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Factors Associated with High Cholesterol levels in Lusaka, Zambia: A Community-Based Study

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ABSTRACT

***Background**:* High cholesterol level is a risk factor for cardiovascular disease. The objective of the study was to estimate the prevalence and correlates for high cholesterol levels in Lusaka district, Zambia.

***Methods**:* A modified World Health Organization STEPwise approach to surveillance method was used to collect data among adults. Odds ratios and their 95% confidence intervals were used to estimate magnitudes of associations.

***Results**:* A total of 1928 individuals participated in the survey. Overall, 15.8% (12.8% among male and 17.3% among female, p=0.013) respondents had high cholesterol levels. Compared to males aged 45 years or older, males of age 25-34 years were 44% less likely to have raised cholesterol levels. Males with body mass index (BMI) <18.5 and 25.0-29.9 were 87% less and 2.49 times more likely to have raised cholesterol, respectively, compared to males with BMI of 30 or more. Meanwhile, females aged 25-34 years were 22% less likely to have raised cholesterol compared to females aged 45 years or older. Compared to females with BMI of 30 or more, females with BMI of 18.5-24.9 and 25.0-29.9 were 33% less and 57% more likely, respectively, to have raised cholesterol levels.

***Conclusion**:* A series of surveys to determine changes in total and LDL cholesterol are needed to estimate changes in the health level of the residents in Lusaka. These results could be used in the formulation of an action plan to prevent and control high cholesterol and its consequences among Zambian urban residents.

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INTRODUCTION

It is estimated that by 2020 cardiovascular diseases (CVD) will become the leading cause of the global disease burden, accounting for 73 percent of total global mortality and 56 percent of total morbidity[1,2]. Total cholesterol level is a risk factor for cardiovascular disease[3]. A 2007 study reported from the Women's Health Study that high levels of total cholesterol is significantly associated with an increased risk for ischemic stroke, even in women who are otherwise healthy[4]. Capewell and Ford[5] also reported that total cholesterol has major public health importance as a cause of coronary heart disease and ischemic stroke. In a meta-analysis using data from 18 cohort studies involving a total of 257,384 black men and women and white men and women whose risk factors for cardiovascular disease were measured at the ages of 45, 55, 65, and 75 years, Berry et al[6] reported that differences in risk-factor burden (e.g. cholesterol) translated into marked differences in the lifetime risk of cardiovascular disease. These differences were consistent across race and birth cohorts.

Generally, the CVD epidemic was estimated to be on the decline in developed countries[7] but it is emerging in developing countries with little public health response[1]. A similar trend in total cholesterol has also been observed[8]. The prevalence of hypercholesterolaemia in Dar-es-Salaam, Tanzania increased by 3-folds and 10-folds among males and females, respectively, in rural areas; and by 2-folds and 7-folds among males and females, respectively, in urban areas between 1987 and 1998[9].

Overweight and obesity is one of the risk factors for high cholesterol. Although adiposity is associated with hypercholesterolemia, controversy surrounds which adiposity measures to use in their associations with cardiovascular disease risk factors. Schroder et al.[10] reports that body mass index (BMI) is an easily and reliably obtained measure of relative body size, and Ferrannini[11] reported that BMI is often used as an indirect index of adiposity and has been strongly associated with cardiovascular disease risk. In a meta-analysis, van Dijk et al.[12] concluded that waist circumference should be used in clinical and research studies compared with body mass index, although in men the correlations between WC and HDL, and between BMI and HDL were similar; and moderate correlations were observed for WC and BMI with HDL. Therefore, BMI can be used in determining the association between overweight/obesity and high cholesterol levels. A significant positive association has been reported between BMI and cholesterol[13,14]. Contrary to the above finding, Ernst et al.[15] observed a negative association between BMI and HDL-cholesterol. Meanwhile, Walton et al.[16] did not find a significant association between BMI and HDL-cholesterol concentrations. The differences in the above findings indicate differences in the study populations in the terms of adipose tissue-free mass, skeletal muscle and body cell mass[17].

Whilst the prevalence of total cholesterol and its correlates is well documented in developed countries, there is little information on its magnitude and associated factors in Africa. Reddy and Yusuf[1] reported that developing countries are at different levels of socioeconomic growth, demographic change, and lifestyle practices; and hence the direction and pace of the CVD epidemic is unlikely to be uniform. It is thus important to track the CVD epidemic in each country, and hence the current study. The current study was designed to estimate the prevalence and correlates for high total cholesterol in Lusaka, the capital city of Zambia.

METHODS

Study setting and design: The survey from which this report was derived was conducted in Lusaka, capital city of Zambia with an estimated population of 2,198,996 (CSO 2011 Census of Population and Housing). The data from which this study is generated was a community-based cross sectional survey.

Sample size and sampling*:* The StatCalc programme in Epi Info version 6.04 was used to compute the sample size. The following parameters were used in the computation of the sample size: level of confidence measure of 1.96, margin of error of 5%, baseline level of the indicator of 50% (as no estimates existed), 8 provincial estimates, and a design effect of 2. Using the above parameters, a sample size of 6128 was computed and after adjusting for 80% response rate, the required sample size was 7660. This sample size was proportionally distributed to the 8 provinces according to their provincial populations, and the sample size for Lusaka district was 1915.

Lusaka district in Lusaka province was conveniently selected because it was the most urbanized district in Zambia. The other districts in Lusaka province were Kafue a peri-urban district; and Chongwe a rural district. Five out of 7 constituencies in Lusaka district were randomly selected. From each selected constituency, one ward was randomly selected. The number of Standard Enumeration Areas (SEAs) selected in each ward was proportional to its population size. SEAs were selected using a systematic random sampling method. Households were then systematically sampled in order to widely cover the selected SEAs. All persons of ages 25 or more years were invited to participate in the survey.

Data collection*:* The modified World Health Organization (WHO) STEPS approach was conducted. The WHO STEPwise approach to Surveillance (STEPS) is a simple, standardized method for collecting, analysing and disseminating data in WHO member countries. This approach combines the collection of self-reported socio-demographic characteristics as well as trained interviewer assessment of weight and height as well as relevant laboratory measurements. Data collection was done in 2007.

Ethical considerations*:* The study protocol was approved by the University of Zambia Research Ethics Committee. Permission to conduct the study was given by the Ministry of Health, Zambia. Informed consent was obtained from each study participant. Interviews were conducted in the homes of the participants, and waist measurement was taken in a private area.

Variables

Weight and height measurements: Weight, recorded in kilograms, was measured using the Heine 737 portable professional adult scale (Seca GmbH & Co. kg Humburg, German), and the Seca Brand 214 Portable Stadiometer was used to measure height that was recorded in centimeters (Seca GmbH & Co. kg Humburg, German).

Waist and hip circumferences: The waist circumference, recorded in centimeters, was measured using the Figure

Finder® Tape Measure. The tape measure was wrapped around the waist between the inferior margin of the last rib and the crest of the ilium directly over the skin or light clothing. Using the same tape measure, the hip circumference was measured at the maximum circumference over the buttocks and recorded in centimeters.

***Total cholesterol estimation**:* Fasting blood was collected for the estimation of cholesterol levels. The Accutrend GCT (Glucose, Cholesterol and Triglycerides) Meter Three-in-One system (Roche Diagnostics GmbH, Mannheim, German) was use to estimate total cholesterol levels that were recorded in mmol/L. Gottschling et al.[18] compared cholesterol results obtained using the Accutrend system with capillary blood with results obtained using the cholesterol oxidase/p-aminophenazone (CHOD-PAP) method with the respective capillary sera. They found that the Accutrend cholesterol was a reliable system for the determination of total cholesterol.

Data entry and analysis: Data were entered using Epi Data version 3.1 by two trained data entry clerks. The data entry template had consistency and range checks embedded in it. After the data were validated and cleaned, they were exported to SPSS version 14.0 for analysis.

The analysis included running cross tabulations and logistic regression for each sex. The unadjusted odds ratio and its 95% confidence interval were used to estimate the magnitude of association in bivariate analysis. We calculated the proportion of high total cholesterol and also by stratifying by sex (gender). Meanwhile, in multivariate analysis the adjusted odds ratio and its 95% confidence interval were used to estimate the magnitude of association. A backward variable selection method was used to enter variables in a multivariate logistic model. Body mass Index (BMI) was categorized as <18.5 kg/m^2 (lean), 18.5-24.9 kg/m^2 (normal), 25.0-29.9 kg/m^2 (overweight), and 30+ kg/m^2 (obese). A waist-hip ratio was grouped into two: <1 (normal) and >1 (raised); and cholesterol levels were either normal (<5.2 mmol/L) or otherwise raised.

RESULTS

A total of 1928 individuals participated in the survey, of which 33.0% were males. About half of the participants were of age 25-34 years (53.2%) as shown in Table 1. Overall, 15.8% (12.8% of males and 17.3% of females, p=0.013) of the respondents had raised cholesterol levels (Table 2).

Table 1: Demographic characteristics for the sampled population in Lusaka, Zambia

Factor	Total n (%)	Male n (%)	Female n (%)
Age group (years)			
25-34	1015 (53.2)	337 (53.7)	675 (52.9)
35-44	413 (21.6)	135 (21.5)	277 (21.7)
45+	481 (25.2)	156 (24.8)	323 (25.3)
Sex			
Male	634 (33.0)	-	-
Female	1288 (67.0)	-	-
Education			
None	408 (21.5)	76 (12.2)	330 (26.0)
Primary	276 (14.5)	61 (9.8)	214 (16.9)
Secondary	679 (35.8)	242 (38.8)	435 (34.3)
College/university	534 (28.1)	244 (39.2)	290 (22.9)

Table 2: Distribution of cholesterol levels by sex in Lusaka, Zambia

Factor	Total n (%)	Males n (%)	Females n (%)
Cholesterol level (mmol/L)			
Normal (<5.2)	1574 (84.2)	533 (87.2)	1036 (82.7)
Raised (5.2+)	296 (15.8)	78 (12.8)	217 (17.3)

Factors associated with raised cholesterol levels are shown in Table 3. Age, body mass index, and waist hip ratio were significantly associated with raised levels of cholesterol among males. Compared to males aged 45 years or older, males of age 25 to 34 years were 44% (AOR=0.56; 95% CI [0.39, 0.81]) less likely to have raised cholesterol levels. While males with BMI <18.5 were less likely (AOR=0.13; 95% CI [0.03, 0.60]) to have raised cholesterol, males with BMI between 25.0 and 29.9 were 2.49 (95% CI [1.29, 4.79]) times more likely to have raised cholesterol compared to males with BMI of 30 or more. Compared to males with waist/hip ratio of more than 1, males with waist/hip ratio of 1 or less were 53% (AOR=0.47; 95% CI [0.25, 0.88]) less likely to have raised cholesterol.

Among females, only age and BMI were significantly associated with raised cholesterol. Females aged 25-34 years were 22% (AOR=0.78; 95% CI [0.63, 0.96]) less likely to have raised cholesterol compared to females aged 45 years or older. Compared to females with BMI of 30 or more, females with BMI of 18.5-24.9 were 33% (AOR=0.67; 95% CI [0.51, 0.89]) less likely to have raised cholesterol levels, while females with BMI of 25.0-29.9 were 57% (AOR=1.57; 95% CI [1.20, 2.06]) more likely to have raised cholesterol levels.

Table 3: Factors associated with raised cholesterol levels in bivariate and multivariate logistic regression analyses stratified by sex in Lusaka, Zambia

	Males		Females	
Factor	OR (95% CI)	AOR (95% CI)	OR (95% CI)	AOR (95% CI)
Age	p<0.001		p<0.001	
25-34	0.51 (0.36, 0.71)	0.56 (0.39, 0.81)	0.71 (0.58, 0.87)	0.78 (0.63, 0.96)
35-44	1.38 (0.97, 1.96)	1.45 (1.00, 2.10)	0.86 (0.67, 1.10)	0.83 (0.65, 1.07)
45+	1	1	1	1
Education	p=0.006		p=0.116	
None	0.87 (0.46, 1.67)	-	1.29 (1.01, 1.65)	-
Primary	0.64 (0.29, 1.42)		0.86 (0.63, 1.17)	
Secondary	0.90 (0.57, 1.44)		1	
College/ University	1			
Body mass index (kg/m^2)	p<0.001		p<0.001	
<18.5	0.11 (0.03, 0.51)	0.13 (0.03, 0.60)	0.66 (0.39, 1.13)	0.71 (0.41, 1.22)
18.5-24.9	0.88 (0.49, 1.59)	1.14 (0.62, 2.10)	0.65 (0.49, 0.86)	0.67 (0.51, 0.89)
25.0-29.9	2.47 (1.30, 4.67)	2.49 (1.29, 4.79)	1.54 (1.18, 2.02)	1.57 (1.20, 2.06)
30+	1	1	1	1
Waist hip ratio	p<0.001		p=0.701	
≤1	0.32 (0.18, 0.54)	0.47 (0.25, 0.88)	Undefined	-
>1	1	1		
Consumed alcohol past 30 days	p=0.693		p=0.860	
Yes	0.83 (0.50, 1.40)	-	0.93 (0.65, 1.35)	-
No	1		1	
Ate vegetables 5-7 days in a previous week	p=0.523		p=0.123	
Yes	0.79 (0.47, 1.34)	-	0.60 (0.33, 1.09)	-
No	1		1	

DISCUSSIONS

Perhaps the novel finding in the current study is that participants who were overweight were more likely to have raised cholesterol levels than obese participants. In addition, the current study presents the first estimate of prevalence of raised cholesterol in Zambia, and adds to a few reported levels of raised cholesterol levels in sub-Saharan Africa. Overall, 15.8% of the participants (12.8% of males and 17.3% of females) had higher cholesterol levels in a community-based study in Lusaka-Zambia. This prevalence is lower than the 21% reported in Kenya[19] but higher than the 11% for females and 6% for males in Malawi[20].

The finding that overweight participants were more likely to have raised cholesterol levels than obese participants is interesting. An explanation may be that when one is obese, he/she may likely change habits and more likely to access healthcare services more readily than the not so fat. If cholesterol lowering drugs are to be prescribed, the doctor is more inclined to do so among the very heavy than they would to those not so heavy. However, the current study did not obtain information on participants who were on drugs to lower cholesterol levels in order to substantiate our hypothesis.

Findings from this study indicate a sex difference in higher cholesterol values. This is similar to what Njelekela et al.[21] reported from a study of cardiovascular disease risk factors in urban Tanzania, but different from previous report from Nigeria[22] and South Africa[23] where there was no sex difference among Lagos and Soweto residents. The sex difference may be due to the fact that men living in Lusaka were more physically active than women. In a study of rural-urban gradient in the prevalence of the metabolic syndrome in Benin, Ntandou et al.[24] reported that men who lived in city were as physically active as those living in semi-urban and rural areas while urban resident women were significantly less active than those from semi-urban and rural areas.

Among both males and females, age was positively associated with cholesterol levels. This is likely to be a consequence of diet, exercise or physical activity and lipid metabolism varying with age. In males, the waist-hip ratio of <1 was associated will reduced likelihood among males but not in females. The differences between males and females could be due to genetics and hormonal influences. No other variables assessed (alcohol, education) were associated with high cholesterol levels.

Limitations

The current study has several limitations. Socio-demographic characteristics such as age, educational level, alcohol intake and diet were self-reported. To the extent that study respondents mis-reported, our results may be biased. However, there is no reason to suggest that individuals who were later found to have higher cholesterol levels were more likely to have mis-reported compared to those with lower values. Secondly, study respondents submitted blood samples for cholesterol assessment only once. There is likely to be intra-individual variations in cholesterol level which was not considered in this study. While the consumption of fruits as a surrogate measure of healthy eating was assessed, a meta-analysis has shown that the consumption of nuts of nearly any type improves blood lipid levels, lowering total- and low-density lipoprotein (LDL)-cholesterol levels, and improves important lipid ratios[25]. Consumption of nuts was not assessed in the present study.

CONCLUSION

The prevalence of high cholesterol was high among Lusaka residents, particularly among women. A series of surveys to determine changes in total and LDL cholesterol are needed to estimate changes in the health level of the residents in Lusaka. These data could be used in the formulation of an action plan to prevent and control high cholesterol and its consequences among Zambian urban residents.

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