVD risk factors such as pre-diabetes, diabetes, hypertension, central obesity, low high density lipoprotein, hypertriglyceridemia and hypercholesterolemia, however they recorded significant gender differences in the levels of total cholesterol, triglyceride, high density lipoprotein cholesterol and body mass index (BMI) [94].

In our study, history of hypertension (X^2-20.0; P-0.001), diabetes mellitus (X^2-5.87; P-0.016) and smoking (X^2-23.42; P-0.001) were significantly related to the level of 10-year CV event risk in our study. Our finding agrees with several studies showing hypertension is an established risk factor for CVD and BP control has been shown to be crucial in decreasing CVD risk [95, 96]. A reduction of systolic BP by 3-5 mmHg has been shown to reduce stroke risk by 2-3% and coronary artery disease risk by 16% [96]. Increased urbanization has resulted in an increased prevalence of risk factors such as smoking, hypertension and diabetes mellitus which were hitherto rare in rural areas [97, 98]. Increasing life expectancy and urbanisation are major determinants of CVD in developing countries [99, 100].

Limitations

The use of just two blood pressure readings taken at one sitting may have affected the prevalence of hypertension. The lack of gender differences may have been influenced by the gender skew towards male preponderance. Also, the lack of assessment of incomes of the households and its effect on CV event may have led to an underestimation of the 10-year risk of CV event.

Conclusion

The high prevalence of several cardiovascular risk factors in this rural population is worrisome. Even though the 10-year risk of CV event is still low in the population, it is pertinent that an effective surveillance and monitoring of traditional CVD risk factors be instituted in this locality to forestall an increase in risk that may result from adoption of western lifestyles and increased life expectancy. CVD risk in rural communities requires awareness, monitoring and an integrated approach in their prevention, detection, and treatment.

Acknowledgements

The authors are grateful to all the residents of Okolobiri and Obunagha communities who consented to be part of the study.

Disclosure of conflict of interest

None.

Address correspondence to: Tamaraemumoemi Emmanuella Okoro, Department of Internal Medicine, Niger Delta University Teaching Hospital, Okolobiri, Bayelsa State, Nigeria. Tel: 234-08033091-319; E-mail: nuellaokoro@gmail.com

References

[1] Graziano TA. Reducing the growing burden of cardiovascular disease in the developing world. Health Aff 2007; 26: 13-24.

[2] World Health Organization Cardiovascular diseases (CVDs) fact sheet. Updated May 2017. http://www.who.int/news-room/fact-sheets/detail/cardiovascular-diseases-(cvds). Accessed April 2, 2018.

[3] The World Health Report 2002: reducing risks, promoting healthy life. Geneva, World Health Organization, 2002.

[4] Roth GA, Johnson C, Abajobir A, Abd-Allah F, Abera F, Abyu G, Ahmed M, Aksut B, Alam T , Alam K, Alla F, Alvis-Guzman N, Amrock S, Ansari H, Ärnlöv J, Asayesh H, Atey TM, Avila-Burgos L, Awasthi A, Banerjee A, Barac A, Bärnighausen T , Barregard L, Bedi N, Ketema EB, Bennett D, Berhe G, Bhutta Z, Bitew S, Carapetis J, Carrero JJ, Malta DC, Castañeda-Orjuela CA, Castillo-Rivas J, Catalá-López F, Choi J, Christensen H, Cirillo M, Cooper L, Criqui M, Cundiff D, Damasceno A, Dandona L, Dandona R, Davletov K, Dharmaratne S, Dorairaj P, Dubey M, Ehrenkranz R, Zaki ME, Faraon EJA, Esteghamati A, Farid T, Farvid M, Feigin V, Ding EL, Fowkes G, Gebrehiwot T, Gillum R, Gold A, Gona P, Gupta R, Habtewold TD, Hafezi-Nejad N, Hailu T, Hailu GB, Hankey G, Hassen HY, Abate KH, Havmoeller R, Hay SI, Horino M, Hotez PJ, Jacobsen K, James S, Javanbakht M, Jeemon P, John D, Jonas J, Kalkonde Y, Karimkhani C, Kasaeian A, Khader Y , Khan A, Khang Y, Khera S, Khoja A T, Khubchandani J, Kim D, Kolte D, Kosen S, Krohn KJ, Kumar A, Kwan GF, Lal DK, Larsson A, Linn S, Lopez A, Lotufo PA, El Razek HMA, Malekzadeh R, Mazidi M, Meier T , Meles KG, Mensah G, Meretoja A, Mezgebe H, Miller T, Mirrakhimov E, Mohammed S, Moran AE, Musa KI, Narula J, Neal B, Ngalesoni F, Nguyen G, Obermeyer CM, Owolabi M, Patton G, Pedro J, Qato D, Qorbani M, Rahimi K, Rai RK, Rawaf S, Ribeiro A, Safiri S, Salomon JA, Santos I, Milicevic MS, Sartorius B, Schutte A, Sepanlou S, Shaikh MA, Shin M, Shishehbor M, Shore H, Silva DAS, Sobngwi E, Stranges S, Swaminathan S, Tabarés-Seisdedos R, Atnafu N T, Tesfay F, Thakur JS, Thrift A, Topor-Madry R, Truelsen T, Tyrovolas S, Ukwaja KN, Uthman O, Vasankari T, Vlassov V, Vollset SE, Wakayo T, Watkins D, Weintraub R, Werdecker A, Westerman R, Wiysonge CS, Wolfe C, Workicho A, Xu G, Yano Y, Yip P, Yonemoto N, Younis M, Yu C, Vos T, Naghavi M and Murray C. Global, regional, and national burden of cardiovascular diseases for 10 causes, 1990 to 2015. JACC 2017; 70: 1-25.

[5] Clark H. NCDs: a challenge to sustainable human development. Lancet 2013; 381: 510-1.

[6] World Health Organisation. Non-communicable Diseases. Country Profiles; 2018. Available from: https://www.who.int/nmh/countries/nga_en.pdf [Last accessed on 2019 Dec 30].

[7] Zaridze D, Brennan P, Boreham J, Boroda A, Karpov R, Lazarev A, Konobeevskaya I, Igitov V, Terechova T, Boffetta P and Peto R. Alcohol and cause-specific mortality in Russia: a retrospective case-control study of 48,557 adult deaths. Lancet 2009; 373: 2201-14.

[8] Malik VS, Willett WC and Hu FB. Global obesity: trends, risk factors and policy implications. Nat Rev Endocrinol 2013; 9: 13-27.

[9] Chow CK, Teo KK, Rangarajan S, Islam S, Gupta R, Avezum A, Bahonar A, Chifamba J, Dagenais G, Diaz R, Kazmi K, Lanas F, Wei L, Lopez-Jaramillo P, Fanghong L, Ismail NH, Puoane T, Rosengren A, Szuba A, Temizhan A, Wielgosz A, Yusuf R, Yusufali A, McKee M, Liu L, Mony P and Yusuf S; PURE (Prospective Urban Rural Epidemiology) Study investigators. Prevalence, awareness, treatment, and control of hypertension in rural and urban communities in high-, middle-, and low income countries. JAMA 2013; 310: 959-68.

[10] Farzadfar F, Finucane MM, Danaei G, Pelizzari PM, Cowan MJ, Paciorek CJ, Singh GM, Lin JK, Stevens GA, Riley LM and Ezzati M; Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group (Cholesterol).

National, regional, and global trends in serum total cholesterol since 1980: systematic analysis of health examination surveys and epidemiological studies with 321 country-years and 3.0 million participants. Lancet 2011; 377: 578-86.

[11] Danaei G, Finucane MM, Lin JK, Singh GM, Paciorek CJ, Cowan MJ, Farzadfar F, Stevens GA, Lim SS, Riley LM and Ezzati M; Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group (Blood Pressure). National, regional, and global trends in systolic blood pressure since 1980: systematic analysis of health examination surveys and epidemiological studies with 786 country-years and 5.4 million participants. Lancet 2011; 377: 568-77.

[12] Finucane MM, Stevens GA, Cowan MJ, Danaei G, Lin JK, Paciorek CJ, Singh GM Gutierrez HR, Lu Y, Bahalim AN, Farzadfar F, Riley LM, and Ezzati M; Global Burden of Metabolic Risk Factors of Chronic Diseases Collaborating Group (Body Mass Index). National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. Lancet 2011; 377: 557-67.

[13] Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S, Chiuve SE, Cushman M, Delling FN, Deo R, de Ferranti SD, Ferguson JF, Fornage M, Gillespie C, Isasi CR, Jiménez MC, Jordan LC, Judd SE, Lackland D, Lichtman JH, Lisabeth L, Liu S, Longenecker CT, Lutsey PL, Mackey JS, Matchar DB, Matsushita K, Mussolino ME, Nasir K, O'Flaherty M, Palaniappan LP, Pandey A, Pandey DK, Reeves MJ, Ritchey MD, Rodriguez CJ, Roth GA, Rosamond WD, Sampson UKA, Satou GM, Shah SH, Spartano NL, Tirschwell DL, Tsao CW, Voeks JH, Willey JZ, Wilkins JT, Wu JH, Alger HM, Wong SS and Muntner P; American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics-2018 update: a report from the American heart association. Circulation 2018; 137: e67-e492.

[14] Leeder S, Raymond S, Greenberg H, Liu H and Esson K. A race against time: the challenge of cardiovascular disease in developing economies. New York: The Center for Global Health and Economic Development; 2004.

[15] Hendriks ME, Bolarinwa OA, Nelissen HE, Boers AC, Gomez GB, Tan SS, Redekop W, Adenusi P, Lange JMA, Agbede K, Akande T and Schultsz C. Costs of cardiovascular disease prevention care and scenarios for cost saving: a micro-costing study from rural Nigeria. J Hypertens 2015; 33: 376-684.

[16] Tunstall-Pedoe H, Kuulasmaa K, Tolonen, H, Davidson M, Mendis S, Amouyel P, Arveiler D, Asplund K, Balaguer-Vintró I, Beaglehole R, Bingham A, Bluzhas J, Busquin P, Cesana G, De Backer G, De Henauw S, Davidson M, Dobson A, Domarkiene S, Ducimetière P, Evans A, Ferrario Marco, Ferrières J, Fortmann S, Giampaoli S, Gregor R, Greiser E, Gutzwiller F, Heinemann L, Hense H, Hobbs, M, Jakovljevic D, Janhsen K, Jones D, Keil U, Kornitzer, M, Kromhout D, Kuulasmaa K, Luepker R, McCrum, E, Mähönen, M, Malyutina S, Mendis S, Moltchanov V, Nikitin Y, Pajak A, Pilotto L, Planojevic M, Písa, Z, Puska P, Rywik S, Ruokokoski E, Sans S, Schroll M, Shalnova S, Shatchkute A, Sigfússon N, Skodová Z, Stewart A, Thelle D, Tolonen H, Topór-Ma R, Tunstall-Pedoe H, Tuomilehto J, Vanuzzo D, Wietlisbach V, Wilhelmsen L, Williams D, Wolf H, Yach D, Yarnell J and Zhaosu W; The WHO MONICA Project. MONICA monograph and multimedia sourcebook: world's largest study of heart disease, stroke, risk factors, and population trends 1979-2002 WHO MONICA Project 2003. World Health Organization. https://apps.who.int/iris/handle/10665/42597.

[17] Otgontuya D, Oum S, Palam E, Rani M and Buckley BS. Individual-based primary prevention of cardiovascular disease in Cambodia and Mongolia: early identification and management of hypertension and diabetes mellitus. BMC Public Health 2012; 12: 254.

[18] Abegunde DO, Mathers CD, Adam T, Ortegon M and Strong K. The burden and costs of chronic diseases in low-income and middle-income countries. Lancet 2007; 370: 1929-38.

[19] Kuklina EV. Assessing and managing risk for cardiovascular disease: a worldwide perspective. N Am J Med Sci 2010; 3: 94-103.

[20] Mendis S, Lindholm LH, Mancia G, Whitworth J, Alderman M, Lim S and Heagerty T. World Health Organization (WHO) and International Society of hypertension (ISH) risk prediction charts: assessment of cardiovascular risk for prevention and control of cardiovascular disease in low and middle-income countries. J Hypertens 2007; 25: 1578-82.

[21] D'Agostino RB Sr, Vasan RS, Pencina MJ, Wolf PA, Cobain M, Massaro JM and Kannel WB. General cardiovascular risk profile for use in primary care: the framingham heart study. Circulation 2008; 117: 743-53.

[22] Zhang XF, Attia J, D'Este C, Yu XH and Wu XG. A risk score predicted coronary heart disease and stroke in a Chinese cohort. J Clin Epidemiol 2005; 58: 951-8.

[23] Asia Pacific Cohort Studies Collaboration, Barzi F, Patel A, Gu D, Sritara P, Lam TH, Rodgers A and Woodward M. Cardiovascular risk prediction tools for populations in Asia. J Epidemiol Community Health 2007; 61: 115-21.

[24] WHO/ISH Risk prediction charts for 14 WHO epidemiological sub-regions [internet]. 2007. [Accessed Nov 2019]. Available from: http://ishworld.com/downloads/activities/colour_charts_24_ Aug_07.pdf.
[25] World Health Organization: Prevention of cardiovascular disease: Guidelines for assessment and management of cardiovascular risk. Geneva: WHO; 2007.
[26] Mendis S, Lindholm LH, Anderson SG, Alwan A, Koju R, Onwubere BJC, Kayani AM, Abeysinghe N, Duneas A, Tabagari S, Fan W, Sarraf-Zadegan N, Nordet P, Whitworth J and Heagerty A. Total cardiovascular risk approach to improve efficiency of cardiovascular prevention in resource constrained settings. J Clin Epidemiol Dec 2011; 64: 1451-62.
[27] Ndindjock R, Gideon J, Mendis S, Paccaud F and Bovet P. Potential impact of single-risk-factor versus total risk management for the prevention of cardiovascular events in Seychelles. Bull World Health Organ Apr 2011; 89: 286-95.
[28] Batsis JA and Lopez-Jimenez F. Cardiovascular risk assessment-from individual risk prediction to estimation of global risk and change in risk in the population. BMC Med 2010; 8: 29.
[29] Bitton A and Gaziano T. The framingham heart study's impact on global risk assessment. Prog Cardiovasc Dis 2010; 53: 68-7
[30] Kannel WB, McGee D and Gordon T. A general cardiovascular risk profile: the Framingham study. Am J Cardiol 1976; 38: 46-51
[31] Assmann G, Cullen P and Schulte H. Simple scoring scheme for calculating the risk of acute coronary events based on the 10-year follow-up of the prospective cardiovascular Munster (PROCAM) study. Circulation 2002; 105: 310-315.
[32] Conroy RM, Pyörälä K, Fitzgerald AP, Sans S, Menotti A, De Backer G, De Bacquer D, Ducimetière P, Jousilahti P, Keil U, Njølstad I, Oganov RG, Thomsen T, Tunstall-Pedoe H, Tverdal A, Wedel H, Whincup P, Wilhelmsen L and Graham IM; SCORE project group. Estimation of ten-year risk of fatal cardiovascular disease in Europe: the score project. Eur Heart J 2003; 24: 987-1003.
[33] D'Agostino RB, Russell MW, Huse DM, Ellison RC, Silbershatz H, Wilson PW and Hartz SC. Primary and subsequent coronary risk appraisal: new results from the Framingham study. Am Heart J 2000; 139: 272-281.
[34] Hippisley-Cox J, Coupland C, Vinogradova Y, Hippisley-Cox J, Coupland C, Vinogradova Y, Robson J, May M and Brindle P. Derivation and validation of QRISK, a new cardiovascular disease risk score for the United Kingdom: prospective open cohort study. BMJ 2007; 335: 136.
[35] Jones AF, Walker J, Jewkes C, Game FL, Bartlett WA, Marshall T and Bayly GR. Comparative accuracy of cardiovascular risk prediction methods in primary care patients. Heart 2001; 85: 37-43.
[36] Wilson PW, D'Agostino RB, Levy D, Belanger AM, Silbershatz H and Kannel WB. Prediction of coronary heart disease using risk factor categories. Circulation 1998; 97: 1837-1847.
[37] D'Agostino RB Sr, Grundy S, Sullivan LM and Wilson P; CHD Risk Prediction Group. Validation of the Framingham coronary heart disease prediction scores: results of a multiple ethnic group investigation. JAMA 2001; 286: 180-7.
[38] Sheridan S, Pignone M and Mulrow C. Framingham-based tools to calculate the global risk of coronary heart disease. A systematic review of tools for clinicians. J Gen Intern Med 2003; 18: 1039-1052.
[39] Grundy SM, Pasternak R, Greenland P, Smith S Jr and Fuster V. Assessment of cardiovascular risk by use of multiple-risk-factor assessment equations: a statement for healthcare professionals from the American heart association and the American college of cardiology. Circulation 1999; 100: 1481-92.
[40] Gaziano TA, Young CR, Fitzmaurice G, Atwood S and Gaziano JM. Laboratory based versus non-laboratory based method for assessment of cardiovascular disease risk: the NHANES I follow-up study. Lancet 2008; 371: 923-931.
[41] Otgontuya D, Oum S, Buckley BS and Ruth Bonita R. Assessment of total cardiovascular risk using WHO/ISH risk prediction charts in three low and middle income countries in Asia. BMC Public Health 2013; 13: 539.
[42] Ejim EC, Okafor CI, Emehel A, Mbah AU, Onyia U, Egwuonwu T, Akabueze J and Onwubere BJ. Prevalence of cardiovascular risk factors in the middle-aged and elderly population of a nigerian rural community. J Trop Med 2011; 2011: 308687.
[43] Alikor CA and Emem-Chioma PC. Clustering of cardiovascular disease risk factors in a rural adult population in Nigeria. IJRMS 2018; 6: 765.
[44] Ghorpade AG, Shrivastava SR, Kar SS, Sarkar S, Majgi SM and Roy G. Estimation of the cardiovascular risk using World Health Organization/International Society of Hypertension (WHO/ISH) risk prediction charts in a rural population of South India. Int J Health 2015; 4: 531-6.
[45] Khanal MK, Ahmed MS, Moniruzzaman M, Banik PC, Dhungana RR, Bhandari P, Devkota S and Shayami A. Total cardiovascular risk for next 10 years among rural population of Nepal using WHO/ ISH risk prediction chart. BMC Res Notes 2017; 10: 120.

[46] Sani MU, Wahab KW, Yusuf BO, Gbadamosi M, Johnson OV and Gbadamosi A. Modifiable cardiovascular risk factors among apparently healthy adult Nigerian population-a cross sectional study. BMC Res Notes 2010; 3: 11.
[47] Amole IO, OlaOlorun AD, Odeigah LO and Adesina SA. The prevalence of abdominal obesity and hypertension amongst adults in Ogbomoso, Nigeria. Afr J Prim Heal Care Fam Med 2011; 3: 1-5
[48] National Population Commission Abuja, Nigeria. 2006 Housing population Census: population on distribution by age and sex: state and local government area, Priority table. 2010; 4: 54-58.
[49] Abdulraheem AF, Olalekan MF and Edet MA. Mother and father adolescent relationships and substance use in the Niger delta: a case study of twenty-five (25) communities in Yenagoa local government of Bayelsa state, Nigeria. Sociol Int J 2018; 2: 541-548.
[50] Eng J. Sample size estimation: how many individuals should be studied? Radiographics 2003; 227: 309-313.
[51] The WHO STEPwise approach to Surveillance of non-communicable diseases (STEPS); 2018. Available from: http: //www.who.int/chp/steps/en. Accessed July 31, 2018.
[52] World Health Organization. Obesity: Preventing and Managing the Global Epidemic. Geneva: WHO Technical Report Series World Health Organization; 2000:8-9. https://www.who.int/nutrition/publications/obesity/WHO_TRS_894/en/.
[53] World Health Organization. Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation. Geneva; 2008:8-11. https: //www.who.int/publications/i/item/9789241501491.
[54] Bacopoulou F, Efthymiou V, Landis G, Rentoumis A and Chrousos GP. Waist circumference, waist-to-hip ratio and waist-to-height ratio reference percentiles for abdominal obesity among Greek adolescents. BMC Pediatr 2015; 15: 50.
[55] Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Prabhakaran D, Ramirez A, Schlaich M, Stergiou GS, Tomaszewski M, Wainford RD, Williams B and Schutte. International Society of hypertension global hypertension practice guidelines. Hypertension 2020; 75: 1334-57.
[56] World Health Organization. 2003 World Health Organization (WHO)/International Society of Hypertension (ISH) statement on management of hypertension. World Health Organization (WHO)/International Society of Hypertension Writing Group. J Hypertens 2003; 21: 1983-92.
[57] Fox K, Borer JS, Camm AJ, Danchin N, Ferrari R, Lopez Sendon JL. Steg PG, Tardif JC, Tavazzi L and Tendera M; Heart Rate Working Group. Resting heart rate in cardiovascular disease. J Am Coll Cardiol 2007; 50: 823-830.
[58] Kristal-Boneh E, Silber H, Harari G and Froom P. The association of resting heart rate with cardiovascular, cancer and all-cause mortality. Eight year follow-up of 3527 male Israeli employees (the CORDIS Study). Eur Heart J 2000; 21: 116-124.
[59] Borer JS. Heart rate: from risk marker to risk factor. Eur Heart J Supplements 2008; 10 (Supplement F): F2-F6.
[60] Bugajska J, Jędryka-Góral A, Widerszal-Bazyl M Orłowska-Baranowska E, Sagan A, Michalak JM, Zużewicz K and Konarska M. Job strain, overtime, life style, and cardiovascular risk in managers and physical workers. Int J Occup Saf Ergon 2011; 17: 25-32.
[61] Pollock ML, Gaesser GA, Butcher JD, Després JP, Dishman RK, Franklin BA and Garber CE. The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. Med Sci Sports Exerc 1998; 30: 975-91.
[62] Appel LJ, Champagne CM, Harsha DW, Cooper LS, Obarzanek E, Elmer PJ, Stevens VJ, Vollmer WM, Lin P, Svetkey LP, Stedman SW and Young DR; Writing Group of the PREMIER Collaborative Research Group. Effects of comprehensive lifestyle modification on blood pressure control: main results of the PREMIER clinical trial. JAMA 2003; 289: 2083-2093.
[63] World medical association declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA 2013; 310: 2191-2194.
[64] Adeloye D, Basquill C, Aderemi A, Thompson JY and Obi FA. An estimate of the prevalence of hypertension in Nigeria; a systematic review and meta-analysis. J Hypertens 2015; 33: 230-242.
[65] Odili AN, Chori BS, Danladi B, Nwakile PC, Okoye IC, Abdullahi U, Nwegbu MN, Zawaya K, Essien I, Sada K, Ogedengbe JO, Aje A and Isiguzo GC. Prevalence, awareness, treatment and control of hypertension in Nigeria: data from a nationwide survey 2017. Glob Heart 2020; 15: 47.
[66] Aliyu AA and Amadu L. Urbanization, cities, and health: the challenges to Nigeria-A review. Ann Afr Med 2017; 16: 149-58.
[67] Okpechi IG, Chukwuonye II, Tiffin N, Madukwe OO, Onyeonoro UU, Umeizudike TI and Ogah OS. Blood pressure gradients and cardiovascular risk factors in urban and rural populations in Abia State, South Eastern Nigeria using the WHO STEPwise approach. PLoS One 2013; 8: e73403.
[68] Barengo N, Hu G, Lakka T, Pekkarinen H, Nissinen A and Tuomilehto J. Low physical ac-

tivity as a predictor for total and cardiovascular disease mortality in middle-aged men and women in Finland. Eur Heart J 2004; 25: 2204-2211.

[69] Yu S, Yarnell JW, Sweetnam PM and Murray L. What level of physical activity protects against premature cardiovascular death? The Caerphilly study. Heart 2003; 89: 502-506.

[70] Radzeviciene L and Ostrauskas R. Adding salt to meals as a risk factor of type 2 diabetes mellitus: a case-control study. Nutrients 2017; 9: 67.

[71] Millen BE, Abrams S, Adams-Campbell L, Anderson CA, Brenna JT, Campbell WW, Clinton S, Hu F, Nelson M, Neuhouser ML, Perez-Escamilla R, Siega-Riz AM, Story M and Lichtenstein AL. The 2015 dietary guidelines advisory committee scientific report: development and major conclusions. Adv Nutr 2016; 7: 438-444.

[72] Mugavero KL, Gunn JP, Dunet DO and Bowman BA. Sodium reduction: an important public health strategy for heart health. J Public Health Manag Pract 2014; 20 Suppl 1: S1-S5.

[73] Csige I, Ujvárosy D, Szabó Z, Lőrincz I, Paragh G, Harangi M and Somodi S. The impact of obesity on the cardiovascular system. J Diabetes Res 2018; 2018: 3407306.

[74] Oramah IT. The effects of population growth in Nigeria. J Appl Sci 2006; 1332-1337.

[75] Nduka JK and Orisakwe OE. Water-quality issues in the Niger Delta of Nigeria: a look at heavy metal levels and some physicochemical properties. Environ Sci Pollut Res Int 2011; 18: 237-46.

[76] Barrett CB, Reardon T and Webb P. Nonfarm income diversification and household livelihood strategies in rural Africa: concepts, dynamics, and policy implications. Food Policy 2001; 26: 315-31.

[77] Davis B, Winters P, Carletto G, Covarrubias K, Quiñones EJ, Zezza A, Stamoulis K, Azzarri C and Digiuseppe S. A cross-country comparison of rural income generating activities. World Dev 2010; 38: 48-63.

[78] Etemike L and Efanodor OH. Contemporary globalisation and the rural economy in Nigeria. AIJSSR 2015; 4: 3.

[79] Ogah OS, Okpechi I, Chukwuonye II, Akinyemi JO, Onwubere BJC, Falase AO, Stewart S and Sliwa K. Blood pressure, prevalence of hypertension and hypertension related complications in Nigerian Africans: a review. World J Cardiol 2012; 4: 327-340.

[80] Berry KM, Parker WA, Mchiza ZJ, Sewpaul R, Labadarios D, Rosen S and Stokes A. Quantifying unmet need for hypertension care in South Africa through a care cascade: evidence from the SANHANES, 2011-2012. BMJ Glob Health 2017; 2: e000348.

[81] Milman T, Joundi RA, Alotaibi NM and Saposnik G. Clinical inertia in the pharmacological management of hypertension: a systematic review and meta-analysis. Medicine (Baltimore) 2018; 97: e11121.

[82] Iloh GU, Ofoedu JN, Njoku PU, Amadi AN and Godswill-Uko EU. Medication adherence and blood pressure control amongst adults with primary hypertension attending a tertiary hospital primary care clinic in Eastern Nigeria. Afr J Prim Health Care Fam Med 2013; 5: 446.

[83] van der Sande MA, Walraven GE, Milligan PJ, Banya WA, Ceesay SM, Nyan OA and McAdam KP. Family history: an opportunity for early interventions and improved control of hypertension, obesity and diabetes. Bull World Health Organ 2001; 79: 321-328.

[84] Mitsumata K, Saitoh S, Ohnishi H, Akasaka H and Miura T. Effects of parental hypertension on longitudinal trends in blood pressure and plasma metabolic profile: mixed-effects model analysis. Hypertension 2012; 60: 1124-1130.

[85] Ranasinghe P, Cooray DN, Jayawardena R and Katulanda P. The influence of family history of hypertension on disease prevalence and associated metabolic risk factors among Sri Lankan adults. BMC Public Health 2015; 15: 576.

[86] Owen K, Ayres S, Corbett S and Hattersley A. Increased risk of diabetes in first-degree relatives of young-onset type 2 diabetic patients compared with relatives of those diagnosed later. Diabetes Care 2002; 25: 636-637.

[87] Calhoun DA, Jones D, Textor S, Goff DC, Murphy TP, Toto RD, White A, Cushman WC, White W, Sica D, Ferdinand K, Giles D, Falkner B and Carey RM; American Heart Association Professional Education Committee. Resistant hypertension: diagnosis, evaluation, and treatment: a scientific statement from the American heart association professional education committee of the council for high blood pressure research. Circulation 2008; 117: e510-e526.

[88] Etty Osher E and Stern N. Obesity in elderly subjects: in sheep's clothing perhaps, but still a wolf! Diabetes Care 2009; 32 Suppl 2: S398-S402.

[89] Thom T, Haase N, Rosamond W, Howard VJ, Rumsfeld J, Manolio T, Zheng ZJ, Flegal K, O'Donnell C, Kittner S, Lloyd-Jones D, Goff DC Jr, Hong Y, Adams R, Friday G, Furie K, Gorelick P, Kissela B, Marler J, Meigs J, Roger V, Sidney S, Sorlie P, Steinberger J, Wasserthiel-Smoller S, Wilson M and Wolf P; American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Heart disease and stroke statistics-2006 update: a report from the American heart association statistics committee and stroke statistics subcommittee. Circulation 2006; 113: e85-151.

[90] Chou AF, Scholle SH, Weisman CS, Bierman AS, Correa-de-Araujo R and Mosca L. Gender disparities in the quality of cardiovascular disease care in private managed care plans. Women's Health Issues 2007; 17: 120-30.
[91] Gu Q, Burt VL, Paulose-Ram R and Dillon CF. Gender differences in hypertension treatment, drug utilization patterns, and blood pressure control among US adults with hypertension: data from the national health and nutrition examination survey 1999-2004. Am J Hypertens 2008; 21: 789-98.
[92] Hayes SN. Preventing cardiovascular disease in women. Am Fam Physician 2006; 74: 1331-1340.
[93] Adedapo AD. Rising trend of cardiovascular diseases among South-Western Nigerian female patients. Nig J Cardiol 2017; 14: 71-4.
[94] Oguoma VM, Nwose EU, Skinner TC, Digban KA, Onyia IC and Richard RS. Prevalence of cardiovascular disease risk factors among a Nigerian adult population: relationship with income level and accessibility to CVD risks screening. BMC Public Health 2015; 15: 397.
[95] McFarlane SI, Jean-Louis G, Zizi F, Whaley-Connell AT, Ogedegbe O, Makaryus AN and Maraj I. Hypertension in the high-cardiovascular-risk populations. Int J Hypertens 2011; 2011: 746369.
[96] Blood Pressure Lowering Treatment Trialists' Collaboration, Turnbull F, Neal B, Ninomiya T, Algert C, Arima H, Barzi F, Bulpitt C, Chalmers J, Fagard R, Gleason A, Heritier S, Li N, Perkovic V, Woodward M and MacMahon S. Effects of different regimens to lower blood pressure on major cardiovascular events in older and younger people: meta-analysis of randomised trials. BMJ 2008; 336: 1121-1123.
[97] Aspray TJ, Mugusi F, Rashid S, Whiting D, Edwards R, Alberti KG and Unwin NC; Essential Non-Communicable Disease Health Intervention Project. Rural and urban differences in diabetes prevalence in Tanzania: the role of obesity, physical inactivity and urban living. Trans R Soc Trop Med Hyg 2000; 94: 637-44.
[98] Ogunmola OJ, Olaifa AO, Oladapo OO and Babatunde OO. Prevalence of cardiovascular risk factors among adults without obvious cardiovascular disease in a rural community in Ekiti State, Southwest Nigeria. BMC Cardiovasc Disord 2013; 13: 89.
[99] Reddy KS. Cardiovascular disease in the developing countries: dimensions, determinants, dynamics and directions for public health action. Public Health Nutr 2002; 5: 231-7.
[100] Gaziano TA, Bitton A, Anand S, Abrahams-Gessel S and Murphy A. Growing epidemic of coronary heart disease in low- and middle-income countries. Curr Probl Cardiol 2010; 35: 72-115.