

Original Research Article

One-year follow-up of the distribution of dyslipidemias among Cameroonian diabetic patients in Ngaoundere, 2014-2015

ABSTRACT

Background: Diabetes constitutes an important faction of the health and economic burden worldwide and its occurrence continues to rise especially in developing countries.

Aim: to study the distribution in dyslipidemia occurrence over a period of 1 year in a diabetic and non-diabetic population in Ngaoundere.

Methodology: This was a cross sectional case control study carried out at the Hypertension and Diabetes units of the Ngaoundere Regional and Protestant Hospitals from June 2015 to February 2016. All participants provided a written consent and were subjected to a questionnaire. Blood pressure and anthropometric parameters were measured and venous blood collected for fasting blood sugar, lipid profile, glycated hemoglobin and uric acid analysis using commercially acquired kits. Data were organized and analyzed using an Excel spreadsheet and SPSS version 20.0. respectively, with statistical significance considered at $p < 0.05$.

Results: Of the 321 participants enrolled, 191 were diabetic and 130 non-diabetic having sex ratios (F/M) of 1.3 and 1.1 respectively. Compared to the 73.3% dyslipidemia, 28.9% hypercholesterolemia, 15.6% hypertriglyceridemia and 28.9% mixed hyperlipidemia reported by the authors in the same diabetic population a year earlier, the occurrence of dyslipidemias, hypercholesterolemia, hypertriglyceridemia and mixed hyperlipidemia were 59.7%, 49.5%, 7.0%, and 3.2%. Likewise, similar trends were observed with the corresponding non-diabetic control groups. 39 patients (20.4%) and 29 controls (22.3%) had knowledge on cholesterol, while 9.9% of diabetic participants had tested for blood cholesterol levels at some point.

Conclusion: We observed meaningful drops in the occurrence of hypertriglyceridemia, mixed hyperlipidemia, and a rise in hypercholesterolemia among diabetics and nondiabetics, with a low level of awareness on dyslipidemias. Much is needed in sensitizing and controlling cardiometabolic risks towards improving the management of diabetic patients in our context.

Keywords: Diabetes, Dyslipidemia, cardiometabolic risk, Ngaoundere, Cameroon.

1. INTRODUCTION

Once considered a rare disease in sub-Saharan Africa, diabetes is clearly expanding [1], being a common cause for consultation in Africa and around the world [2]. The International Diabetes Federation reported in 2013 that the number of adults with diabetes worldwide will increase by 55% (381.8 million in 2013 to 591.9 million in 2035) with sub-Saharan Africa recording the largest increase in the population with diabetes, projecting an expected increase of 109.6% (19.8 million in 2013 to 41.5 million in 2035) [3]. This global expansion of diabetes has become a serious public health problem and in the presence of poor

glycemic control, diabetics run a risk of several metabolic disorders, among which dyslipidemias exercise a preponderant role [1,4].

A previous survey in Northern Cameroon portrays abdominal obesity, physical inactivity, and hypertension respectively as the dominant cardiovascular disease (CVD) risk factors in the general population, with hyperglycemia being an independent determinants of high blood pressure [5]. In a prequel study including diabetic patients attending the Diabetes and Hypertension clinic of the Ngaoundere Regional Hospital, Cameroon, hypercholesterolemia, hypertriglyceridemia, and mixed hyperlipidemias were estimated at 28.9%, 15.6%, 28.9% among diabetic patients compared to 22.2%, 15.6%, 6.7% in nondiabetic controls respectively [6].

As earlier suggested, the level of awareness of lipid abnormalities is still poor in African populations [7] and since it represents a principal determinant of the practice of health promoting recommendations, we were thus motivated to carry out a follow-up study with the goal of to determine the prevalence of selected cardiometabolic risk factors and investigate the variations in the occurrence of dyslipidemias in a diabetic population we previously studied and sensitized on dyslipidemias and CVD risk prevention.

2. METHODOLOGY

2.1 Study design

We carried out a cross sectional case control study from June 2015 to February 2016 in Ngaoundere, Adamawa region of Cameroon. 191 diabetic persons were consecutively recruited at the Hypertension and Diabetes units of both the Ngaoundere Regional and Protestant Hospitals, among whom 5 participants were excluded post-laboratory analysis for triglyceride levels > 400 mg/dL, affecting LDL calculation thus. A control population was included in this study constituting of 130 healthy non-diabetic participants selected from the general population following a two-staged sampling procedure as previously described [5]. Individuals who refused to consent to this study, infected with HIV, on corticosteroid therapy, pregnant and breast feeding women were excluded from this study.

2.2 Specimen and data collection

Prior to specimen collection, participants were adequately informed on the study and were expected to sign a written consent. Each participant thereafter filled a questionnaire through which data on sociodemography, therapy, disease awareness and complications were obtained. Blood pressure measurements were subsequently recorded and 5 ml of fasting whole venous blood collected for glucose and other biochemical analysis. Blood glucose levels were determined, while the rest of the blood samples were divided equally into an EDTA tube for immediate glycated hemoglobin measurement, and a dry tube to clot. The dry tubes were subsequently centrifuged at 3000 rpm for 5 minutes, with serum separated into Eppendorf tubes and frozen at -20°C prior to weekly analysis.

2.3 Study variables

Parameters of interest included serum lipids, glycated hemoglobin (HbA1 and HbA1c), fasting blood glucose (FBG), and blood pressure (BP).

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57 **2.3.1 Blood Pressure**

58 Participants' blood pressures were estimated using a manual mercury sphygmomanometer
59 (ADC Prosphyg, model 770) in accordance with the WHO STEPs recommendations [8].
60 Measurements were performed on both the left and right arms after a 15–20 minutes rest
61 period with the patient assuming an upright sitting posture. High blood pressure was defined
62 as BP values $\geq 140/90$ mmHg.

63 **2.3.2 Biochemical Measurements**

64 Blood glucose levels were measured using a glucometer (Accu-Chek, Performa) after an 8
65 to 12-hour overnight fast. In accordance with WHO recommended glucose threshold,
66 hyperglycemia was defined as FBG ≥ 126 mg/dL [8]. Using EDTA whole blood samples,
67 glycated hemoglobin (HbA1c) levels were estimated following an ion exchange resin method
68 as previously described [9], and calculation of the HbA1c fraction ensued as 80% of HbA1.
69 Frozen serum samples were thawed prior to analysis and total cholesterol, triglyceride, and
70 high density lipoprotein cholesterol (HDLc) performed with the aid of a semi-auto
71 biochemistry analyser (Mindray BA-88A, BH7AB2710, China). All measurements were
72 performed using commercially acquired kits based on previously described methods [10,11].
73 Total cholesterol measurement was based on the CHOD-PAP method, with normal ranges
74 defined as < 200 mg/dL. Serum triglycerides were determined based on the TGO-PAP
75 method with reference values stated as males: 40-160 mg/dL and females: 35-135 mg/dL.
76 HDL concentration was estimated following a two-step method consisting firstly of
77 separation and precipitation of low density lipoprotein cholesterol (LDLc) and very low
78 density lipoprotein (VLDL) lipoprotein fractions facilitated by a divalent cation-dependent
79 polysaccharide sulphate and next by cholesterol estimation in the HDLc containing
80 supernatant. Reference values were considered as; males > 55 mg/dL and females > 65
81 mg/dL. LDLc levels were estimated with the aid of the Friedwald's formula as follows: LDLc
82 (mg/dL) = TC - TG/5 - HDLc, for all corresponding triglyceride levels < 400 mg/dL [12],
83 where TC = total cholesterol and TG = triglycerides. Values less than 130 mg/dL were
84 considered normal. We also estimated participants' Cholesterol ratio using the formula
85 TC/HDLc, with normal values considered as < 4.85 [13].

86 **2.3.3 Estimation of Cardiovascular (CV) Risk**

87 10 year CV risk estimates were determined using the Framingham SCORE model for all
88 participants older than 20 years old, which takes into consideration 5 principal factors
89 including age, gender, smoking (at least 10 cigarettes daily), total cholesterol level and
90 systolic BP. These calculations were carried out on the www.cardiorisk.fr website and risk
91 levels were explored accordingly Low $< 5\%$, Moderate 5-10%, Intermediate 10-20%, high
92 risk $> 20-40\%$ and Very high $> 40\%$ [14].

93 **2.3.4 Classification of Dyslipidemia**

94 We adopted the GENNES and Fredrickson classification of dyslipidemias [15] as follows

95 Hypercholesterolemia, Type IIa: LDL > 160 mg/dL and TG < 200 mg/dL

96 Hypertriglyceridemia, Type V, IV, I: LDL < 160 mg/dL and TG > 200 mg/dL

97 Mixed hyperlipidemias, Type III, IIb LDL > 160 mg/dL and TG > 200 mg/dL

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99 **2.1 Quality assurance**

100 Recommended glass and plastic ware were used throughout the study with sample
101 collection, transport, storage and analysis performed in accordance with standard
102 procedures. Method calibration was performed using the Calimat calibrator (reference:
103 62321, lot number: 1003001280 Biomérieux, France) and analytical quality was ensured
104 using the Lyotrol™ N/P quality control serum (reference: 62373, lot number: 1003001280
105 Biomérieux, France) in conformity with Levey-Jennings and Westgard's rules. An electronic
106 blood pressure meter (Omron HEM712C, 6416799LF, China) and a second semi-automated
107 spectrophotometer (SECOMAM Basic/70V B0358, SN: 1790) were used to verify the
108 reproducibility BP and biochemical measurements at random intervals.

109 **2.1 Ethical consideration**

110 This study was approved by the Ngaoundere Regional Hospital ethical committee (Ref:
111 2015/113/UN/DFS/CD_SBM). Interested persons were given adequate information about
112 the study in a language of best comprehension prior to obtaining a written consent and
113 subsequent enrollment. Participation was voluntary and confidentiality was maintained and
114 those with abnormal results were referred to a Cardiologist.

115 **2.1 Data management and analysis**

116 Statistical analyses were performed using the statistical package for social sciences (SPSS
117 for Windows, version 20.0, SPSS Corporation Inc. Chicago IL USA) and results compared
118 with those obtained using R version 3.0.2 software. With statistical significances considered
119 at $p < 0.05$, ANOVA or Mann-Whitney U/Wilcoxon W tests were used to compare means,
120 while chi-square or Fisher's exact tests were used to compare proportions.

121 **3. RESULTS**

122 **3.1 General Characteristics of the Study Population**

123 A total of 321 participants were enrolled in the study, 191 were diabetic (study group) and
124 130 non-diabetic (control group). Both the diabetic and non-diabetic participants portrayed
125 equivalent sex ratios (F/M) of 1.3 and 1.1 respectively. The average age of diabetics was
126 55.30 ± 12.38 years (men: 57.05 ± 13.05 years, women: 53.96 ± 11.7 years). The majority
127 (69.12%) of the study group participants were over 50 years of age, whereas 82.31% of the
128 control group were 50 years and below. Worth noting was the predominance of housewives
129 and married persons in both groups, Muslims among diabetic patients and Christians in the
130 control group. 20.94% of the diabetic population possessed at least a secondary level of
131 education compared to 52.31% of non-diabetics. Sociodemographic characteristics of the
132 study participants are presented table 1.

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138 **Table 1:** Sociodemographic characteristics of the study population

Variables	Patients		Controls	
	n	%	n	%
Age (years)				
< 30	6	3.14	46	35.38
30 – 50	53	27.75	61	46.92
> 50	132	69.12	23	17.69
Level of Education				
Uneducated	20	10.47	30	23.08
Koranic School	76	39.79	2	1.54
Primary	55	28.80	30	23.08
Secondary	31	16.23	46	35.38
University	9	4.71	22	16.92
Marital Status				
Single	27	14.14	18	13.85
Married	128	67.02	89	68.46
Divorced	7	3.66	4	3.08
Widows/Widowers	29	15.18	20	15.38
Religion				
Christians	56	29.32	117	90.00
Muslims	135	70.68	13	10.00
Profession				
Formal sector	28	14.66	28	21.54
Trader	22	11.52	14	10.77
Housewives	72	37.70	49	37.69
Informal sector	47	24.61	25	19.23
Retired	18	9.42	2	1.54
Student	4	2.10	12	9.23

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 140 Comparing the means of selected clinical and biochemical parameters, only TG and HDLc
 141 did not demonstrate statistical differences between diabetic and non-diabetic participants
 142 contrary to other studied variables which recorded significantly higher values in diabetic
 143 persons (table 2). Value for TG portrayed a high degree of variation, owing to four diabetic
 144 participants recording triglyceride levels of more than 1000mg/dL, and one above
 145 4000mg/dL.

146 **Table 2:** Comparison of means of variables between diabetic patients and controls

Variables	Patients (Mean ± SD)	Control (Mean ± SD)	P value
Age (years)	55.30 ± 12.38	37.09 ± 13.63	< .001
Glucose (mg/dL)	175.93 ± 93.87	86.99 ± 11.72	< .001
Total cholesterol (mg/dL)	239.21 ± 73.65	212.03 ± 56.08	< .001
Triglyceride (mg/dL)	192.69 ± 743.21	92.23 ± 39.45	.125
HDLc (mg/dL)	43.26 ± 15.87	46.43 ± 11.64	.053
LDLc (mg/dL)	168.28 ± 68.89	145.24 ± 53.75	.002
Cholesterol Ratio	5.99 ± 2.51	4.80 ± 1.60	< .001
HbA1 (%)	13.13 ± 4.26	7.68 ± 1.32	< .001
HbA1c (%)	10.51 ± 3.41	6.14 ± 3.06	< .001
SBP (mmHg)	142.01 ± 27.14	133.16 ± 20.55	.002
DBP(mmHg)	91.96 ± 15.80	87.49 ± 11.96	.007
Cardiovascular risk	21.60 ± 9.74	6.18 ± 7.00	< .001

147 3.2 Distribution of Dyslipidemias and Cardiovascular Risk in the Study 148 Population

149 The prevalence of dyslipidemias was 59.7% and 36.2% among patients and controls
150 respectively, with hypercholesterolemia, hypertriglyceridemia and mixed hyperlipidemia
151 observed at 49.5%, 7.0%, 3.2% in patients and 33.1%, 2.3%, 0.8% in controls respectively.
152 The difference in the distribution of dyslipidemias between diabetic and non-diabetic
153 participants was not statistically significant (table 3).

154 Significant differences in the distribution of CV risk were observed between diabetic and
155 non-diabetic participants, with high CV risk being more prevalent among former compared to
156 the latter population (62.7% versus 5.4%) (table 3).

157 **Table 3:** Distribution of dyslipidemias and cardiovascular risk between patients and controls.

Variables		Patients n (%)	Controls n (%)	P value
Dyslipidemias	Yes	111 (59.7)	47 (36.2)	.054
	No	75 (40.3)	83 (63.8)	
	Total	186 (100)	130 (100)	
Type of Dyslipidemias	Hypercholesterolemia	92 (82.9)	43 (91.5)	.231
	Hypertriglyceridemia	13 (11.7)	3 (6.4)	
	Mixed hyperlipidemia	6 (5.4)	1 (2.1)	
	Total	111 (100)	47 (100)	
Cardiovascular Risk	Low	11 (5.9)	86 (66.2)	< .001
	Moderate	27 (14.6)	24 (18.5)	
	Intermediate	31 (16.8)	13 (10.0)	
	High	116 (62.7)	7 (5.4)	
	Total	186 (100)	130 (100)	

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159 Antidiabetic pharmacotherapy represents a primary component in management of full-blown
160 diabetes. In this study, it was discovered that 15.2% diabetic patients were not on any form
161 drug therapy. Persons who were strictly on conventional pharmacotherapy or traditional
162 therapy constituted 39.8% and 11% of our patients respectively, while 33% were
163 simultaneously on both. In addition, the occurrence of dyslipidemias was highest among
164 diabetics without therapy (72.4%) and those strictly on traditional regimen (76.2%) (table 4).
165 Several treatment categories were poorly represented in our sample population, making
166 their results non-representative for dyslipidemia distribution.

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Table 4: Distribution of diabetic persons following treatment protocol and dyslipidemia

Treatment protocol	Proportion of patients n (%)	Hypercholesterolemia n (%)	Hypertriglyceridemia n (%)	Mixed Dyslipidemia n (%)	Total Dyslipidemias n (%)
None	29 (15.2)	18 (62.1)	1 (3.4)	2 (6.9)	21 (72.4)
Monotherapy	42 (22.0)	15 (35.7)	3 (7.1)	1 (2.4)	19 (45.2)
Bitherapy	29 (15.2)	14 (48.3)	3 (10.3)	-	17 (58.6)
Tritherapy	1 (0.5)	-	-	-	-
Insulin	3 (1.6)	-	1 (33.3)	-	-
Monotherapy + Traditional	33 (17.3)	14 (42.4)	-	2 (6.1)	16 (48.4)
Bitherapy + Traditional	28 (14.7)	16 (57.1)	-	1 (3.6)	17 (60.8)
Insulin + Traditional	2 (1.0)	1 (50.0)	1 (50.0)	-	-
Oral + Insulin	1 (0.5)	-	-	-	-
Oral + Insulin + Traditional	2 (1.0)	1 (50.0)	1 (50.0)	-	-
Traditional only	21 (11.0)	13 (61.9)	3 (14.3)	-	16 (76.2)

3.3 Knowledge of Dyslipidemias and Other Diabetes Complications

We performed a simple assessment of the level of awareness of both diabetic and non-diabetic participants on “cholesterol”, and it was observed to be equivalently low in both sub-populations (20.4% and 22.3% respectively). However, a small proportion of diabetic persons (9.9%) had previously performed a cholesterol test compared to the controls (Table 5).

Furthermore, we recorded current diagnosis of some CVDs and other diabetes complications among patients where after, hypertension (66.5%) was observed to be the most frequent, followed by retinopathy (39.8%) (table 5).

Table 5: Knowledge on cholesterol and complications of diabetes among participants

Variables	Patients		Controls	
	Yes n (%)	No n (%)	Yes n (%)	No n (%)
Knowledge on Dyslipidemias				
Have you ever heard about cholesterol?	39 (20.4)	152 (79.6)	29(22.3)	101 (77.7)
Have you ever done a cholesterol test?	19 (9.9)	172 (90.1)	-	130 (100)
Knowledge on Diabetes Complications				
Hypertension	127 (66.5)	64 (33.5)	-	130 (100)
Retinopathy	76 (39.8)	115 (60.2)	6(4.6)	124 (95.4)
Cardiac insufficiency	8 (4.2)	183 (95.8)	-	130 (100)
Diabetic ulcer	7 (3.7)	184 (96.3)	-	130 (100)
Polyneuropathy	29 (15.2)	162 (84.8)	-	130 (100)
Obstructive Arteriopathy of lower limbs	18 (9.4)	173 (90.6)	-	130 (100)
Coronaropathy	40 (20.9)	151 (53.7)	-	130 (100)

3. DISCUSSION

Diabetes continues to pose a metabolic burden in afflicted persons, multiplying thus the risk of dyslipidemias and cardiovascular events, especially in developing countries where specialized care is rarely available or non-extensive. Dyslipidemias are the most significant modifiable CVD risk factors and are one of the leading causes of morbidity and mortality in most developed and developing countries [16-18]. Obesity, glucose intolerance, diabetes and metabolic syndrome are often commonly associated with atherogenic dyslipidemia,

193 implying an increase in long-term risk of developing CVD [19]. Metabolic anomalies
194 frequently occur among diabetics, especially in those with a type 2 diabetes. Such
195 anomalies are usually characterized principally with raised levels of total blood cholesterol
196 (and/or LDLc), triglycerides, and reduced HDLc concentration [3].

197 Following a previous survey which we carried out in 2014 [6], this study aimed at assessing
198 the trends in the occurrence of dyslipidemias over a 1-year period. Compared to the 73.3%
199 dyslipidemia, 15.6% hypertriglyceridemia and 28.9% mixed hyperlipidemia reported by the
200 authors in the previous study [6], the current study recorded relatively lower occurrences of
201 59.7%, 7.0%, and 3.2% respectively. Conversely, hypercholesterolemia increased from
202 28.9% to 49.5% in the same study. Likewise, the prevalence of dyslipidemia,
203 hypercholesterolemia, hypertriglyceridemia and mixed hyperlipidemia observed variations
204 from 44.4%, 22.2%, 15.6%, 6.7% to 36.2%, 33.1%, 2.3%, 0.8% respectively in the
205 corresponding nondiabetic control participants. Excluding the effect an increased sample
206 size in this follow-up study, the recorded changes probably reflect significant reductions in
207 triglyceride-rich lipoproteins levels. These changes could possibly be attributed to an
208 increased adherence to recommended lifestyle modifications including but not exclusive to
209 frequent regular physical exercise, dietary adjustments, and reduced alcohol and tobacco
210 consumption, which are known to lower plasma lipoprotein levels [20,21]. Considerable
211 decreases in prevalence were principally confined to hypertriglyceridemia and mixed
212 hyperlipidemia, while the occurrence of hypercholesterolemia increased: these probably
213 reflect significant reductions in triglyceride-rich lipoproteins levels.

214 We used Fredrickson's classification of dyslipidemias in the current study, but this was not
215 the case in the previous one. Despite an increase in cut-off levels for classification of
216 dyslipidemias in the current study compared to the previous, the frequency of
217 hypercholesterolemia significantly increased, most likely due in parts to the availability of
218 cholesterol-rich dairy foods characterizing this geographical region. Moreover, exogenous
219 influences on diet and metabolic capacity such as the transient effects of Ramadan fasting
220 characteristic of our study area where the Muslim religion is widely practiced, may explain
221 the observed changes in lipid profile [21-23]. In the current study, just like the previous,
222 hypercholesterolemia was the commonest type of dyslipidemia followed by
223 hypertriglyceridemia, concurring with the findings of other authors [17,24,25].

224 The existence of a considerable number of diabetic participants without any form of
225 antidiabetic therapy (15.2%) or on under-researched indigenous therapies (traditional
226 medicine) (45%) could inadvertently and/or nonspecifically affect lipid metabolism.

227 Knowledge and practice are independent determinants of disease risk, control and
228 complications. Our simple assessment of the "knowledge of cholesterol" and "testing
229 cholesterol levels" recorded 20.4% and 9.9% among diabetic persons compared to 22.3%
230 and 0% among nondiabetic controls respectively for a "yes" response. This is indicative of
231 an overall low level of awareness in both the high risk and general populations. In a
232 Canadian study, 57% of diabetic individuals had no knowledge on dyslipidemias [25].
233 Likewise, in Burkina-Faso, only 27.4% of diabetics knew that age, physical inactivity,
234 hypertension, dyslipidemia and obesity could be associated with diabetes and CV risk [26].
235 Generally, with diabetic persons being more likely to develop CVDs compared to the general
236 population, they are expected to be more informed as they obtain information from trained
237 clinical practitioners, while the general population are predominantly informed by means of
238 the media [27]. Our results could be due in parts to suboptimal sensitization and/or
239 inappropriately adapted methods, as well as the level of education observing that more than
240 three quarters of the diabetic participants possessed a maximum of primary education.

241 Total cholesterol levels and blood pressure represent 2 vital intersecting factors in the
242 determination of CV risk. Hence, our findings on the increasing trends of
243 hypercholesterolemia justify to at least 50% the exaggerated increase in CV risk > 5%
244 observed over a period of one year: that is, from 25.2% to 94.1% in diabetic patients and
245 18.2% to 33.8% in nondiabetic controls.

246 **4. CONCLUSION**

247 This study demonstrated meaningful decreasing trends in hypertriglyceridemia, mixed
248 hyperlipidemia, and increases in hypercholesterolemia over a one-year period, with a low
249 level of awareness on dyslipidemias in both the diabetic and non-diabetic populations. Much
250 is needed in sensitizing both high risk groups, medical personnel, care givers, and the
251 general population at large on current methods in diabetes management and prevention of
252 diabetes complications, while appropriately adapting these methods to specific populations.

253 **STUDY LIMITATIONS**

254 This study was aimed primarily at examining the trends in the prevalence of dyslipidemias,
255 as such we constituted another sample of the same population of diabetic patients studied a
256 year earlier without particular interest on sample population overlaps. Since the sample
257 population contained persons who were not enrolled in the previous survey (trend), the
258 observed variations were approximatively compared to if the same participants (cohort) were
259 studied a second time.

260 **FURTHER RESEARCH AND PERSPECTIVES**

261 The rising economic and public health burden of diabetes in sub-Saharan Africa is a call for
262 prompt efforts in reinforcing and adapting management strategies to the specific
263 sociocultural and economic activities of different population settlements. More work is
264 envisaged in determining the periodic clinical and biochemical variations in high CVD risk
265 cohorts towards evaluating the performance of and adherence to recommended therapy.

266 **COMPETING INTERESTS**

267 Authors have declared that no competing interests exist.

268 **REFERENCES**

- 269 1. Mbanya JC , Motala AA, Sobngwi E, Assah FK, Enoru ST. Diabetes in sub-Saharan Africa,
270 The Lancet. 2010; 375(9733): 2254-2266. DOI: 10.1016/S01406736(10)605508. PMID:
271 20609971.
- 272 2. Olutayo AC, Oluranti FB, Olawale OO, Raimi TH, Balogun WO, Odusan O et al. Community
273 based diabetes risk assessment in Ogun state, Nigeria (World diabetes foundation project
274 08-321). Indian J Endocrinol Metab. 2013; 17(4): 653-658, DOI: 10.4103/22308210.113756.
275 PMID: PMC3743365.
- 276 3. Aguiree F, Brown A, Cho NH, Dahlquist G, Dodd S, Dunning T et al. IDF Diabetes Atlas:
277 sixth edition. 6th ed. Basel, Switzerland: International Diabetes Federation, 2013.

- 278 4. Szu-Chi C. and Chin-Hsiao T. Dyslipidemia, kidney disease, and cardiovascular disease in
279 diabetic patients. The review of diabetic studies. 2013; 10(2-3): 88-100. DOI
280 10.1900/RDS.2013.10.88.
- 281 5. Mbouemboue OP, Derew D, Ngoufack TJO, Tamanji MT A Community-Based Assessment
282 of Hypertension and Some Other Cardiovascular Disease Risk Factors in Ngaoundéré,
283 Cameroon. Int J Hypertens. 2016; Article ID 4754636. DOI:10.1155/2016/4754636.
- 284 6. Pancha OM, Damdam FB, Tamanji MT. Comparison of lipid profiles and 10 year
285 cardiovascular disease risk estimates between indigenous northern diabetic and non-
286 diabetic persons in Adamawa region, Cameroon. Journal of Medical and Biomedical
287 Sciences. 2015; 4:18-24. DOI:10.4314/jmbs.v4i3.3
- 288 7. Mahmoud AM, Bhogireddy N, Bhaskaran AA. The Enormity of Total Serum Cholesterol
289 Levels and the Scale of Awareness on Control and Management of Cholesterol in Diabetics
290 in Zanzibar. Int J Pharm Phytopharmacol Res. 2014; 3 (6): 429-433.
- 291 8. World Health Organization. The WHO STEPwise Approach to Chronic Disease Risk Factor
292 Surveillance/Non-Communicable Diseases and Mental Health. WHO. Geneva, Switzerland;
293 2005.
- 294 9. Nathan DM. The clinical information value of the glycosylated hemoglobin assay. N Engl J
295 Med. 1984; 310: 340-346. DOI: 10.1056/NEJM198402093100602.
- 296 10. Tietz, NW in: Wu, Alan HB editor. Clinical guide on laboratory tests. 3rd Ed. Philadelphia,
297 W.B Saunders Co; 1995.
- 298 11. Burtis CA, Ashwood E. Tietz Textbook of Clinical chemistry. 3rd edition. Saunders:
299 Philadelphia; 1999. ISBN-13: 978-0721656106.
- 300 12. Friedwald WT, Levy RI, Fredrickson DS. Estimation of the concentration of low-density
301 lipoprotein cholesterol in plasma, without use of the preparative ultracentrifuge. Clinical
302 Chemistry. 1972; 18 : 449-502.
- 303 13. Grade G. The dyslipidemias: screening, diagnosis and treatment. Quebec: Quebec Society
304 of Lipidology, Nutrition and Metabolism; 2008. French.
- 305 14. Scheen AJ. How do I explore ... absolute cardiovascular risk at age 10: from Framingham
306 1998 to SCORE 2003. Rev Med Liege. 2004; 59 (7-8): 460-466. French.
- 307 15. Pasche O, Pache S, Cornuz J, Darioli R. and Rodondi N. How to implement clinical practice
308 recommendations? The example of dyslipidemias. Rev Med Switzerland. 2008; 4: 662-665.
309 French.
- 310 16. Shuang W, Liang X, Jost BJ, Qi SY, Ya XW, Hua Y. Prevalence and associated factors of
311 dyslipidemia in the adult Chinese population. PLoS ONE. 2011; 6(3): e17326.
312 doi:10.1371/journal.pone.0017326.t002.
- 313 17. Sun G-Z, Li Z, Guo L, Zhou Y, Yang H-M, Sun Y-X. High prevalence of dyslipidemia and
314 associated risk factors among rural Chinese adults. Lipids in Health and Disease 2014,
315 13:189 DOI: 10.1186/1476-511X-13-189.

- 316 18.Iciar MT, Sevillano-Collantes C, Amparo SG, Canizo-Gomez FJ. Type 2 diabetes and
317 cardiovascular disease: Have all risk factors the same strength. World journal of diabetes.
318 2014;5(4): 444-470. DOI: 10.4239/wjd.v5.i4.444.
- 319 19.Bosomworth NJ. Ways to identify and manage atherogenic dyslipidemia: A metabolic
320 consequence of obesity and diabetes, Canadian Family Physician. 2013; 59: e479-91.
321 French.
- 322 20.Redaeli L, Garlaschelli K, Grigore L, Norata GD, Catapano AL. Association between the
323 Adherence to AHA Step 1 Nutrition Criteria and the Cardiometabolic Outcome in the General
324 Population-A Two Year Follow-Up Study. Food and Nutrition Sciences. 2012; 3: 274-280.
- 325 21.Shehab A, Abdulle A, El Issa A, Al Suwaidi J, Nagelkerke N. Favorable Changes in Lipid
326 Profile: The Effects of Fasting after Ramadan. PLoS ONE. 2012; 7 (10): e47615. DOI:
327 10.1371/journal.pone.0047615.
- 328 22.Zadegan N, Atashi M, Naderi G, Baghai A, Asgary S, et al. The Effect Of Fasting In
329 Ramadan on the Values and Interrelations Between Biological,Coagulation and
330 Hematological Factors. Annals of Saudi Medicine. 2000; 20: 5-6.
- 331 23.Barkia A, Mohamed K, Smaoui M, Zouari N, Hammami M, Nasri M. Change of Diet, Plasma
332 Lipids, Lipoproteins, and Fatty Acids during Ramadan: A Controversial Association of the
333 Considered Ramadan Model with Atherosclerosis Risk. J Health Popul Nutr. 2011; 29: 486-
334 493.
- 335 24.Dixit AK, Dey R, Suresh A, Chaudhuri S, Panda AK, Mitra A, Hazra J. The prevalence of
336 dyslipidemia in patients with diabetes mellitus of ayurveda Hospital. J Diabetes Metab
337 Disord. 2014; 13: 58. DOI: 10.1186/2251-6581-13-58.
- 338 25.Joffres M, Shields M, Tremblay MS, Gorber SC. Dyslipidemia prevalence, treatment, control,
339 and awareness in the Canadian health measures survey. Canadian journal of public health.
340 2013; 104, e252-e257.
- 341 26.Yameogo TM, Sombie I, Kyelem CG, Rouamba N, Ouedraogo SM, Yameogo AA et al.
342 Diagnosis and prevalence of the metabolic syndrome in diabetics followed in a context of
343 limited resources: the case of Burkina-Faso. Pan Afr Med J. 2014; 19: 364.French.
- 344 27. Lensel AS, Lermusiaux NJ. Is knowledge of cardiovascular risk factors better after the
345 occurrence of a major ischemic event? Survey of 135 cases and 260 witnesses. Journal of
346 Vascular Diseases. 2013; 38 (6): p.360-366.French.