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Cardiovascular Risk Factors among Outpatients: An Alarming Sign of the Epidemiological Transition in Developing Country?

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Abstract

Background: Noncommunicable diseases are the leading cause of death in the world and low and middle-income countries suffer from preventable premature death. The aim of this study was to assess the risk factors for noncommunicable disease (NCDs) in general and particular cardiovascular diseases (CVDs) among the outpatients of our department of medicine. **Methods:** We performed a cross-sectional study from April to December 2017 by the consecutive enrollment of outpatients who attended in our department of medicine of Hôpital Sominé DOLO de Mopti, Mali. Clinical and laboratory data were measured for cardiovascular risk assessment. Framingham Risk Score (FRS) and Systemic Coronary Risk Estimation (SCORES) were computed by using Framingham and SCORE equations. Metabolic syndrome was defined using the harmonized criteria from the International Diabetes Federation (IDF) and the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI). Data were captured in excel and analyzed with R version 4.0.3. The statistical significance was set at p = 0.05. **Results:** A total of 292 patients were enrolled in this study. The prevalence of traditional cardiovascular risk factors was 36.64%, 21.57%, 14.04%, and 13.01% for high blood pressure, hyperglycemia, smoking, and alcohol consumption, respectively. The metabolic syndrome accounted for 23.63%. The mean body mass index was 26.10 ± 7 kg/m^2. The overall 10-year risk for cardiovascular events or death was 26.3% and 8.6% according to the FRS and SCORE equation, respectively. The 10-year risk of cardiovascular events according to the FRS was significantly higher in subjects aged 50 and above compared to subjects aged under 50 years, 34.46% vs 13.16%, $p < 0.001$. Likewise, the 10-year risk for cardiovascular death according to SCORE equation was also significantly higher in subjects aged 50 and above compared to subjects under 50 years, 9.43% vs 2.09%, $p = 0.02$. Regarding gender, the FRS was significantly higher in men compared to women 49.50% vs 7.84%, $p < 0.001$. This same trend was observed with the SCORE, 14.67% vs 4.13%, $p = 0.03$. **Conclusion:** Our data corroborate the increasing prevalence of cardiovascular risk factors in SSA. A comprehensive cardiovascular risk factors assessment should be implemented in all stages of health facilities and a longitudinal follow-up could help shed a light on the epidemiology of NCDs in general and particularly CVDs and thereby improve their control policies in SSA.

Keywords

Cardiovascular Risk Factors, Framingham Risk Score, SCORE, Metabolic Syndrome

1. Introduction

Non-communicable diseases (NCDs) are the leading cause of death in the world. It accounts for 71% of the 57 million global deaths. According to the World Health Organization (WHO), every year 16 million people die prematurely between 30 and 69 years of age due to NCDs. In 2016, 78% of all NCDs deaths, and 85% of premature adult NCDs deaths, occurred in low-and middle-income countries (LMICs) which are characterized by poor health systems and less trained or insufficient partitioners. In Mali, NCDs deaths account for 30% of all causes of death, among these cardiovascular death represented 12% [1]. In the face of this alarming global situation, the WHO estimates that if nothing changes in the LMICs, the burden attributable to NCDs would be the US $11.2 billion per year by 2025 far beyond the financial capacity of the health systems of these countries. Given that more than 80% of these premature deaths due to CVD are related to modifiable risk factors [1] and in order to reduce NCDs burden, a number of prevention strategies are taking place. However, a good knowledge of the epidemiology of risk factors is necessary for the informed policies making process. There are some tools that allow estimating the 10-risk of cardiovascular events (fatal or non-fatal coronary artery disease, stroke, peripheral vascular disease, chronic heart failure, heart death), this is the case of the American model Framingham 8 Risk Score (FRS) equation [2] [3]. The European cardiovascular risk assessment tool named Systemic COronary Risk Estimation (SCORE) equation estimates a 10-year risk of cardiovascular death [4] [5]. Metabolic syndrome (MetS) is a cluster of risk factors associated with cardiovascular diseases and diabetes type 2. There are different definitions and criteria for MetS. The first came from WHO, 1998 [6], the second criteria came from the National Cholesterol Education Program Adult Treatment Panel III (NCEP-ATP III) [7] in 2001 and the third criteria came from the International Diabetes Federation (IDF) and the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI) [8]. The AHA/NHLBI slightly modified the NCEP-ATP III criteria but did not mandate abdominal obesity as a required risk factor. According to the AHA/NHLBI recommendation, the cut points of the threshold for waist circumference to define abdominal obesity in people of European origin (Europids) should be ≥102 and ≥88 cm, for men and women, respectively. The remaining 4 risk factors elevated triglyceride (TG), reduced high-density lipoprotein cholesterol (HDL-C), elevated blood pressure, and elevated fasting glucose was similar in definition to those of the IDF [9]. The purpose of this study was to assess cardiovascular risk factors and epidemiological characteristics among outpatients through a comprehensive assessment of in the department of Medicine of Mopti Hospital (HSD-M).

2. Material and Methods

The study was conducted at the department of medicine of HSD-M where outpatients attended. We performed a cross-sectional study by consecutive recruitment from April to November 2017. The inclusion criteria were: adults steady outpatients from 25 to 70 years old, who attend in our department of medicine, and having given their consent by signing an informed consent. The exclusion criteria were: current pregnancy and the presence of unsteady pathologies. The sample size was computed according to the proportion of cardiovascular outpatients in the department of medicine (3.96%). By setting the precision to 5% and the 95% confidence interval (CI) to, the number of outpatient required was 292. Demographic and clinical data: age, years, sex, smoking statute, harmful alcohol consumption, diabetes, height, weight, body mass index (BMI), waist size, hip circumference, systolic and diastolic blood pressure, diastolic blood pressure and use of hypertensive drugs were measured. Blood samples were also collected to measure total cholesterol (TC), HDL-C, low-density lipoprotein cholesterol (LDL-C), TG, creatinine, uric acid, and glucose levels. The abdominal obesity index (AOI) was defined as the ratio of waist circumference to hip circumference. The average atherogenicity index (AI) was defined as the ratio of total cholesterol to HDL-cholesterol. Participants provided written informed consent and the Hospital institutional review board approved this study. Data were captured on Microsoft Excel, then imported and analyzed on Ri386 version 4.0.3. The 10-year cardiovascular risk scores were computed by using Framingham Risk Equation package and SCORE risk were calculated using an online application developed by the corresponding author. FRS equation takes into account age, sex, TC, HDL-C, systolic blood pressure, smoking status, diabetes and hypotensive therapy. FRS was used to stratify patients into 3 categories of risk as follows: FRS ≤ 10%

(low risk), 10 < FRS ≤ 20% (intermediate risk) and FRS > 20% (high risk). The same parameters used for FRS equation calculation were used for SCORE risk equation except of HDL-C, the existence of diabetes, and ages under 45 and over 65. The scores obtained by SCORE risk equation were also used to categorize patients, according to cardiovascular risk: SCORE > 10% (very high risk), 5% ≤ SCORE < 10%) (High risk), 1% < SCORE < 5% (moderate risk) and at the end SCORE < 1% (low risk). MetS was defined using the harmonized criteria from the International Diabetes Federation (IDF) and the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI). Pearson's chi-square or Fisher's exact test was used for the comparison of proportions. The statistical significance level was set in a $p \leq 0.05\%$.

3. Results

A total of 292 patients was collected during this cross sectional study. The prevalence's of traditional risk factors were 14.04% of smokers, 13.01% of harmful alcohol consumption, 23.63% of MetS, 21.57% of hyperglycemia and 36.64% of high blood pressure (**Figure 1**). The average age of our series was 45.7 ± 13.1 years with the limits ranging from 25 to 70 years (**Table 1**). We found an average BMI of 26.1 ± 7 kg/m^2. The BMI varies between 12.1 and 59.2 kg/m^2. The majority of our patients had a normal BMI (18.5 to 25.0), 107 (36.64%). The overweight patients, BMI between 25.0 and 30.0 were 84 (28.77%). Moderate obesity, BMI between 30.0 and 35.0 was present in 40 patients (13.70%) while severe obesity, BMI between 35.0 and 40.0 was 15 (5.14%). Undernutrition, BMI (≤ 16.5) was present in 14 patients (4.79%). The thinness patients, BMI between 16.5 and 18.5 accounted for 20 patients (6.85%) (**Table 2**). The AOI had an average of 0.9 and varied from 0.7 to 1.1. The mean AI was 3.9 and ranged from 1.4 to 14.0. (**Table 1**). The global score of the 10-year risk was 26.3% and 8.6%, according to FRS and SCORE equation, respectively. FRS equation showed that 35.62% of our

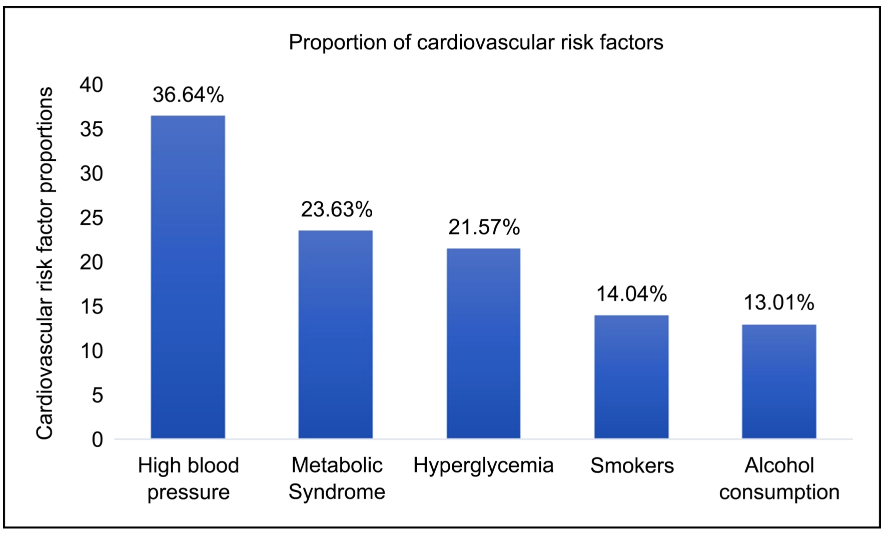

Figure 1. Proportions of cardiovascular risk factors.

patients had a high risk, 23.29% had an intermediate risk and 41.09% had a low risk (Table 3). According to SCORE equation, 16.44% of our patient had very high risk, 19.86% had high risk, 48.63% had moderate risk and 15.07% had low risk (Table 4). The 10-year risk, according to FRS equation was significantly higher in subjects aged 50 years and above compared to subjects aged under 50, 34.46% versus 13.16%, p < 0.001 (Figure 2(a)). Likewise, the 10-year risk, according to SCORE equation was also significantly higher in subjects aged 50 years and above compared to subjects under 50 years, 9.43% versus 2.09%, p = 0.02 (Figure 2(b)). Regarding gender, 10-year risk FRS was significantly higher in men compared to women 49.50% versus 7.84%, p < 0.001 (Figure 2(c)). This same trend was observed with 10-years risk, according to SCORE equation, 14.67% versus 4.13%, p = 0.03 (Figure 2(d)).

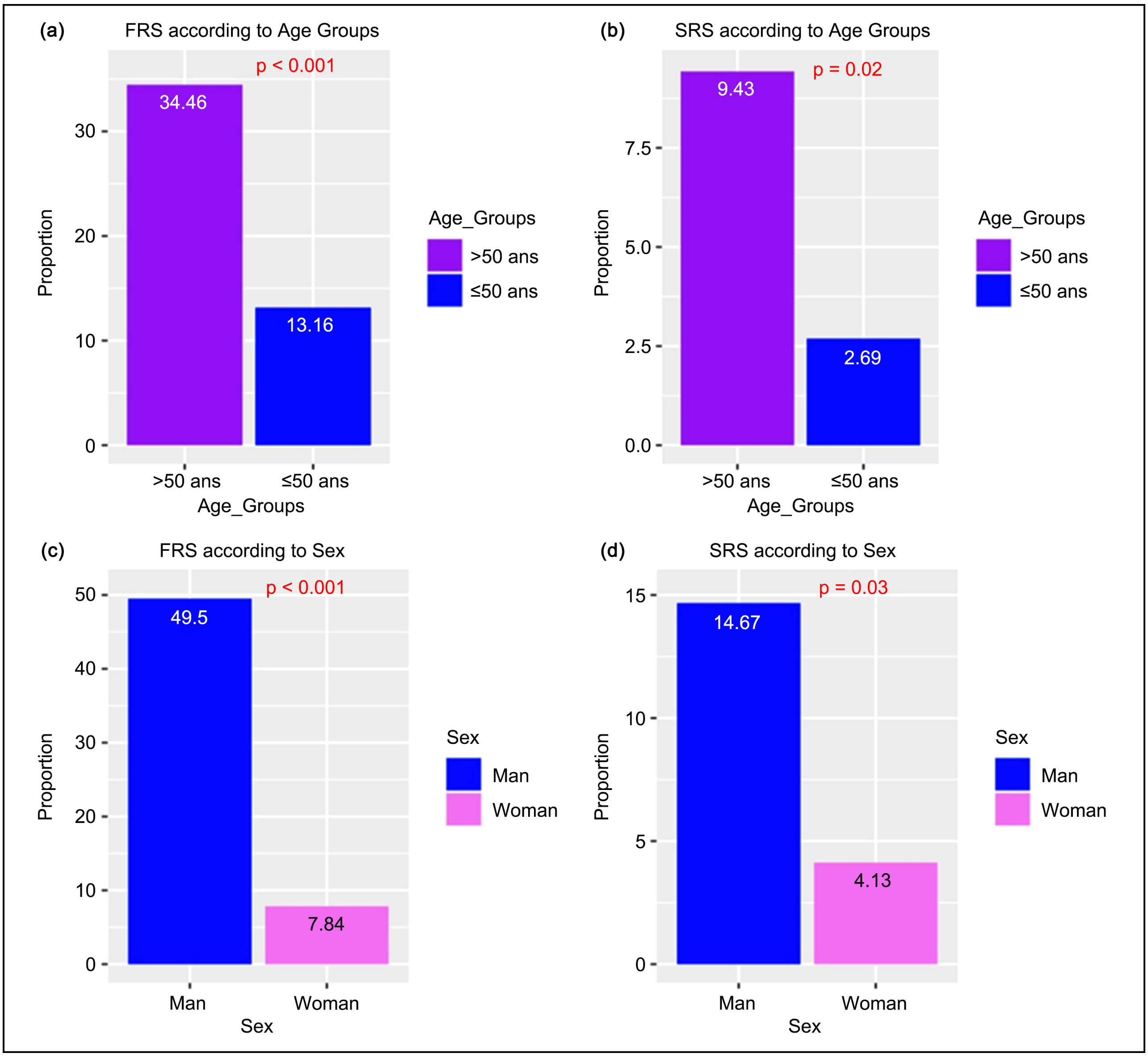

Figure 2. Proportion of Framingham Risk Score (FRS) and SCORE equations to sex and age groups.

Table 1. Descriptive statistics of quantitative variables.

Quantitative variables	Descriptive statistics			
	Minimum	Mean	SD	Maximum
Age (years)	25	45.7	13.1	70
Systole (mmHg)	70	134	27.2	220
Diastole (mmHg)	40	86.8	17.8	200
Cardiac frequency (b/mm)	48	78.4	18.3	142
Body mass index (kg/m^2)	12.1	26.1	7.0	59.2
Waist size (cm)	59	89.8	14.8	161
Hip circumference (cm)	65	100.1	15.0	165
Waist size/Hip circumference	0.7	0.9	0.1	1.1
Total cholesterol (mmol/L)	2.2	4.6	1.2	8.6
Triglycerides (mmol/L)	0.3	1.2	0.7	7.1
HDL cholesterol (mmol/L)	0.3	1.3	0.5	2.6
LDL cholesterol (mmol/L)	0.3	2.7	1.1	6.0
AI (Total-C/HDL-C)	1.4	3.9	1.7	14.0
Glucose (mmol/L)	1.4	6.1	2.8	27.3
Creatinine (µmol/L)	15.0	103.7	156.9	1586.8
Uric acid (µmol/L)	59.5	247.6	120.4	714
hs-CRP (mg/L)	0.4	4.7	5.5	36.7

Table 2. Distribution of patients, according to WHO BMI classification.

BMI classes (Kg/m^2) according to WHO	Body mass index classes proportions	
	N	Percent (%)
Undernutrition (BMI < 16.5)	14	4.79
Thinness (16.5 ≤ BMI < 18.5)	20	6.85
Reference value (18.5 ≤ BMI < 25.0)	107	36.64
Overweight (25.0 ≤ BMI < 30.0)	84	28.77
Moderate obesity (30.0 ≤ BMI < 35.0)	40	13.70
Severe obesity (35.0 ≤ BMI ≤ 40.0)	15	5.14
Massive obesity (BMI > 40)	12	4.11
Total	292	100

Table 3. Distribution of patients, according to 10-year risk of cardiovascular events (FRS).

Framingham Risk Score (FRS)	10-year risk of cardiovascular events	
	N	Percent (%)
Low risk (FRS ≤ 10%)	120	41.09
Intermediate risk (10 < FRS ≤ 20%)	68	23.29
High risk (FRS > 20%)	104	35.62
Total	292	100

Table 4. Distribution of patients, according to 10-year risk of cardiovascular death (SCORE).

SCORE Risk score	10-year risk of cardiovascular death	
	N	Percent (%)
Low risk (SCORE < 1%)	44	15.07
Moderate risk (1% < SCORE < 5%)	142	48.63
High risk (5% ≤ SCORE < 10%)	58	19.86
Very high risk (SCORE > 10%)	48	16.44
Total	292	100

4. Discussion

NCDs are the leading cause of death in the world. The majority of premature deaths, 82%, occurred in low-and middle-income countries [1]. This cross-sectional study aimed to describe the cardiovascular disease risk factors among outpatients by consecutive recruitment from April to November 2017.

A total of 292 outpatients aged 25 to 70 years who attended our department of medicine were enrolled in this study. The sex-ratio was 0.66, in over hand women were mostly represented 176/292 (60.27%). The average age was 45.7 ± 13.1 years with extremes ranging from 25 to 70 years old. These data are in line with those obtained by Yehia BA, *et al.*, 20011 [10] in the survey of the prevalence of cardiovascular disease risk factors in Tlemcen (Algeria) for a sample of 1088 subjects (612 women, 476 men), aged ≥ 25 years (mean age: 42.6 years). Lemma B, *et al.*, 2020 [11] also reported 47 ± 11 years as the mean of patients age and 56.4% of women in a cross-sectional survey was conducted in two referral hospitals in Eastern Ethiopia. The same trend of age median was reported by Maria F, *et al.*, 2019 [12], however, the proportion of male sex 58.3% in this study was in the opposite sense of our sex-ratio. Data about the median age of several cardiovascular risk assessment studies showed that the incidence of cardiovascular diseases over time has been steady or has increased in young adults [13]. The mean BMI was 26.10 ± kg/m^2. This result falls into the interval from 25 to 30 kg/m^2 which belongs to overweight peoples. In fact, only 36.64% patient of our series had a normal BMI (18.5 to 25.0). The remainder, 51.72% were represented by subjects who were overweight or had one of the 3 forms of obesity (moderate, severe, massive). About 11.64% of our patients were thinness or undernutrition condition. Several studies reported the relationship between BMI and CVDs. In fact, in Mali, in a study of hypertension and associated factors in rural and urban areas, Hamidou OB, *et al.*, 2018 [14] showed that the overweight and obese patients were associated with high blood pressure OR = 1.54 (1.04, 2.27), OR = 2.67 (1.64, 4.36), respectively. A Cameroonian series performed by Epacka E, *et al.*, 2011 [15] also reported an average of BMI ≥ 30 kg/m^2. Christopher B, *et al.*, 2015 [16] found that 10.2% of obesity during a cardiovascular risk survey in patients with chronic kidney disease attending a tertiary hospital in Uganda. In a descriptive study of the epidemiology of cardiovascular risk factors and diabetes in Sub-Saharan Africa, George AM, *et al.*, 2013 [17] reported a rising BMI, especially in women in Southern Africa. Across the Atlantic, Peter WF, *et al.*, 2002 [18] in a study of the determinants of cardiovascular risk (CVR) showed that high population attributable risks were related to excess weight (BMI ≥ 25) for the outcomes hypertension (26% men; 28% women), angina pectoris (26% men; 22% women), and coronary heart disease (23% men; 15% women). In the same range, Maria Fedchenko, *et al.*, 2019 [12] found that 48.6% of adult patients with coarctation of the aorta were overweight or obese. The prevalence of smoking among our patients was 14.04%. Our series had more smokers than the prevalence survey of cardiovascular risk factors in the general population in Saint-Louis (Senegal) with a prevalence of 5.8% smokers reported by Pessinaba S, *et al.*, 2013 [19]. Smoking is a well-known and modifiable risk factor for CVDs as reported by many studies [20] [21] [22] [23]. The prevalence of harmful alcohol consumption in our patients was 13.01%. Hamidou OB, *et al.*, 2018 [14] reported 2.6% of alcohol consumption exclusively represented by male sex in their series in the department of cardiology at the teaching hospital Gabriel Touré of Bamako (Mali). The high rate of harmful alcohol consumption in our series could be explained by the fact that Mopti is a crossroads that experience an unprecedented insecurity and armed conflict that could promote harmful alcohol consumption. The mean systolic and diastolic blood pressure in our series were 134.04 and 86.85 mm Hg respectively. The prevalence of high blood pressure (HBP) was 36.64%. Hamidou OB *et al.*, 2018 [14] reported 137 versus 141.16 mm Hg as the mean of systolic blood pressure (SBP) and 69.1% versus 73.1% as the prevalence of hypertension in female and male respectively. HBP was less prevalent in our series than Baldé MD, *et al.*, 2006 [24] series who reported a prevalence of 43.6% of hypertension in an extra-hospital study at Foutah-Djallon in Guinea. Christopher B, *et al.*, 2015 [16] in an assessment of CVR in patients with chronic kidney disease reported 90.0% of hypertension. The prevalence of hyperglycemia was 21.57% in our series. Lower prevalences were reported by Pessinaba S, *et al.*, 2013 [19] who found 10.4% of diabetes in Senegal; Christopher B, *et al.*, 2015

[16] reported 16.1% in their series while Chandrasekhar D, *et al.*, 2015 [25] reported 51.0% diabetic in a population presenting an acute coronary syndrome. Baldé MD, *et al.*, 2006 [24] found a significant difference in the prevalence of diabetes among hypertensive subjects and subject in normotension 5.9% versus 9.65, $p < 0.001$. The global 10-year risk of cardiovascular events (fatal or non-fatal coronary artery disease, stroke, peripheral vascular disease, chronic heart failure and heart death) or cardiovascular death was 26.33% and 8.57% according to FRS and SCORE, respectively. Pessinaba S, *et al.*, 2013 [19] in Senegal in a cross-sectional study in subjects aged 15 years and older reported an overall cardiovascular risk of 24.9% according to the FRS and 6.1% according to the SCORE model. The difference in 10-years FRS score between Pessinaba S, *et al.*, and our series could be explained by the lower limit of age that was 25 years in our series versus 15 years for Pessinaba S. The distribution of our patients, according to the FRS showed that 35.62% were at high risk (FRS > 20%). Patients at intermediate risk (10% < FRS ≤ 20%) represented 23.29% and patients at low risk (FRS ≤ 10%) were 41.09%. Naveen G, *et al.*, 2017 [26] in a study on the comparison of different cardiovascular risk score calculators for cardiovascular risk prediction and guideline recommended statin uses, showed that FRS-CVD risk assessment model has performed the best as it could identify the highest number of patients (51.9%) to be at high CVD risk while WHO and atherosclerotic cardiovascular disease (ASCVD) calculators have performed the worst (only 16.2% and 28.3% respectively were stratified into high CVD risk) considering 20% as cut off for high risk definition. According to the 10-year SCORE assessment, the distribution of our patients was as follows: patients at very high risk were 16.44%, patients at high risk were 19.86%, patients at moderate risk were 48.63% and patients at low risk were 15.07%. Heleniak Z *et al.*, 2018 [27] in an assessment of cardiovascular risk in renal transplant recipients showed that high and very high risk of cardiovascular endpoint according FRS and SCORE scales was found in 10%, and 41% of patients, respectively. After 5 years of follow-up, the prevalence of patients at high and very high risk, according to FRS and SCORE reached 18%, and 45%, respectively. A low prevalence of patients at very high 10-years risk was reported by José LRA *et al.*, 2014 [28] in a cardiovascular risk assessment according to a national calibrated score, risk index in psoriatic arthritis patients without clinically evident cardiovascular disease or classic atherosclerosis risk factors 11%. The risk scores must be interpreted according to the population and the clinical setting because of the disparity between geographical areas. Because of the discrepancies of FRS, SCORE algorithm was developed in Europe to take into account geographic disparities. SCORE does not assess the overall 10-year risk of coronary events like Framingham but the 10-year risk of cardiovascular death. SCORE algorithm takes into account the same risk factors as Framingham (except HDL-C level, existence of diabetes and ages under 45 and over 65 years) [4] [5]. Moreover, beyond traditional CVDs 10-years risk assessment tools, there are new imaging technology and biomark-

ers that could significantly improve discriminatory value of FRS and SCORE by providing cardiovascular risk reclassification or informed therapeutic policies. Among these, we can cite the coronary artery calcium (CAC) Udo H, *et al.*, 2016 [29], Congying X *et al.*, 2020 [30], the deep "omics" studies, Charlotte A *et al.*, 2019 [31] and the high sensitivity-C-reactive protein (*hs*-CRP) Peter WF *et al.*, 2008 [32] and José LRA *et al.*, 2014 [28]. According to the sex, the 10-year risk scores were significantly higher in men than women, 49.54% versus 7.84%, $p < 0.001$ and 14.67% versus 4.13% $p = 0.03$ for FRS and SCORE, respectively. Our results are in line with Eleazar E, *et al.*, 2020 [23] who reported that patients at FRS high risk account for 46% versus 15% and at SCORE high risk were 32.4% versus 11.8% for men and women, respectively. In contrast, Karice K Hyun, *et al.*, 2019 [33] in a meta-analysis study reported that the CVD risk score and risk factors were similar in women and men and the pooled, adjusted likelihood of having the risk score were comparable between women and men: OR (95% CI): 0.87 (0.70, 1.07); 1.41 (0.89, 2.25); and 1.15 (0.82, 1.60), respectively. The debate on the differences between men and women in terms of cardiovascular risk prediction still drives ongoing research. Some authors have reported that women under the age of 50 years were less likely to experience myocardial infarction compared to men of the same age, but after menopause, the incidence in women reach almost the same proportion of men, suggesting that estrogen could play a cardioprotective role but results from randomized clinical trials challenge this hypothesis according to Gretchen LW *et al.*, 2016 [34]. The 10-year risk scores increased with age in our series. In fact, we found significant differences between subjects aged 50 years and above compared to those under 50 years, 34.46% versus 13.16%, $p < 0.001$ and 9.43% versus 2.69%, $p = 0.02$ for FRS and SCORE, respectively. These results are in line with those obtained by the Framingham and MONICA studies, which showed that the risk of coronary heart disease increased markedly with age Charlotte A *et al.*, 2019 [31], Gostynski M, *et al.*, 2004 [35]. Grzegorz G, *et al.*, 2020 [22] reported that in the subgroup aged 50 years and above, high and very high cardiovascular risk scores were observed in almost one-third of Polish soldiers and moderate or high risk score was found in younger subgroups.

One of the limitations of this study is the lack of cardiovascular risk assessment tool adapted to the Sub Saharan African population. It is known that Framingham risk score and SCORE risk developed for American et European populations do not express cardiovascular risk in the same pattern when used in other populations [36] [37] [38]. The second is that our data are intra-hospital, it will be interesting to perform a comprehensive assessment of NCDs at the community level. The third is that although our work take into account cross-sectional data in analyses, it did not tease apart the relative impact of the baseline of risk factor in predicting future CVD risk in a longitudinal study like Framingham heart study and SCORE study. So there is a need for longitudinal studies in Sub Saharan African in order to develop informed policies adapted to the geographic and behavioral disparities, linked to this population as coined by previous authors [31] [36]. Moreover, in 2007 the WHO and the International Society of Hypertension (ISH) published the WHO/ISH CVD risk charts for all WHO epidemiological sub-regions of the world. These charts are to be used as part of the WHO's Package of Essential NCD (PEN) Interventions for Primary Health Care in Low-Resource Settings in jurisdictions that do not have their own population-derived risk assessment algorithms [39]. However, our study could help the comparison between different populations or could help the calibration of assessment tools.

Community-level assessment of cardiovascular risk factors and the longitudinal studies are needed for a better understanding of the epidemiology of cardiovascular risk factors in order to refine informed prevention and therapeutic policies.

5. Conclusion

Our data corroborate the increasing prevalence of cardiovascular risk factors in SSA. A comprehensive cardiovascular risk factor assessment should be implemented in all stages of health facilities and a longitudinal follow-up could help shed a light on the epidemiology of NCDs in general and particularly CVDs and thereby improve their control policies in SSA.

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Statement of Informed Consent

Each participant gave fully informed written consent prior to enrollment. The protocol was reviewed and approved by the Mopti hospital scientific committee.

Disclosure of Conflict of Interest

The authors certify that there is no actual or potential conflict of interest in relation to this article.

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