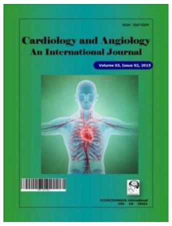

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Distribution of Elevated Serum Cholesterol and Triglyceride Levels in the General Adult Population of Ngaoundere, Cameroon

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Dyslipidemia is a major cardiovascular disease (CVD) risk factor with an increasing occurrence in sub-Saharan Africa.
Aim: To determine the distribution of elevated serum cholesterol and triglyceride levels, and assess the level of awareness of dyslipidemias in the general adult population of Ngaoundere, Cameroon.
Methodology: This was a community-based cross-sectional study conducted from February to December 2015 in Ngaoundere town. Following a three-stage sampling method, a total 932 participants of at least 20 years old were enrolled. Demographic data were collected, and body

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mass index (BMI), waist circumference, blood pressure, fasting blood glucose (FBG), serum total cholesterol (TC) and triglycerides (TG) were measured.

Results: The overall prevalence of raised cholesterol and triglyceride levels were 25.97% (n=242) and 5.26% (n=49) respectively. The overall mean concentrations of TC and TG were 207.30± 54.18 mg/dL and 105.49 ± 51.22 mg/dL respectively. The population's level of awareness of dyslipidemias was recorded at 0.77% (n=2), and no participant was on lipid-lowering drugs. The 40-64 years (OR:2.21, P<0.001) and ≥ 60 years (OR:2.19, P=0.006) age ranges, abdominal obesity (OR:1.76, P=0.026) and hypertriglyceridemia (OR:4.53, P<0.001) were independently associated with hypercholesterolemia, while the age range 40-64 years (OR:2.11, P=0.027), hypertension (OR:2.38, P=0.011) and hypercholesterolemia (OR:4.63,P<0.001) were independently associated with hypertriglyceridemia.

Conclusion: The present study portrayed a high prevalence of elevated serum cholesterol level, a very low level of awareness and poor treatment coverage of dyslipidemias in the Ngaoundere population while reaffirming the relationships between advance age, abdominal obesity, hypertension and dyslipidemias.

Keywords: Cholesterolemia; triglyceridemia; general population; Ngaoundere; Cameroon.

1. INTRODUCTION

Dyslipidemias are major CVD risk factors [1,2], and their association with cardiovascular diseases is now well established [3,4]. Recent data even suggest that dyslipidemia may precede the development of other known traditional cardiovascular disease risk factors [5].

It has been shown that death from CVD in individuals with serum TC levels >300 mg/dL is five folds higher compared to other CVD risk factors [1]. It is also known that a serum TC level ≥240 mg/dL multiplies by 2.15 to 3.63 the risk of death from coronary artery disease, and by 1.39 to 1.49 the risk of global death [1]. According to World Health Organization (WHO), a 10% reduction in serum TC may lead to a reduction in the prevalence of coronary artery diseases by up to 50% within five years [4]. Likewise, serum TG has been shown to be an independent CVD risk indicator. Recent findings hold that an elevated TG level is a direct cause of CVD [2].

Even though research in this field is still growing in African countries [6], in some areas like the northern regions of Cameroon, very few studies carried out chiefly in hospital settings have described serum lipid levels and the prevalence of dyslipidemias [7,8].

The objective of this study was to determine the distribution and to assess the level of awareness of hypercholesterolemia and hypertriglyceridemia in the general adult population of Ngaoundere (Northern Cameroun).

2. METHODOLOGY

2.1 Study Area and Design

This was a community-based cross-sectional study conducted in Ngaoundere from February to December 2015. Ngaoundere is the chief town of the Adamawa region (Cameroon). With almost 158348 inhabitants, it is located in a mild tropical climate zone, and the main economic activities in the region are cattle rearing and agriculture.

2.2 Participants Selection and Sampling Criteria

Participants were recruited following a method previously described [9]. In brief, it was a three-stage procedure beginning with the selection 15 quarters in accordance with a cluster sampling technique, followed by the systematic enrolment of 1100 households. In each household, one inhabitant was randomly selected among adults of age 20 years or above irrespective of gender, with the exclusion of pregnant women. Included in this study were inhabitants residing within the study area for at least two years and who consented to participate in the survey.

2.3 Study Variables

The study variables included sociodemographic characteristics (gender, age and level of education), body mass index, waist circumference, blood pressure, FBG, serum TC and TG, awareness of and treatment of dyslipidemias. Sociodemographic, awareness and treatment data were collected using a pre-tested semi-structural questionnaire.

2.3.1 Anthropometric and clinical measurements

Height, weight and waist circumference measurements were based on the WHO STEP wise approach [10]. Body mass index was calculated as weight (kg) / height $(m)^2$ [11]. Blood pressure was measured following the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC 7) recommendations [12].

2.3.2 Biological measurements

Whole blood collection for the determination of FBG, serum TC and TG levels was done on each participant in the morning hours after an 8-12 hour fast following standard procedures. FBG, TG and TC measurements were carried out at the clinical Laboratory service of the Ngaoundere Regional Hospital using a semi-automated chemistry analyzer (SECOMAN, type BASIC/70V BO3.58, Ref. 1790, SECOMAM, France). Commercially acquired kits were used for blood analyses (Glucose RTU©, Ref/Lot: 61270, BioMérieux^SA, France; Triglyceride PAP, Ref/Lot: TG6300O041, Immesco laboratories, Germany and Cholesterol-Liquizyme CHOD-PAP Ref/Lot: 230006, Spectrum diagnostics, Egypt) in accordance with manufacturer's instructions and standard spectrophotometric procedures [8]. Analytical quality was controlled as previously described [7].

2.3.3 Definitions

Overweight and obesity were defined respectively as BMI ranging from 25.0 to 29.9 kg/m^2 and BMI ≥ 30 kg/m^2 [13]. Abdominal obesity was defined as waist circumference higher than 102 cm in males and 88 cm in females [13,14]. High blood pressure was defined as blood pressure ≥140/90 mmHg at the time of the study, or current use of antihypertensive drugs [10,12,13]. Participants who answered "yes" to the question "have you ever been told by a health professional that you have high blood pressure?" were also considered as hypertensives. Diabetes was defined as FBG ≥126 mg/dL or current use of antidiabetic drugs [10,13]. Elevated serum cholesterol and triglyceride were defined following the Third Report of the National Cholesterol Education Program, Adult Treatment Panel III (NCEP-ATP III) criteria, as total plasma cholesterol ≥240 mg/dL and triglyceride ≥200 mg/dL respectively, or current use of lipid lowering drugs [14]. Participants who answered by "yes" to the question "have you ever been told by a health professional (or do you know) that you have high blood cholesterol or triglycerides?" were defined as aware of dyslipidemia. Participants under the use of lipid lowering drugs for at least two weeks were define as treated.

2.4 Data Analysis

Microsoft Excel 2013® and SPSS 20.0 (SPSS for Windows, version 20.0, SPSS Corporation Inc. Chicago IL USA) softwares were used to clean, code and perform statistical analysis. Chi-square or Fisher exact tests were employed in comparing frequencies, while the ANOVA or Mann-Whitney/Wilcoxon tests were used in comparing means. Factors associated with lipid disorders were determined using logistic regression analysis. P-values <0.05 were considered statistically significant.

2.5 Ethical Consideration

This study was approved by ethical committee of the Ngaoundere regional hospital (Ref:1121/L/RC/RA/DSP/HR/NGD/CLE) and the Ngaoundere Urban Health District (Ref: 529/AS/RA/DV/DS/NGDU). Before their enrollment, a written consent was obtained from all participants after being adequately informed about the study goals, merits and demerits. All personal data were kept strictly confidential.

3. RESULTS

3.1 Prevalence of Hypercholesterolemia and Hypertriglyceridemia

The study population consisted of 932 participants (males: 461, females: 471), having mean age of 38.81 ± 14.96 years.

The overall prevalence of high serum cholesterol and triglycerides were 25.97% (n=242) and 5.26% (n=49) respectively.

The prevalence of elevated serum cholesterol was higher in males than in females (29.51% vs 22.34%, P=0.013) and significantly increased with participants age (P<0.001) and BMI (P<0.001). Also, it was significantly higher in participants with family history of diabetes (P<0.010), abdominal obesity (P<0.001), high blood pressure (P<0.001), hyperglycemia (P=0.026) and raised serum triglycerides (P<0.001).

On the other hand, the occurence of high serum triglyceride significantly varied between levels of education P<(0.001), increased with age P<(0.001) and was significantly higher in participants with high blood pressure (P<0.001) and raised cholesterol level (P<0.001).

Details on the prevalence of high cholesterol and triglyceride levels are presented in Table 1.

Table 1. Distribution of elevated serum cholesterol and triglyceride following selected sociodemographic, clinical and biological characteristics of the study population

Parameters	High cholesterolemia		High triglyceridemia	
	n (%)	*P*-value	n (%)	*P*-value
Overall	242 (25.97)		49 (5.26)	
Gender				
Males	103 (22.34)	.013*,a	25 (5.42)	.823b
Females	139 (29.51)		24 (5.10)	
Age (years)				
20 – 39	103 (18.26)		18 (3.19)	
40 – 64	113 (38.31)	< .001*,a	29 (9.83)	< .001*,b
≥ 65	26 (35.62)		2 (2.74)	
Level of education				
Had not been at school	17 (23.29)		4 (5.48)	
Only koranic	70 (32.11)		16 (7.34)	
Primary	58 (26.61)		8 (3.67)	
Secondary	74 (23.34)	.150 a	19 (5.99)	< .001*,b
Higher	23 (21.70)		2 (1.89)	
Personal history of stroke				
Yes	5 (31.25)	.576 b	2 (12.50)	.198 a
No	237 (25.87)		47 (5.13)	
Personal history of CAD				
Yes	3 (37.50)	.434 b	1 (12.50)	.151 b
No	239 (25.87)		48 (5.19)	
Family history of hypertension				
Yes	71 (22.83)	.122 a	17 (5.47)	.795 b
No	171 (27.54)		32 (5.15)	
Family history of diabetes				
Yes	32 (18.18)	.010*,a	7 (3.98)	.620 b
No	210 (27.78)		42 (5.56)	
BMI				
Normal	125 (22.32)		24 (4.29)	
Overweight	70 (27.34)	< .001*,a	18 (7.03)	.001*, b
Obesity	47 (40.52)		7 (6.03)	
Abdominal obesity				
Yes	79 (39.70)	< .001*, a	10 (5.03)	.008*, a
No	163 (21.76)		39 (5.21)	
High blood pressure				
Yes	137 (31.28)	< .001*,a	35 (7.99)	< .001*,a
No	105 (21.26)		14 (2.83)	
Hyperglycemia				
Yes	20 (39.22)	.026*, a	4 (7.84)	.095 b
No	222 (25.20)		45 (5.11)	
High serum triglyceride				
Yes	30 (61.22)	< .001*,a	-	-
No	212 (24.01)		-	-
High serum cholesterol				
Yes	-	-	30 (12.40)	< .001*, a
No	-	-	19 (2.75)	

*CAD: coronary artery disease; BMI: Body Mass Index; [a] Chi-square; [b] Fisher-exact; * P values< .05*

3.2 Mean Concentrations of Serum Total Cholesterol and Triglycerides

The overall means of serum TC and TG levels were 207.30 ± 54.1 mg/dL and105.49 ± 51.22 mg/dL respectively.

Mean serum TC level was significantly higher in males than in females (213.03 ± 52.58 mg/dL vs. 201.45 ± 55.22 mg/dL, P=0.001). Mean TC levels significantly increased with age (P=0.001) and BMI (P<0.001), and recorded higher levels in participants with, high blood pressure (P<0.001), abdominal obesity (P<0.001), hyperglycemia (P=0.009) and raised triglyceridemia (P<0.001) (Table 2).

Mean serum TG level was also observed to be higher in participants with abdominal obesity (P=0.008), high blood pressure (P<0.001), raised cholesterolemia (P<0.001), personal history of stroke (P=0.034) and coronary artery disease (P=0.008). Further noted were the significant variations in mean serum TG levels with participants' age (P<0.001), level of education (P<0.001) and BMI (P=0.013) (Table 2).

3.3 Awareness and Treatment of Dyslipidemias

Among the 261 participants who recorded elevated serum lipid levels, only two of them (0.77%) were aware of dyslipidemias. None of these participants were taking lipid lowering drugs.

3.4 Factors Associated with Lipid Disorders

Following multivariate analysis, the risk of elevated cholesterolemia was found to be 2.21 times higher in participants aged 40 to 64 years (P<0.001) and 2.19 times higher in participants aged 65 years and above (P=0.006) compared with those 20 to 39 years old. While the odds of having high serum cholesterol level was 1.76 in participants with abdominal obesity compared to those without (P=0.026), those with increased triglyceridemia were 4.53 times more likely to develop high cholesterolemia compared to those without (P<0.001).

The risk of elevated triglyceride was found to be 2.11 times higher in participants aged 40–64 years compared to those within the 20–39 years age range (P<0.027). Having a high blood pressure (P=0.011) or a high serum cholesterol level (P<0.001) was 2.38 and 4.75 times more likely to record elevated triglyceride levels respectively (Table 3).

4. DISCUSSION

4.1 Prevalence of Hypercholesterolemia and Hypertriglyceridemia

Findings from this study indicate that one quarter (25.97%) of adult population living in Ngaoundere presented with raised serum cholesterol levels. Although close to the 21.6% reported in Malaysia [15], this prevalence is higher than the 11.1% reported in Angola [16] and lower than the 50.4% reported in Iran [17]. In the study population, the prevalence of elevated cholesterol levels was significantly higher in females (29.51%) than in males (22.34%). Higher rates have been reported among male (37%) and female (52%) Latinos and Hispanics residing in United States of America [18]. These observed disparities in the prevalence of hypercholesterolemia may be due to the inherent socio-anthropological and economic differences existing between these populations. Following multivariate analysis, age (40 - 64 years: OR = 2.21; 65 years and over: OR = 2.19) and abdominal obesity (OR = 1.76) were independently associated with the odds of having high serum cholesterol. This is in line with the results of Veghari et al. [17] who reported that the age range 55-65 years (OR = 2.79) and abdominal obesity (OR = 2.47) were associated with hypercholesterolemia.

According to related literature, the occurrence of hypertriglyceridemia is often lower than that of hypercholesterolemia for a given population [15,19,20]. Similarly, the findings of the present study are in line with these observations. The recorded prevalence of high serum cholesterol was 5.26%, results which are closer to the 7.11% reported in Senegal [20], although lower than those reported in other likewise resource deficient settings [15], and in some countries with more favorable economic status [21,22]. In this study, the prevalence of elevated serum triglycerides was highest in participants aged 40–64 years and lowest in those aged 65 years and over (P<0.001). Participants who had high blood pressure or high serum cholesterol presented significantly higher occurence of raised serum triglycerides as compared to those without. Furthermore, participants aged 40–64 years old (OR: 2.11, 95% CI: 1.09 -4.07, P<0.027) and those with high blood pressure (OR: 2.38,95%

CI: 1.20 - 4.73, P<0.011) were independently associated with the odds of developing high triglyceridemia. These results are consistent with the reports of Aekplakorn et al. [21] in a Thai population where individuals with hypertension had higher triglyceride levels compared to those without. The significant association between high serum cholesterol and high serum triglyceride observed in this study could be explained by the fact that cholesterol and triglycerides represent two essential components of lipoproteins and both undergo interconnected metabolic pathways [14].

Table 2. Mean distribution of serum cholesterol and triglycerides following selected sociodemographic, clinical and biological characteristics of the study population

Parameters	Serum total cholesterol		Serum triglycerides	
	Mean (SD)	***P* value**	**Mean (SD)**	***P* value**
Overall	**207.30 (54.18)**		**105.49 (51.22)**	
Gender				
Males	201.45 (55.22)	.001*,c	106.23 (55.41)	.660c
Females	213.03 (52.58)		104.77 (46.81)	
Age (years)				
20 – 39	198.19 (52.54)		97.87 (41.99)	
40 – 64	220.92 (55.34)	< .001*,c	120.43 (65.42)	< 0.001*,c
≥ 65	222.65 (47.09)		104.02 (35.10)	
Level of education				
Had not been at school	206.40 (48.98)		107.23 (46.13)	
Only koranic	216.35 (55.53)		115.01 (57.39)	
Primary	208.40 (51.38)		106.68 (55.97)	
Secondary	301.93 (56.07)	.040*,c	103.77 (47.96)	< .001*,c
Higher	203.87 (54.41)		89.15 (34.21)	
Personal history of stroke				
Yes	217.73 (42.53)	.602 c	128.58 (57.57)	.034*,c
No	207.21 (54.12)		105.09 (51.05)	
Personal history of CAD				
Yes	220.48 (50.42)	.484 c	153.16 (123.58)	.008*,c
No	207.28 (53.98)		105.08 (50.11)	
Family history of hypertension				
Yes	207.41 (52.94)	.966 c	104.63 (47.50)	.134c
No	207.25 (54.47)		105.93 (53.02)	
Family history of diabetes				
Yes	200.62 (49.74)	.064 c	101.14 (40.86)	.212c
No	208.96 (54.78)		106.51 (53.32)	
BMI				
Normal	203.26 (53.15)		101.102 (49.58)	
Overweight	208.32 (54.12)	< .001*,c	110.94 (55.88)	.013*,c
Obesity	224.52 (56.3)		113.24 (45.3)	
Abdominal obesity				
Yes	223.23 (53.06)	< .001*,c	114.09 (47.15)	.008*,c
No	203.06 (53.79)		103.20 (52.04)	
High blood pressure				
Yes	214.80 (55.75)	< .001*,c	115.34 (56.72)	< .001*,c
No	200.65 (51.91)		96.77 (44.04)	
Hyperglycemia				
Yes	226.49 (52.98)	.009*,c	123.64 (89.63)	.095 c
No	206.19 (54.07)		104.44 (47.95)	
High serum triglyceride				
No	205.19 (52.12)	< .001*,d	-	
Yes	245.42 (73.87)		-	
High serum cholesterol				
No	-		97.38 (40.90)	< .001*,c
Yes	-		128.62 (68.03)	

*SD: Standard deviation, CAD: coronary artery disease, BMI: Body Mass Index, cANOVA, dMann-Whitney/Wilcoxon, * P values < .05*

Table 3. Determinants of elevated serum cholesterol and triglyceride among the study population

Parameters	Hypercholesterolemia			Hypertriglyceridemia		
	OR	95% CI	*P* value	OR	95% CI	*P* value
Gender						
Males/Females	0.89	0.63-1.26	.518	1.11	0.57-2.15	.756
Age (years)						
40 – 64/20 – 39	2.21	1.56-3.12	< .001*	2.11	1.09-4.07	.027*
≥ 65 /20 – 39	2.19	1.25-3.83	.006*	0.49	0.11-2.25	.356
BMI						
Overweight/Normal	1.03	0.70-1.51	.887	1.79	0.90-3.54	.097
Obesity/Normal	1.27	0.73-2.20	.403	1.52	0.52-4.48	.449
Abdominal obesity						
Yes/No	1.76	1.09-2.83	.026*	0.40	0.15-1.11	.067
Personal history of stroke						
Yes/No	0.75	0.24-2.39	.628	2.20	0.44-10.90	.334
Personal history of CAD						
Yes/No	1.06	0.36-7.63	.519	2.56	0.20-32.17	.466
High blood pressure						
Yes/No	1.09	0.78-1.52	.631	2.38	1.20-4.73	.011*
Hyperglycemia						
Yes/No	1.32	0.71-2.43	.374	1.05	0.34-3.20	.935
High serum triglyceride						
Yes/No	4.53	2.44-8.42	< .001*	-	-	-
High serum cholesterol						
Yes/No	-	-	-	4.75	2.54-8.88	< .001*

*CAD: Coronary artery disease, BMI: Body Mass Index, OR: Odd ratio. * (P< .05).Multivariate regression analysis*

4.2 Mean Concentrations of Serum Total Cholesterol and Triglycerides

The overall mean serum TC level (207.30 mg/dL) recorded in the study population is close to the 203.6 mg/dL and the 206.4 mg/dL respectively reported in a study by Veghari et al. [17] and Eakplakorn et al. [21]. Female participants recorded higher mean serum TC compared with their male counterparts. Besides, there was a significant increase in the mean TC levels with age, and BMI. Similar results have been reported by Al-Nuaim et al. [23]. Moreover, higher mean TC levels were recorded in participants with abdominal obesity, hyperglycemia and high serum TG compared to those without. These results are consistent with previous literature data according to which obesity, abdominal obesity and diabetes independently affect lipid metabolism and may contribute to dyslipidemia [13,24,25].

The mean serum TG level in this study was 105.49 mg/dL, results which are lower than the 131.4 mg/dL and the 135.2 mg/dL reported in Thailand [21] and in Korea [26] respectively. The link between BMI and blood TG levels has been well elucidated in the Framingham study [27]. According to data from NCEP III, overweight and obesity are common causes of hypertriglyceridemia [14]. A recent study carried out by Mohammadifard reported a positive relationship between mean WC, TC and TG levels on one hand, and a positive relationship between BMI, TC and TG on the other hand [25]. Also, because of their connected metabolic pathways, higher plasma TG levels are often concomitant to higher plasma TC [14].

4.3 Awareness and Treatment of Lipid Disorders

Healthy lifestyle and the use of lipid lowering drugs has been shown to reduce plasma lipids [2,29,34]. According to Catapano et al. [28], there is strong evidence that dietary factors influence plasma lipids. A recent study by Asghari et al. showed that adherence to the «healthy eating index-2005 (HEI-2005)» recommendations was associated with reduced TG concentration in an urban adult population [2]. Another study by Sillah et al. revealed that weight loss, smoking cessation, and physical activity were associated with an improvement of high-density lipoprotein cholesterol (HDL-C) and TC/HDL-C ratio [29]. Obviously, these modifications strongly link with the awareness of individuals on lipid risk factors.

Compared to high income countries, awareness on dyslipidemias remains poor in resource deficient populations. Data from The Minnesota Heart Survey showed that among hypercholesterolemic individuals residing in USA, the percentage of those who were aware of their condition varied from 20% in black men to 34% in white men [30]. In NHANES III, it was reported that almost 68% of adults with hypercholesterolemia were aware of it [31]. Another study carried out by Wang et al. [32] revealed that the proportion of a Chinese adult population with dyslipidemia who were either aware or on treatment was 50.9% and 23.8% respectively. Other observed awareness rates are extremely higher compared to the 0.77% (less than 1%) recorded in the present study. Moreover, no participant with elevated serum cholesterol or triglyceride was under lipid lowering drug.

The extremely low of level awareness, high rates of elevated serum cholesterol and the lack of treatment among probable dyslipidemic participants observed in this study indicate a poor epidemiological state regarding dyslipidemias in the general population. In most resource constraint settings, the need for laboratory measurement of plasma lipids is either poorly judged, undermined or not well understood by medical personnel. Population related factors impeding health seeking behaviors and access to healthcare services such as level of disease awareness, finances, geographical location, sociocultural and anthropological factors among others, play a vital role in propagating dyslipidemias. A study carried out by Tiahou et al. [33] showed that among all the laboratory requests registered in the Laboratory service of an Ivorian University Teaching Hospital, only 5.7% included a lipid parameter, contrasting with the high rates of at-risk persons to cardiovascular disease in this area. It may also be attributed to insufficient infrastructural and personnel capacity among several other technical deficiencies, as well as the lack of appropriate health insurance services, even in the case where lipid profile analysis are prescribed.

4.4 Study Limitations

The present study observed some limitations thus: BP was measured twice on a single visit following a standard protocol. According to WHO and JNC7 guidelines, hypertension should be defined on the basis of at least two BP readings taken on two or more visits after an initial screening. Also, diagnosis of diabetes was based on one fasting blood glucose test only, without oral glucose tolerance test. Besides, these lipid measurements were done on a single venous blood specimen collected at a single point within the study, thus giving room for the influence of transient lipoproteinemia variations on the results.

4.5 Perspectives and Future Research

In spite of its limitations, the present study is the first of its kind with a considerable sample size and sufficient representation of the general population providing detailed information on the risk of dyslipidemia at population level in the northern regions of Cameroon. A more comprehensive study may be carried out in the future, involving a broader range of blood lipid parameters and their determinants, as well as piloting extensive investigations on causality.

5. CONCLUSION

In conclusion the study portrays a high prevalence of high cholesterolemia, very low level of awareness and poor treatment coverage of dyslipidemias in the Ngaoundere population. Furthermore, gender, age, high blood pressure, hyperglycemia, overweight and obesity (including abdominal) were associated with increased serum cholesterol and triglycerides. Extensive sensitization on dyslipidemias and major risk factors of cardiovascular diseases is strongly needed in this population in general and others alike.

CONSENT

As per international standard or university standard, patient’s written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Haït R, Leroy G. Facteurs de risque cardiovasculaire: Les enseignements des grands essais cliniques. Editions Frison-Roche, Paris; 2003.
2. Asghari G, Mirmiran P, Hosseni-Esfahani F, Nazeri P, Mehran M, Azizi F. Dietary quality among Tehranian adults in relation to lipid profile: Findings from the Tehran lipid and glucose study. J Health Popul Nutr. 2013;31(1):37-48. PMCID: 3702357.
3. Guyton AC, Hall JE. Textbook of medical physiology-11th ed. Elsevier Saunders. Philadelphia; 2006.
4. World Health Organization. Global atlas on cardiovascular disease prevention and control. Mendis S, Ruska P, Norrving B, Editors. World Health Organization, Geneva; 2011.
5. Paynter NP, Kiefe CI, Lewis CE, Loria CM, Goff DC, Lloyd-Jones DM. Accumulation of metabolic cardiovascular risk factors in black and white young adults over 20 years. J Am Heart Assoc. 2015;4:e001548. DOI: 10.1161/JAHA.114.001548
6. Noubiap JJN, Nansseu JRN, Bigna JJR, et al. Prevalence and incidence of dyslipidaemia among adults in Africa: A systematic review and meta-analysis protocol. BMJ Open. 2015;5:e007404. DOI: 10.1136/bmjopen-2014-007404
7. Ngoufack JOT, Mbouemboue OP, Sakinatou I, Velinga AC, Tamanji TM, Koona Koona JA. Association between blood pressure, waist circumference, cholesterolaemia and triglyceridaemia in a population of Cameroonian adults. Res. J. of Health Sci. 2017;5(1):26-34. DOI: 10.4314/rejhs.v4i4.4
8. Pancha OM, Damdam FB, Tamanji MT. Comparison of lipid profiles and 10 year cardiovascular disease risk estimates between indigenous northern diabetic and non-diabetic persons in Adamawa region, Cameroon. Journal of Medical and Biomedical Sciences. 2015;4:18-24. DOI: 10.4314/jmbs.v4i3.3
9. Mbouemboue OP, Derew D, Ngoufack TJO, Tamanji MT. A community-based assessment of hypertension and some other cardiovascular disease risk factors in Ngaoundéré, Cameroon. Int J Hypertens; 2016. Article ID: 4754636. DOI: 10.1155/2016/4754636
10. World Health Organization. The WHO STEPwise approach to chronic disease risk factor surveillance/non-communicable diseases and mental health. World Health Organization, Geneva; 2005.
11. Garabed Eknoyan. Adolphe Quetelet (1796–1874): The average man and indices of obesity. Nephrol Dial Transplant. 2008;23:47–51.
DOI: 10.1093/ndt/gfm517
12. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, evaluation, and treatment of high blood pressure: The JNC 7 report. JAMA. 2003;289:2560-72.
13. Perk J, De Backer G, Gohlke H, Graham I, Reiner Z, Verschuren WMM, et al. European Guidelines on cardiovascular disease prevention in clinical practice (version 2012). Eur Heart J. 2012;33:1635-1701.
DOI: 10.1093/eurheartj/ehs092
14. Grundy SM, Becker D, Clark LT, Cooper RS, Denke MA, Howard J, et al. Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection. Evaluation, and treatment of high blood cholesterol in adults (Adult Treatment Panel III): Final Report. Circulation. 2002;106(25):3143.
15. Lian CW, Yein LP, Yaman K, Wahab RA. A preliminary study on the prevalence of cardiovascular disease risk factors in selected rural communities in Samarahan and Kuching Division, Sarawak, Malaysia. Malaysian J Med Sci. 2011;18(2):58-65.
16. Capingana DP, Magalhães P, Silva ABT, Gonçalves MAA, Baldo MP, Rodrigues SL, et al. Prevalence of cardiovascular risk factors and socioeconomic level among public-sector workers in Angola. BMC Public Health. 2013,13:732.
DOI: 10.1186/1471-2458-13-732
17. Veghari G, Sedaghat M, Joshghani H, Niknezad F, Angizeh A, Tazik E, et al. Plasma total cholesterol level and some related factors in northern Iranian people. J Nat Sci Biol Med. 2013;4(2):359-363.
18. Daviglus ML, Talavera GA, Santa MLA, Allison M, Cai J, Criqui MH, et al. Prevalence of major cardiovascular risk factors and cardiovascular diseases among Hispanic/Latino individuals of diverse backgrounds in the United States. JAMA. 2012;308(17):1775-1784.

19. Sun GZ, Li Z, Guo L, Zhou Y, Yang HM, Sun YX. High prevalence of dyslipidemia and associated risk factors among rural Chinese adults. Lipids in Health and Disease. 2014;13:189.
20. Doupa D, Seck SM, Dia CA, Diallo FA, Kane MO, Kane A, et al. Dyslipidemia, obesity and other cardiovascular risk factors in the adult population in Senegal. Pan African Medical Journal. 2014;19:181.
21. Aekplakorn W, Taneepanichskul S, Kessomboon P, Chongsuvivatwong V, Putwatana P, Sritara P, et al. Prevalence of dyslipidemia and management in the Thai population, National Health Examination Survey IV, 2009. Journal of Lipids; 2014. Article ID: 249584.
22. Huang Y, Gao L, Xie X, Tan SC. Epidemiology of dyslipidemia in Chinese adults: Meta-analysis of prevalence, awareness, treatment, and control. Population Health Metrics. 2014;12:28.
23. Al-Nuaim AR, Al-Rubeaan K, Al-Mazrou Y, Al-Attas O, Al-Daghari N. Prevalence of hypercholesterolemia in Saudi Arabia, epidemiological study. Int J Cardiol. 1996;54(1):41-9.
24. Vergès B. Pathophysiology of diabetic dyslipidaemia: Where are we? Diabetologia; 2015.
25. Mohammadifard N, Nazem M, Sarrafzadegan N, Nouri F, Sajjadi F, Maghroun M, Alikhasi H. Body mass index, waist-circumference and cardiovascular disease risk factors in Iranian adults: Isfahan healthy heart Program. J Health Popul Nutr. 2013;31(3):388-397.
26. Choi SJ, Park SH, Lee KS, HY Park. The prevalence, awareness and treatment of high low density lipoprotein cholesterol in Korean adults without coronary heart diseases-the third Korea national health and nutrition examination survey, 2005. Korean Circulation Journal. 2012;42(2):86-94.
27. Wilson PWF. Lipids and vascular disease: A Framingham perspective. Global Heart. 2013;8(1):25-33. DOI: 10.1016/j.gheart.2012.12.009
28. Alberico L, Catapano IG, De Backer G, Wiklund O, Chapman MJ, Drexel H, et al. 2016 ESC/EAS Guidelines for the Management of Dyslipidaemias. European Heart Journal. 2016;37:2999-3058. DOI: 10.1093/eurheartj/ehw272
29. Sillah A, Sidebottom AC, Miedema MD, Knickelbine T, Boucher JL, Van Wormer JJ. Short term effects of lifestyle changes on HDL and the total cholesterol / HDL ratio in the heart of New Ulm Project. Circulation. 2014;130:A16278.
30. Sprafka JM, Burke GL, Folsom AR, Hahn LP. Hypercholesterolemia prevalence, awareness, and treatment in blacks and whites: The Minnesota Heart Survey. Prev Med. 1989;18(4):423-32. PMID: 2798366.
31. Earl S. Ford, Ali H. Mokdad, Wayne H. Giles, George A. Mensah. Serum total cholesterol concentrations and awareness, treatment, and control of hypercholesterolemia among US adults: Findings from the National health and nutrition examination survey, 1999 to 2000. Circulation. 2003;107:2185-2189. DOI:10.1161/01.CIR.0000066320.27195.B4
32. Wang S, Xu L, Jonas JB, You QS, Wang YX, Yang H. Prevalence and associated factors of dyslipidemia in the adult Chinese population. PLoS ONE. 2011;6(3):e17326. DOI: 10.1371/journal.pone.0017326
33. Tiahou G, Deret K, Monde A, Agniwo CCM, Djohan Y, Djessou P, Sess D. Fréquence des bilans lipidiques et prévalence des dyslipidémies au laboratoire de biochimie du CHU de Cocody J Sci Pharm Biol. 2010;11(2):60-65.
34. Thompson GR. Management of dyslipidemia. Heart. 2004;90:949-955. DOI: 10.1136/hrt.2003.021287

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