

Research Article

Differences in the Cardiovascular Risk Assessment in Cardiology Outpatients in Mali: Comparison between Framingham Body Mass Index-Based Tool and Low-Information World Health Organization Chart

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Objective. This study aimed to compare 2 laborless tools, namely, the body mass index-based Framingham (bmi-Frm) and low-information WHO- (li-WHO-) based risk scores, and assess their agreement in outpatients in a cardiology department. **Methodology.** Data stem from a cross-sectional previous study performed from May to September 2016 in the Cardiology Department of University Hospital Gabriel Touré (UH-GT) in Bamako. All patients aged 40 and more were included in the study allowing the assessment of bmi-Frm and li-WHO prediction charts. The cardiovascular risk (CVR) was evaluated using a calculator prepared by D'Agostino et al. for the bmi-Frm and the li-WHO chart for the Afro-D region of the WHO. The risk score for both ranged from <10 to ≥40. The data were entered in an ACCESS 2010 database, then processed by MS Excel 2010, and finally analysed using IBM SPSS Statistics 20. Continuous variables were presented as means and standard deviations, and categorical variables were presented as frequencies with percentages. $P < 0.05$ was considered the statistical significance level. After sample description, the risk score was assessed using bmi-Frm and li-WHO prediction tools. Finally, a kappa test was performed to check for the interreliability of both methods. For weighted kappa, coefficients were given all five classes of risk groups in 0, 25 steps from 1 for total concordance to 0 for total discordance. **Results.** This study involved 793 outpatients, 63.7% being female, 35.1% of them younger than 50 years, 57.9% with no formal education, and 67.7% with no medical insurance. Means for age, body mass index (BMI), and systolic blood pressure (SBP) were, respectively, 53.81 ± 16.729 years, 25.29 ± 06.151 kg/m², and 139.49 ± 27.110 mm Hg. Using the li-WHO prediction chart gives a much higher proportion of low-risk patients compared to bmi-Frm (83.6 vs. 37.7). Sociodemographic characteristics such as education or income level were not different in risk score neither for the bmi-Frm nor for the li-WHO risk score. The percentage of agreement between both tools was 40.4%, and agreement (kappa of 0.1 and weighted kappa of 0.2) was found to be slight. **Conclusion.** Using the bmi-Frm and li-WHO tool gives a similar risk estimation in younger female patients. Older patients must be evaluated using high-information tools with cholesterol, e.g., versions of the Framingham risk equation or WHO using cholesterol. These must be confirmed in further studies and compared to data from prospective studies

1. Introduction

Cardiovascular diseases (CVD) are the number one cause of death worldwide with 17.9 million deaths in 2016 and made 31% of all causes of death mainly in low- and middle-income countries (LMIC) [1]. Furthermore, high-income countries (HIC) experience a heavy burden of CVD [2] and therefore underlying cardiovascular risk factors. CVD remain a major cause of health loss in all regions of the world [3]. Actions are therefore necessary and some of them easy to implement [4], already in childhood [5] and through implementing cost-effective population-wide strategies [6].

In Africa, particularly in sub-Saharan countries like most LMIC, there is a shift with regression of infectious diseases and increase of noncommunicable diseases [7]. Our country like most LMIC has a high burden of cardiovascular diseases due to the high prevalence of cardiovascular risk factors [8–12], low-level knowledge and awareness, and also a perception of cardiovascular diseases and their risk factors [13].

As treatment cost remains unaffordable for most people in LMIC, prevention is particularly important for chronic diseases such CVD. WHO-PEN strategy adopted by many countries and intervention trials could lead to a decrease of the burden of CVD [14–16].

To allow the prevention of CVD, tools for risk score assessment have been developed for decades, and most of them for HIC [17] and with challenges [18]. One of the most known is the Framingham risk score (FRS) which has the advantage of a published equation allowing an automatic calculation. Only one tool can be considered worldwide, namely, the prediction tool provided by the World Organization of Health and International Society of Hypertension (WHO/ISH) for all WHO 14 subregions [19].

Opposed to the WHO/ISH prediction chart [20], FRS has been used for various populations [21–24].

Since laboratory tests are expensive, laborless tools such as these 2 cited above are the main tools which can be easily used for the prevention and management of patients with cardiovascular diseases and risk factors. Despite the fact that these tools are essential, data on their use and results are scarce.

To fill this lack of publication and guide their use, this study was performed, aiming to compare 2 laborless tools, namely, the body mass index-based Framingham (bmi-Frm) and low-information WHO- (li-WHO-) based risk scores, and assess their agreement in outpatients in a cardiology department.

2. Methods

Data for this study stem from a cross-sectional one carried out from May to September 2016 in the Cardiology Department of University Hospital Gabriel Touré (UH-GT) in

Bamako. We selected patients aged 40 and more with available data allowing FRS estimating.

2.1. Sampling and Data Collection. We included all patients who came to visit during the study time since the required data are already part of the usual clinical exam.

A minimal size of 384 patients was needed for the study using the following formula: $n = z^2 \times p(1-p)/m^2$. This was obtained with a P value set at 0.5, a confidence interval of 95%, z of 1.96, and a margin error of 5%.

Briefly, all patients underwent history taking and complete clinical examination with measures of weight, height, blood pressure, waist, and hip circumference.

Data were first collected using a questionnaire and then inserted in a MS Access database built for this purpose.

2.2. Definition of Terms

- (i) Height and weight were measured using a rigid stadiometer and digital balance, respectively. Readings were recorded to the nearest centimetre and the nearest kg, with participants being weighted and measured without shoes and only light clothed.
- (ii) Body mass index (BMI) was derived from weight and height as $\text{weight (kg)}/\text{height}^2 (\text{m}^2)$
- (iii) Hip circumference (HC) was measured around the widest portion of the buttock whereas waist circumference (WC) was measured with a non-stretchable tape over the light-clothed abdomen at the narrowest point between the lowest rib and the iliac crest. The waist-to-hip ratio (WHR) was WC divided by HC.
- (iv) Income level was based on a multiple of the minimum obligatory salary (MOS) (actually 40 000 FCFA or 71, 5 USD) from 1 to 4 MOS.
- (v) Education level was assessed in terms of years attending in school with four levels defined as follows:
 - (vi) None: no school attending
 - (vii) Primary school: 1 to 6 years
 - (viii) High school: 7 to 12 years
 - (ix) University: 12 years or more
- (x) Blood pressure has been measured using a CONTEC 08A electronic sphygmomanometer allowing the assessment of mean arterial pressure from systolic blood pressure (SBP) and diastolic blood pressure (DBP) by adding to the DBP a third of the differential pressure.

2.3. Risk Assessment. The cardiovascular risk (CVR) was evaluated using a calculator prepared by D'Agostino et al. [15] and the cholesterol-free WHO prediction chart for the Afro-D region. For both, risk assessment was from <10 to ≥ 40 .

2.4. Data Analysis. The data were first exported from the ACCESS database to MS Excel and finally analysed using IBM SPSS Statistics 20. Continuous variables are presented as means and standard deviations, and categorical variables are presented as frequencies with percentages. $P < 0.05$ was considered the statistical significance level.

After sample description, the risk score was assessed using bmi-Frm and li-WHO prediction tools. Finally, a kappa test was performed to check for the interreliability of both methods. For weighted kappa, coefficients were given all five classes of risk groups in 0, 25 steps from 1 for total concordance to 0 for total discordance.

2.5. Ethical Approval. The study as part of a thesis for the medical student has been approved by the institutional board of the UH-GT.

2.6. Results. The study involved 793 outpatients, 63.7% (505) being female and 35.1% (278) younger than 50 years. Most patients had no formal education (57.9%) and no medical insurance (67.7%). More than half of the patients did not give an income level, and the remaining 12.9% and 13.9% had income levels of 1 and 4, respectively (Table 1).

Using both tools, patients with a risk < 10 were highly represented in different proportions with 83.5% for li-WHO and 37.7% for bmi-Frm prediction (Figure 1).

3. Sociodemographic Characteristics and Risk Scores (Table 3)

3.1. With bmi-Frm Tool. Patients without medical insurance had 43.2% versus 26.2% for those with medical insurance in the lowest risk group and 15.5% versus 21.9% in the highest risk group. The proportion of patients decreased from < 10 to $30 - < 40$ and increased in the highest risk score (≥ 40) for both patients with and without medical insurance ($P < 0.001$).

Female patients had 49.1% in the lowest group and 7, 9% in the highest versus, respectively, 17.7% and 34.4% for male patients ($P < 0.001$).

There was a clear trend in the lowest and highest age groups with a decrease of the proportion of patients from 86.0% (< 10) to 0.0% (≥ 40) for the age group 40–49 and opposite behaviour for patients ≥ 70 with 1.4% (< 10) to 17.5% (≥ 40) ($P < 0.001$).

Education level and income level showed no statistical difference according to the risk score with respective P values of 0.944 and 0.175.

3.2. With li-WHO Tool. Female and male patients showed the highest proportion of risk group < 10 with, respectively, 86.7% and 78.7%.

The low-risk group < 10 was the most important but in decreasing proportions with increasing age.

As for bmi-Frm, education and income level showed no statistical difference according to the risk score (P values of 0.624 and 0.569, respectively).

TABLE 1: Sociodemographic characteristics of the sample of 793 patients in the CVR assessment study.

Variables	N	%	
Sex	M	288	36.3
	F	505	63.7
Age group (years)	<40–49	278	35.1
	50–59	169	21.3
	60–69	203	25.6
	≥ 70	143	18.0
Education level (school years)	None	459	57.9
	Primary	157	19.8
	High school	111	14.0
	University	066	08.3
Medical insurance	No	537	67.7
	Yes	256	32.3
Income level (in multiple of MOS*)	NA	435	54.9
	1	102	12.9
	2	057	07.2
	3	089	11.2
	4	110	13.9

*Minimal obligatory salary. Means for age, BMI, and SBP were, respectively, 53.81 ± 16.729 years, 25.29 ± 06.151 kg/m², and 139.49 ± 27.110 mm Hg (Table 2).

TABLE 2: Means for anthropometric and pressure values in the sample of 793 patients in the CVR assessment study.

	Mean	Min-max	SD
Age (years)	53.81	16–96	16.729
Weight (kg)	68.43	29–137	16.564
Height (cm)	164.60	143–187	08.057
BMI* (kg/m ²)	25.29	11.9–50.3	06.151
WC** (775)	88.49	50–138	14.024
HC*** cm (633)	96.17	55–190	14.049
WHR**** (632)	0.92	0.47–1.23	0.069
HR+/min (685)	83.24	43–180	16.067
SBP++ mm Hg	139.49	76–230	27.110
DBP+++ mm Hg	87.18	30–163	14.926
MBP- mm Hg	104.58	65–117	17.780
PP-- mm Hg	52.32	10–120	18.029

*Body mass index. **Waist circumference.*** Hip circumference. ****Waist-to-hip ratio. +Heart rate. ++Systolic blood pressure. +++Diastolic blood pressure. -Mean blood pressure. --Pulsed pressure.

4. Agreement

The percentage of agreement was 40.4% (321/793) and the kappa value was 0, 1 meaning slight agreement. The weighted kappa of 0, 2 revealed light improvement of agreement (Table 4).

4.1. Agreement Status and Sociodemographic Characteristics (Table 5). There was significantly more agreement among female patients (52.5%) versus 19.4% for male patients ($P < 0.001$). The agreement rate decreased significantly with increasing age from 87.4% for patients under 50 years to 04.9% for those older than 70 years ($P < 0.001$).

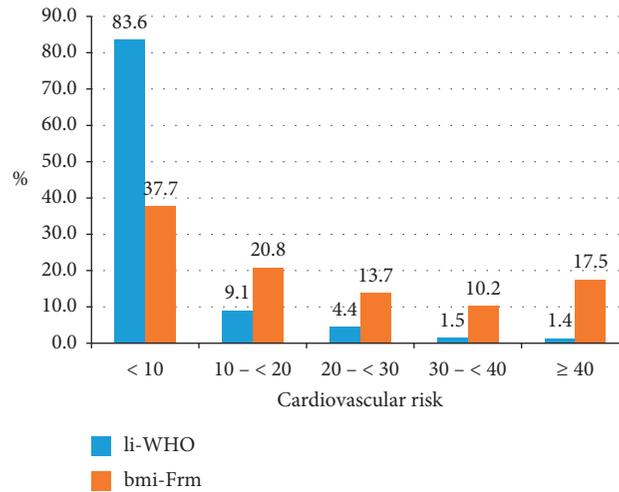


FIGURE 1: Body mass index-based Framingham and low-information WHO-based cardiovascular risk scores in the sample of 793 patients.

TABLE 3: bmi-based Framingham risk and low-information WHO risk prediction according to various sociodemographic characters.

Sociodemographic characters	P value	
	bmi-frm	li-WHO
Medical insurance	<0.001	0.792
Sex	<0.001	<0.001
Age group (years)	<0.001	<0.001
Education level	0.944	0.624
Income level	0.175	0.569

TABLE 4: Agreement between bmi-Frm and li-WHO-based prediction tool in a sample of 793 consecutive outpatients in the cardiology unit of the UH-GT.

	bmi-frm					Total
	<10	10-<20	20-<30	30-<40	≥40	
li-WHO < 10	295	156	99	59	54	663
li-WHO 10- < 20	4	9	6	12	41	72
li-WHO 20- < 30	0	0	4	8	23	35
li-WHO 30- < 40	0	0	0	2	10	12
li-WHO ≥ = 40	0	0	0	0	11	11
Total	299	165	109	81	139	793

Patients without medical insurance showed more agreement with 46% versus 28.9% for those with medical insurance ($P < 0.001$).

We noticed no difference in agreement related to neither education level nor income level.

5. Discussion

To the best of our knowledge, this study is the first to use FRS in the Malian population in a relatively large sample of 793 outpatients seen consecutively. As lipid test is costly, we presented data for the bmi-version of the FRS [25] and the li-WHO risk score.

As can be read from Figure 1, the proportion of low-risk patients is very low compared to that of the laborless version of the WHO/ISH (Afro-D region). Clearly, the WHO/ISH prediction chart detected a few high-risk patients whereas FRS found about 10 times more high-risk subjects.

Similar African studies using WHO risk score found more low-risk patients in 87.7% for only women [26], 94.5% of slum residents [27], 76.9% of civil servants [28], and 87.6% among adults [29].

In our study, there was no significant difference regarding education level or income level as opposed to data from other LMIC countries like Iran [22] or Tunisia [30] in

TABLE 5: Distribution of characteristics according to agreement status of 793 patients in the cardiology unit of the UH-GT.

Variables		Agreement		P
		No (%)	Yes (%)	
Sex	M	232 (80.6)	056 (19.4)	<0.001
	F	240 (47.5)	265 (52.5)	
Age group (years)	40–49	035 (12.6)	243 (87.4)	<0.001
	50–59	121 (71.6)	048 (28.4)	
	60–69	180 (88.7)	023 (11.3)	
	≥70	136 (95.1)	007 (04.9)	
Education level (school years)	None	280 (61.0)	179 (39.0)	0.648
	Primary	089 (56.7)	068 (43.3)	
	High school	067 (60.4)	044 (39.6)	
	University	036 (54.5)	030 (45.5)	
Medical insurance	No	290 (54.0)	247 (46.0)	<0.001
	Yes	182 (71.1)	074 (28.9)	
Income level (in multiple of MOS*)	NA	259 (59.5)	176 (40.5)	0.888
	1	057 (55.9)	045 (44.1)	
	2	033 (57.9)	024 (42.1)	
	3	056 (62.9)	033 (37.1)	
	4	067 (60.9)	043 (39.1)	

selected population studies with men and socially disadvantaged subjects showing a higher risk.

African data are contrasting with no difference using Framingham models for Ahmed et al. [31] and limited interchangeability of Framingham laboratory and non-laboratory tools for Boateng et al. [32]. Both studies involved the same populations in different locations, Somalis for the first and Ghanaians for the latter.

Increasing age is known to be associated with cardiovascular risk factors (CVrf) and therefore cardiovascular events [33]. Thus, Borhanuddin et al. found a higher risk score for male subjects [34]. Female sex was also found to have a lower risk of cardiovascular events [35]. This is certainly explainable by the presence of more risk factors among males.

As per name, CVrf are associated with an increase of the global risk. This fact is known for decades in quantitative estimating by some authors [36]. It is also not surprising that the pressure values and level of risk are directly related as shown in Table 4. Advancing age has been found with increased prevalence of hypertension in Africa [37].

It is also established that anthropometric characteristics are related to cardiovascular risk. This is the case for WC [37, 38] and WHR [39] and explains our findings shown in Table 3.

Blood pressure is strongly related to cardiovascular risk. Several studies brought insights into the role of hypertension in the development of CVD [33, 40]. Blood pressure gradation was used in treatment [41] with our data showing a direct increase of the mean pressure values with increasing risk level.

As our study is the first of its kind, some questions remain unanswered and should be addressed in further studies.

First, this finding needs to be confirmed using a larger sample size. Some authors [42] pointed out a temporal trend in the performance of the FRS, with others recognizing the need for a model of 10-year absolute CVD risk based on a

long-term cohort study for a country-based or ethnicity-based CVD.

Country-based or ethnicity-based CVD risk-prediction models are needed because of substantial variations in the four main contributors to CVD risk assessment in predictive models (mean CVD risk, mean levels of major risk factors, relative risk of a risk factor, and epidemiology of CHD and stroke) among different countries or ethnic groups [21]. Besides classic models with traditional CVrf, the prediction model with lifestyle factors showed an improvement of the predictive ability for cardiovascular death [43]. All these fields are to be explored based on local data.

The main problems will be certainly financial issues as large sample size studies need substantial budgets.

Female patients, those younger than 50, had significantly more agreement; this could mean that there is more agreement in patients with low risk. It is known that female patients especially before menopause had a lower risk than male patients. It is also known that the risk of cardiovascular diseases increases with age.

In this study, patients without medical insurance had a greater agreement. An explanation could be found in the proportion (not showed) of patients with medical insurance in the age groups of 50–59 and 60–69 with 35.5% and 47.3%, respectively.

Education level and income level showed no relationship in this study.

6. Limits

Income level could not be fully studied as data for most patients were not available.

7. Conclusion

Using bmi-Frm and li-WHO tool gives similar risk estimation in younger female patients. Older patients must be

evaluated using high-information tools with cholesterol, e.g., versions of the Framingham risk equation or WHO cholesterol. These data must be confirmed in further studies and compared to data from prospective studies.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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