Clustering of cardiovascular disease risk-factors in semi-urban population in Northern Nigeria

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Abstract

Introduction: Non-communicable diseases (NCDs) are major causes of morbidity and mortality particularly for developing countries. Large proportion of all NCDs deaths are occurring in low- and -middle-income countries are estimated to occur in people under 70-years-old. These low- and middle-income are undergoing epidemiological transition which allows the concomitant occurrence of both communicable and NCDs due to adoption of western life-style that predisposes them to development of these diseases. It is also known that there are risk-factors that tend to cluster in individuals and make them more susceptible to NCDs especially cardiovascular diseases (CVDs). Among NCDs, CVDs constitute the largest share responsible for 48% of all deaths due to NCDs. To determine extend of clustering of these risk-factors in a semi-urban community in northern Nigeria, a population-based study was carried out.

Materials and Methods: This study was conducted in Dakace, a semi-urban settlement near Zaria. A simple random sampling of 199 eligible respondents out of 424 was adopted to select study participants. An interviewer-administered questionnaire was used to collect socio-demographic information, smoking habits, alcohol consumption as well as level of physical activity. The following measurements were carried out on these respondents: Blood pressure (BP), fasting blood glucose, serum lipids, weight, and height to calculate body mass index (BMI).

Results: There were of 199 participants: 94 males (47.2%) and 105 females (52.8%) with an overall mean age of 39.9 ± 15.6 years. About 20% had no risk factor; more females than males had risk-factors. Proportion of subjects with risk-factors increase with increasing BMI, particularly high BP; physical activity does not protect subjects from developing risk-factors.

Conclusion: This study clearly shows that CVD risk-factors are prevalent even in segment of the population that hitherto may be considered free and the prevalence of these risk-factors are high compared to some obtained from other part of Nigeria.

Key words: Cardiovascular, clustering, Dakace, Northern Nigeria, risk-factors

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Introduction

Diseases of the heart and circulation - cardiovascular diseases (CVDs) - are for most adults the risks to life.[1] The important CVD with high-morbidity and mortality include coronary heart disease, stroke, hypertensive heart disease, and peripheral vascular disease.[1] They are increasingly becoming the major causes of morbidity and mortality in several developing countries.[1] In 1996, the burdens of CVDs are highlighted by the estimates provide by the Global Burden of Disease Study[2] and in the World Health Report 1999,[3] which indicated that of the 31.7 million deaths due to non-communicable diseases (NCDs) 16.7 million (50%) are attributed to CVDs; and more than one-third of these deaths occur in middle aged adults.[4] Furthermore, it was estimated that 30.9% of all deaths in 1998, as well as 10.3% of total disease-related burden in terms of disability-adjusted life years loss were attributed

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to CVDs.[3] In developed countries, while heart diseases and stroke, which are their first and second leading causes of death for adult men and women are in the decline, hypertensive heart diseases and stroke in the developing countries are the emerging first and second leading causes of death.[5] One enthusiast has even stated that "in fact, CVD is already the leading cause of death not only in developed countries but, as of the mid-1990s, in developing countries as well,"[6] a statement supported by data in the World Health Report 2003.[4]

In CVD, risk-factor refers to attribute or characteristic that increases one's chance of developing CVD. Identified risk-factors for CVD have been classified into non-modifiable risk-factors such as age, sex, race/ethnicity, family history; and modifiable risk-factors such as elevated low-density lipoprotein (LDL) cholesterol, decreased high-density lipoprotein (HDL) cholesterol, impaired glucose test, excess body fat (overweight and obesity). Modifiable behavioral risk-factors are smoking, high dietary cholesterol, saturated fat, dietary salt, alcohol intake, and sedentary life-style.[7] Four of these risk-factors have been known to cluster in some individuals and have been identified as components of a syndrome called metabolic cardiovascular syndrome, or the "deadly quartet."[8]

As part of larger study to assess the levels of cardiovascular risk-factors among apparently healthy adults in a suburban area near Zaria in Northern Nigeria, clustering of these risk-factors was also assessed to determine their pattern of clustering.

Materials and Methods

The study area

Dakace village is a small semi-urban settlement located about 10 km along the new Zaria-Jos highway. As it is the tradition in Hausaland, Dakace is divided into *Angwa* (or Ward or cluster of settlements that might be contiguous with one another or not), which is the smallest administrative unit headed by a Ward head. Dakace, with an estimated population of 4860,[9] is distinctly divided into two main settlements: (i) Dakace village and (ii) Mangu Dakace. Hausa people whose roots are from the ancient city of Zaria are the pre-dominant inhabitants of Dakace village. Mangu Dakace is the newly developed area where the population is of diverse ethnic groups but, predominantly composes of the *Mangus* (from Jos-Plateau) hence the name, *Ikulus* and *Katafs* (all from Kaduna State).

Sampling technique

Cluster sampling method was used to select respondents. Each of the eight *Angwas* that made up the study area was considered to be a cluster. Two *Angwa* from the original settlement (*Kanawa* and *Ruga*) and one *Angwa* from the newly developed area (*Kataf*) were selected using a simple random technique by balloting based on proportional distribution of the population between the two settlements. In each of the sampled *Angwa*, all eligible respondents were identified by a house-to-house enumeration and registered in a book. In all 492 eligible subjects were identified for the study. The identified eligible respondents were invited to participate in the study and at the end 424 participated. For reason of cost, 199 subjects were selected using a systematic random sampling from the register of the eligible respondents already prepared. The systematic sampling employed every second eligible respondent on the register. This sub-sample constituted the population on which lipids profile and blood glucose analyses were conducted.

Measurements

Following verbal informed consent the questionnaire was administered to sampled respondents, and blood pressure (BP), anthropometric measurements (height and weight), and venous blood taken in that order. Weight was measured to the nearest 0.5 kg using a portable electronic solar powered weighing scale *Seca* model (UNICEF); height was measured, to the nearest 0.5 cm without shoes using a wooden platform with gaze horizontal and a wooden meter rule placed against the wall. Those subjects with bony abnormality that could distort height measurement (and consequently body mass index [BMI]) were excluded from this part of the study but participated in all other aspect of the study, e.g., BP measurement, lipids profile tests.

Following administration of the questionnaire, each subject was asked to rest for about 5 min before the measurement of the BP. The BP was measured using mercury in bulb sphygmomanometer. The BP was measured in a sitting position using the dominant arm at the chest level and supported. Cuffs with adult bladder size (16 cm × 30 cm) were used. The measurements were taken to the nearest 2 mmHg.[10]

Collection of venous blood

The sub-sampled respondents for lipid and blood glucose analyses were asked to do an overnight fasting of at least 14 h, after which, about 5 ml of venous blood was taken using a 5 ml disposable syringe and emptied into a 5 ml EDTA (Ethylene Diamine Triacetic Acid) bottle. All the collected venous blood samples were taken to the Chemical Pathology Department, ABUTH, serum separated within 2 h of collection. The sera were stored at 2-8°C. The samples were analyzed by a trained technologist, thereafter.

Serum glucose was estimated using enzymatic reaction by glucose oxidase and lipid profile tests (cholesterol, HDL, LDL and triglyceride) were carried out by methods described by the manufacturers of the test kits (BioSystem S.A. Costa Brava, 30, Barcelona, Spain).[11-16]

Table 1: International classification of lipid profile

Classification	TC (mmol/L)	LDL (mmol/L)	HDL (mmol/L)	TG (mmol/L)	Glucose (mmol/L)
Desirable	<5.17	<3.36	>1.55	<2.26	<6.11
Borderline	5.17-6.18	3.36-4.11	0.91-1.53	2.26-4.50	6.11-6.94
High	>6.21	>4.14	-	>4.50	>6.94
Low	-	-	<0.91	-	-

HDL=High-density lipoprotein, LDL=Low-density lipoprotein, TG=Triglyceride, TC=Total cholesterol

The cut-off levels

The World Health Organization and the American National Cholesterol Education Program recommended blood lipid concentrations shown in Table 1 were used as reference cut-off points. A systolic BP of 140 mmHg and/or a diastole of 90 mmHg were considered as hypertension. A BMI of between 25.00 and 29.99 was considered as overweight, and a BMI of ≥ 30.00 was considered as obesity. [17,18] These cut-off points were used to classify study participants accordingly.

Results

Total of 199 subjects participated in this part of the study [Table 2]. There were 94 males (47.2%) and 105 females (52.8%); the overall mean of age was 39.9 ± 15.6 years. Majority (70%) are within the age range of 25 and 64 years. For BMI, fasting blood glucose, serum total cholesterol, HDL cholesterol, LDL cholesterol and triglyceride the mean and 95% confidence intervals were 39.9 years (95% CI: 37.8, 42.1), 22.57 kg/m^2 (95% CI: 21.70, 23.44), 133 mmHg (95% CI: 129, 136), 85 mmHg (95% CI: 83, 87), 3.97 mmol/L (95% CI: 3.714.21), 4.45 mmol/L (95% CI: 4.27, 4.62), 1.03 mmol/L (95% CI: 0.97, 1.08), 2.20 mmol/L (95% CI: 2.06, 2.34) and 0.82 mmol/L (0.73, 0.91) respectively [Table 3]. Table 4 shows the prevalence of different risk factors: It ranged from as low as 0.5% (for elevated triglyceride) to 48.2% (decreased level of high density lipoprotein); for hypertension (diastole and or systole) was 31.2%. Figure 3 shows trend of prevalence of hypertension with increasing body mass index which increases linearly with increasing body mass index. Table 5 gives the prevalence of risk factors; 33.2% had at least one risk factor while about 20% of the respondents were free of any risk factors. More females (85.6%) have clustering of risk factors compared to males (73.9%) as shown in Table 6 which is a significant difference.

Table 2: Socio-demographic characteristics of participants

Characteristic	Number	Percentage
Age (years)		
14-24	28	14.1
25-34	61	30.7
35-44	38	19.1
45-54	25	12.6
55-64	27	13.6
65-74	17	8.5
75-84	3	1.5
Sex		
Male	88	44.2
Female	111	55.8
Marital status		
Married	167	83.1
Single	20	10.1
Divorced	3	1.5
Widowed	9	4.5
Educational attainment		
No formal education	74	37.2
Adult literacy class	7	3.5
Primary school	49	24.6
Secondary school	48	24.1
Tertiary school	14	7.0
Missing	7	3.5
Currently smoking		
Yes	20	10.9
No	179	89.1
Currently taking alcohol		
Yes	7	3.5
No	192	96.5
Physical activity level		
Category 1 (<2.50)	37	18.6
Category 2 (2.50-2.99)	62	31.2
Category 3 (3.00-3.49)	47	23.6
Category 4 (3.50-4.99)	53	26.6

Discussion

Globally, NCDs are becoming major cause of morbidity and mortality particularly for developing countries.[19-22] For the developing countries, it is estimated that by the year 2020, 70% of deaths will be attributed to NCDs.[2] Of the estimated 57 million global deaths in 2008, 36 million (63%) were due to NCDs.[23,24] Further, in 2008, around 80% of the NCDs deaths (about 29 million) occurred in low and middle-income countries. In addition, a higher proportion of (48%) of all NCDs deaths in low-and-middle-income countries are estimated to occur in people under 70 years old – contrast to an estimated 26% in high-income countries and a global average of 44%.[25] Nigeria, alongside other developing countries are undergoing epidemiological transition allowing concurrent presence of both communicable and NCDs. Thus, while major communicable diseases – malaria, tuberculosis, measles, HIV/AIDS, worm infestation – still persists, rapid increased

Table 3: Mean and standard deviation of some of the cardiovascular risk-factors

Variable	Mean	SD
Age (years)	39.96	15.59
BMI (kg/m^2)	23.41	4.31
Diastole (mmHg)	85.68	14.34
Systole (mmHg)	133.09	26.16
FBG (mmol/L)	3.96	1.79
Total cholesterol (mmol/L)	4.44	1.27
HDL cholesterol (mmol/L)	1.03	0.40
LDL cholesterol (mmol/L)	2.19	1.02
Triglyceride (mmol/L)	0.82	0.64
Physical activity level	3.00	0.69

BMI=Body mass index, FBG=Fasting blood glucose, HDL=High-density lipoprotein, LDL=Low-density lipoprotein

Table 4: Prevalence of cardiovascular risk factor

Risk factor	Number	Percentage
Hypertension	62	31.2
Overweight	59	29.6
Obesity	14	7.0
Elevated fasting blood glucose	3	1.5
Elevated total cholesterol	17	8.5
Elevated low-density lipoprotein	7	3.5
Decreased high-density lipoprotein	96	48.2
Elevated triglyceride	1	0.5
Current smoking	20	10.9
Alcohol ingestion	7	3.5
Physical inactivity	37	18.6

Table 5: Percent of people with at least one risk factor

Number of risk factor	Number	Percentage
One risk factor	66	33.16
Two risk-factors	37	18.59
Three risk-factors	29	14.57
Four risk-factors	10	5.03
Five risk-factors	4	2.01

Table 6: Association between sex and presence of cardiovascular risk-factors

Sex	Presence of CVD risk factor		Total (%)
	No	Yes	
Male (%)	23 (26.1)	65 (73.9)	88 (44.2)
Female (%)	16 (14.4)	95 (85.6)	111 (55.8)
Total	39 (19.6)	160 (80.4)	199 (100.0)

χ^2=4.28, *P*=0.039, CVD=Cardiovascular disease

urbanization with concomitant rural-urban migration, demographic, environmental, social, cultural and behavioral life-style changes (sedentary life-style, cigarette smoking, excessive alcohol, unhealthy dietary habits) might have led to rapid emergence of NCDs particularly CVDs.[26-28]

Among NCDs, CVDs constitute the largest share. The largest proportion of NCDs deaths is caused by CVD, 48%.[25] The primary risk-factors for CVD are hypertension, high-cholesterol, diabetes, overweight/obesity, cigarette smoking and physical inactivity; hypertension, high-cholesterol, diabetes and overweight have been known to cluster in some persons and identified as part of cardio metabolic syndrome.[29,30]

The current study was a population-based survey in semi-urban settlement in Northern Nigeria. It assessed the burden of CVD risk-factors in this settlement. In respect, to presence of CVD risk-factors, hypertension was found in 31.2% of the subjects. This is similar to what was reported by Ulasi *et al*. in semi-urban and rural communities in Enugu State, Southwestern Nigeria.[30] They reported a prevalence of hypertension of 32.8%, obesity of 17.3% and total cholesterol of 7.1%. Prevalence of obesity is much higher compared to the present study, however.

Working in South- western Nigeria, Oladapo *et al*.[31] documented prevalence of CVD risk- factors as: Hypertension 20.8%, diabetes 2.5%, total cholesterol 3.2%; elevated LDL cholesterol 0.9%, triglyceride 1.9%, obesity 2.0%, smoking 1.7%., physical inactivity 3.2%.[31] The results of these studies in South- Western and South- Eastern Nigeria show some fine variations in prevalence of CVD risk-factors.

Clustering of CVD risk-factors

In this study, modifiable cardiovascular risk-factors in apparently healthy adults (15 years and above) were considered: Hypertension, obesity, elevated fasting blood glucose, elevated total cholesterol, elevated LDL cholesterol, reduced HDL cholesterol, elevated triglyceride, cigarette smoking, physical inactivity, and alcohol ingestion.

Overall, about 20% (or 1 in 5) adults in the study population was free of any of the risk factor investigated. As much as one third (33%) of the respondents have one risk factor and the percentage with at least one risk factor declined steadily to about 2% whom had at least 5 risk-factors [Figure 1]. More females than males have the risk-factors for CVD and the difference is significant (χ^2 = 4.28, P = 0.039). In several studies, obesity seemed to play a central role in clustering of risk-factors. For example, the study by Hoffman and Cubeddu[32] in apparently healthy Hispanics indicated that obese had higher prevalence of hypertension with 30%, low HDL cholesterol 58%, and elevated serum triglyceride 51% compared to the lean population. This study demonstrated that as BMI increases, cardiovascular risk-factors also increases or tend to cluster (χ^2 = 5.34, P = 0.148). Among those considered lean, 64.7% had at least a risk-factor and the proportion with one or more risk factor increases steadily to 78.8% among normal, 86.6% among the overweight and to 92.8% of the obese [Figure 2]. Additionally, this study also demonstrated the pattern of increasing presence hypertension with increasing obesity [Figure 3]. Prevalence

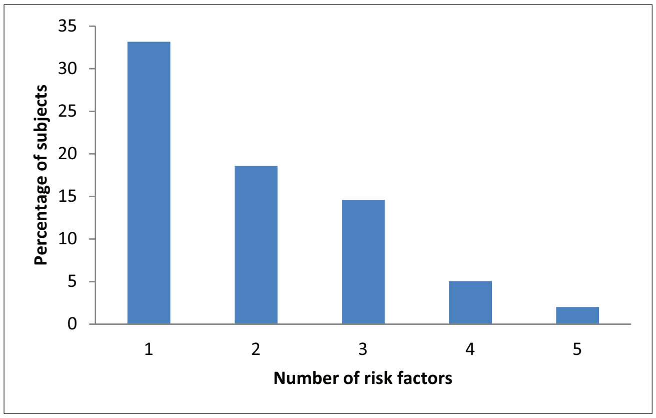

Figure 1: Prevalence of cardiovascular risk-factors

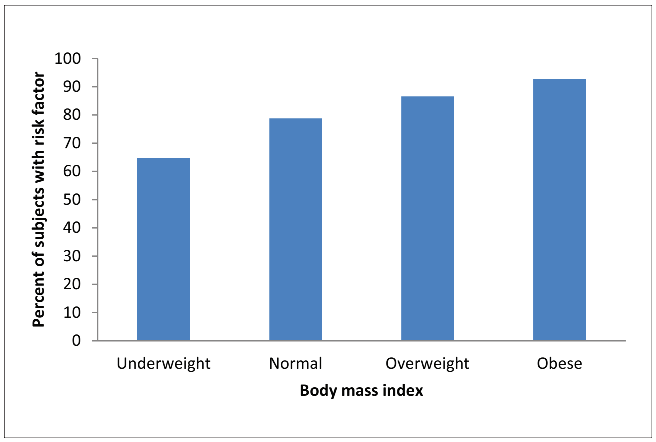

Figure 2: Trend in the prevalence of risk-factors with increasing body mass index

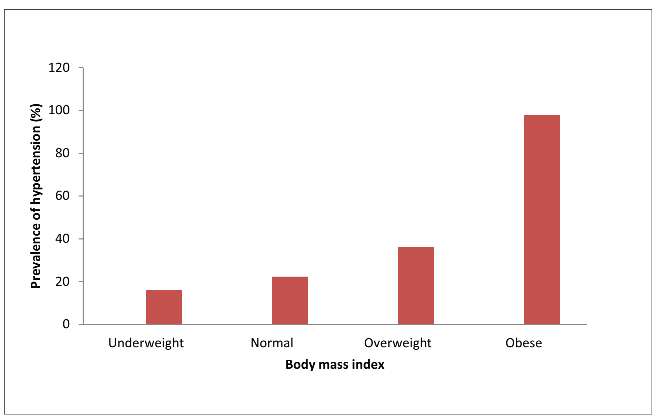

Figure 3: Trend in the prevalence of hypertension with increasing body mass index

of hypertension increased from 22.3% among subjects with normal BMI to 97.8% among the obese subjects. Physical activity does not proffer protection against development of cardiovascular risk-factors as seen in this study. Among those considered physically active (physical activity category 4), 3.8% were lean, 69.8% had normal BMI, 26.4% were overweight while none of the subjects was obese. This trend is significant ($\chi^2 = 17.32$, $P = 0.044$). In all the levels of physical activity categories (i.e., categories 1-4) more people had risk-factors compared to those without; at physical activity level 4, 66% of the subjects had at least one risk-factor compared to 34% who had none. This is results is significant ($\chi^2 = 9.967$, $P = 0.019$) and might be due to small sample size involved in the study. Thus, large-scale study is required to validate this result.

Conclusion

This study clearly shows that CVD risk-factors are prevalent even in segment of the population that hitherto may be considered free and the prevalence of these risk-factors are high compared to some obtained from other parts of Nigeria. There is clustering of these risk-factors among the study participants in which only about 20% are free from these risk-factors.

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