

## ORIGINAL ARTICLE

## Cardiovascular Risk Estimation by the ASCVD Risk Estimator Application in a University Hospital

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### Abstract

**Background:** Cardiovascular diseases (CVDs) are responsible for many deaths in Brazil and in the world, especially in the economically active population. Risk factors for these diseases include comorbidities such as high blood pressure (HBP), diabetes mellitus (DM) and dyslipidemia. Innovation of portable technology combined with the high prevalence of CVDs motivated the development of the ASCVD Risk Estimator by the American Heart Association / American College of Cardiology.

**Objectives:** Estimate the cardiovascular risk of patients hospitalized in the internal medicine wards of Gaffrée e Guinle University Hospital (HUGG) using the ASCVD Risk Estimator, and describe the main risk factors in this population.

**Methods:** A prospective, cross-sectional study was conducted, the following data were collected from the medical records: sex, age, ethnicity, presence of HBP, DM, systolic arterial pressure, smoking habits, total cholesterol and HDL levels. Statistical analysis was performed by the chi-square test, with calculation of p-value, relative risk and confidence interval in the correlations.

**Results:** A total of 339 medical records were reviewed, and 72 (21.2%) fulfilled the inclusion and exclusion criteria. Twenty-three (32%) patients were classified as at high cardiovascular risk by the application. The main risk factors in the high risk group were age greater than or equal to 60 years (n = 21; 91.30%), dyslipidemia (n = 15; 65.2%), high blood pressure (n = 15; 65.2%), male sex (n = 13; n = 56.5%) and smoking (n = 11; 47.8%).

**Conclusion:** Approximately one third of the study population had a high cardiovascular risk; HBP and dyslipidemia were the most prevalent modifiable risk factor in the high risk group. We may say that there is no single protocol or score available able to estimate the cardiovascular risk of all individuals in the same way, and therefore, the physician must individually evaluate the patients and be updated on the best methods of disease prevention to improve current approaches. (Int J Cardiovasc Sci. 2018;31(5)492-498)

**Keywords:** Cardiovascular diseases, Technology, Risk Factors.

### Introduction

Cardiovascular diseases (CVDs) account for more than 308,000 deaths a year from acute myocardial infarction (AMI) and stroke.<sup>1</sup> Because of the high frequency of these conditions, Brazil is among the ten countries with the greatest number of deaths caused by CVDs.<sup>1,2</sup> Half of these deaths in Brazil involve adults aged 30-69 years, i.e., in the productive period of life.<sup>3</sup>

The most common non-communicable diseases, such as high blood pressure (HBP), type 2 diabetes mellitus (DM) and dyslipidemia have many risk factors in common and, for this reason, the World Health Organization (WHO) proposes an integrated preventive and control approach based on reduction of blood pressure (BP), smoking habits, alcohol consumption, sedentary lifestyle, unhealthy diet, obesity and hypercholesterolemia.<sup>2,3</sup>

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Several risk scores and algorithms have been developed to estimate the severity of CVD, such as the Framingham score. This instrument estimates the 10-year risk of AMI or death for coronary disease in individuals with no history of clinical atherosclerosis and identifies those at high and low risk.<sup>4,5</sup>

With the development of portable technology and new mobile phone apps, combined with the increase in information access, the ASCVD Risk Estimator was created. This instrument follows the American Heart Association and American College of Cardiology (AHA/ACC) guideline (2013) on the assessment of cardiovascular risk and the 2013 ACC/AHA Cardiovascular Risk Guideline on the treatment of dyslipidemia to reduce the cardiovascular risk in adults.<sup>6,7</sup>

Considering the relevance of the prevention of CVD risk factors and high rates of mortality, this study aimed to evaluate cardiovascular risk in patients hospitalized in the internal medicine wards of Gaffrée e Guinle University Hospital (HUGG) using the ASCVD Risk Estimator, classify them into high, moderate and high risk, as well as identify associated (modifiable and non-modifiable) risk factors.

## Methods

This was an observational, prospective, cross-sectional study conducted at the HUGG from March 2015 to January 2016.

Eligible patients were aged between 40 and 79 of both sexes, hospitalized in the internal medicine wards of the HUGG, with their hospital admission report attached to the medical record, and laboratory blood test results including lipid profile before admission or from 2 to 5 days of hospitalization.

Patients admitted for cardiovascular conditions such as AMI, ischemic or hemorrhagic stroke, and thromboembolism and its complications, patients with total cholesterol lower than 130 mg/dL and HDL lower than 20 mg/dL (due to the score calculation restrictions), and patients with LDL higher than 190 mg/dL and previously diagnosed atherosclerotic disease (due to the high / confirmed risk of atherosclerotic disease) were excluded.

All inclusion and exclusion criteria followed the ASCVD Risk Estimator recommendations for estimation of the 10-year risk.

Patients' medical records were examined during the 11-month period of the study. The variables necessary for risk estimation were collected – age, sex, race/ethnicity,

chronic diseases (DM and HBP) being treated, systolic BP (SBP) at admission, smoking habits, total and HDL cholesterol levels, cause of admission, weight and height, regularly used medications for DM and HBP, and family history (FamH) of CVD. Data collection was started after ethical approval was obtained in *Plataforma Brasil*, the national integrated database of study projects involving human beings.

Weekly visits were made to the internal medicine wards for review of the medical records. Data were weekly recorded and updated in Excel spreadsheets, separated by ward. The number of individuals who were not included in the study was added to the total number of admissions and the reason for exclusion registered for further analysis.

For risk classification, each patient's data were entered in the fields of the ASCVD Risk Estimator (Figure 1). Patients were considered at high risk if they had an estimated 10-year risk  $\geq 20\%$ , at moderate risk if they had an estimated 10-year risk  $> 10\%$  and  $< 20\%$ , and at low risk if they had an estimated 10-year risk  $\leq 10\%$ , following the AHA/ACC criteria. Patients were considered hypertensive and diabetic if they were under medication for these conditions, and dyslipidemic if they showed LDL levels  $> 160$  mg/dL and/or HDL  $< 40$  mg/dL.

During this analysis, we also identified the main factor that may be related to high risk, including sex, age, comorbidities (HBP, DM, dyslipidemia), smoking, FamH of CVD. Patient's 10-year risk with optimal risk factors was also calculated; these factors included total cholesterol values of 170 mg/dL, HDL of 50 mg/dL and SBP of 110 mmHg in non-hypertensive patients, non-diabetic patients and non-smokers.

Results are expressed as absolute values and percentages. Statistical analysis was performed by chi-square test using the GraphPad InStat 3 software; p-value, relative risk and confidence interval were analyzed.

The study received no external funding.

## Results

A total of 339 medical records were reviewed in the period from March 2015 to January 2016; 267 (78.8%) were excluded considering the inclusion and exclusion criteria (Graph 1).

Seventy-two patients were included, 35 men and 37 women. Thirty-five patients were aged between 40 and 59 years and 37 between 60 and 79 years.

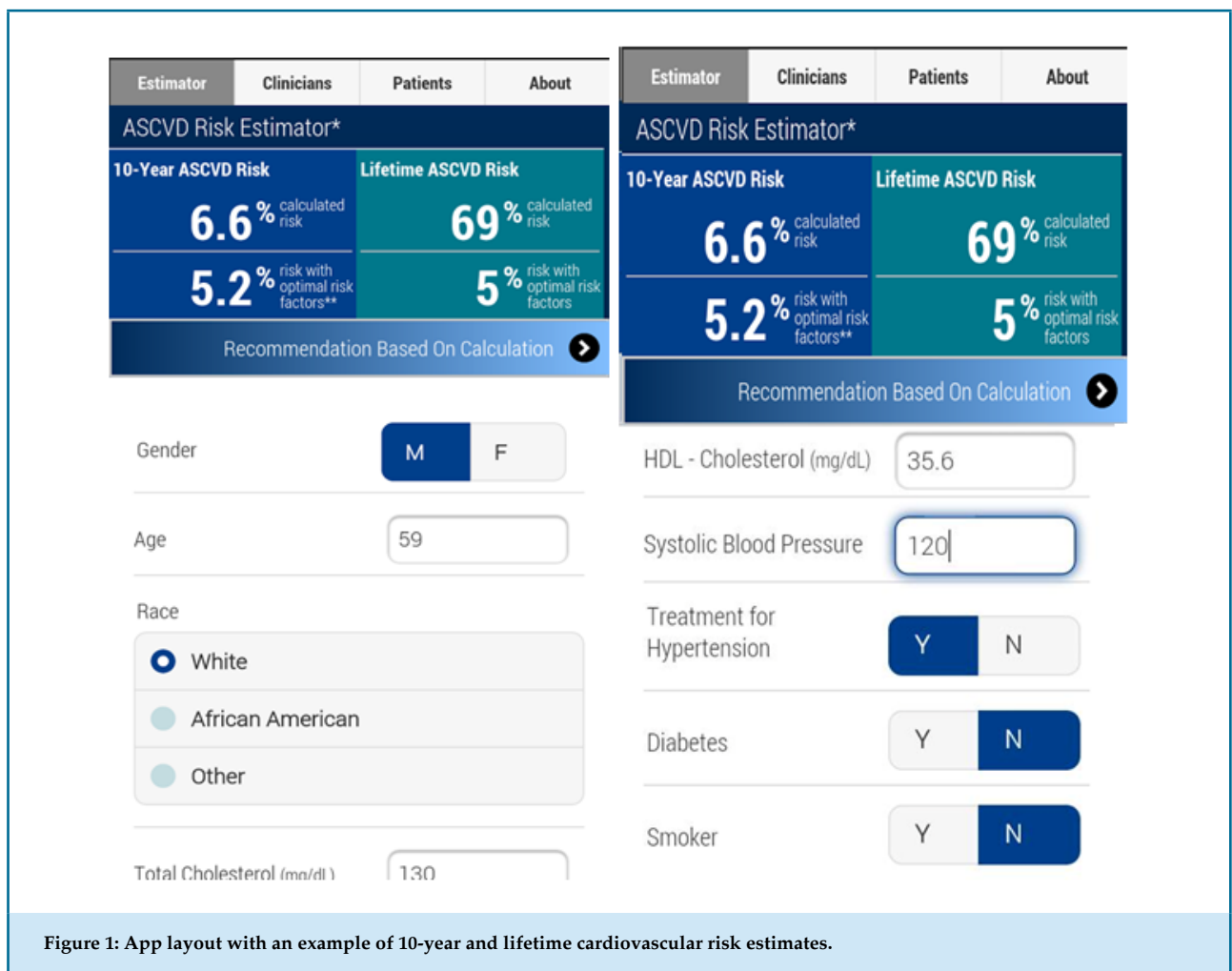


Figure 1: App layout with an example of 10-year and lifetime cardiovascular risk estimates.

With respect to related risk factors, there were 41 dyslipidemic, 39 hypertensive, 27 non-smoking and 21 diabetic patients. Data from the hospital admission report revealed that 26 patients had a FamH of CVD, including AMI, ischemic or hemorrhagic stroke, thromboembolism or sudden death; 19 did not have a family history of CVD; 28 did not know or this information was missing in the report (Table 1).

Estimation of the 10-year risk score using the ASCVD Risk Estimator showed that 32% of patients were at high risk ( $n = 23$ ), 26% at moderate risk ( $n = 19$ ) and 42% at low risk ( $n = 30$ ) (Graph 2).

Table 2 describes percentages, relative risk (odds ratio – OR) and confidence interval obtained in the between-group comparisons (chi-square test).

Considering the optimal risk factors defined by the ASCVD Risk Estimator, 52% ( $n = 12$ ) of patients at high risk and 84% ( $n = 16$ ) of patients at moderate risk had a risk lower than 10% with optimal risk factors.

## Discussion

The ASCVD Risk Estimator, developed by the AHA/ACC in 2013 grounded in the Framingham study,<sup>8,9</sup> evaluates the variables sex, age, ethnicity, total cholesterol and HDL levels, SBP, HBP and DM and smoking habits for the estimation of the 10-year cardiovascular risk.<sup>8</sup> Although the risk score proposed by the 2013 AHA/ACC Guideline<sup>7</sup> considered several groups and large populations, only AMI (fatal and non-fatal) and stroke were considered CVDs.<sup>7</sup>

Approximately 90% of patients with CVDs have at least one related risk factor.<sup>10</sup> In addition to the risk factors described in the Framingham study, other risk factors include obesity, alcohol consumption, stress, depression, low intake of vegetables and fruits, and irregular or no physical activity.<sup>10</sup> Also, some studies have correlated inflammatory markers, e.g. C-reactive protein and homocysteine with the incidence of cardiovascular events and cardiovascular risk prediction.<sup>11</sup>

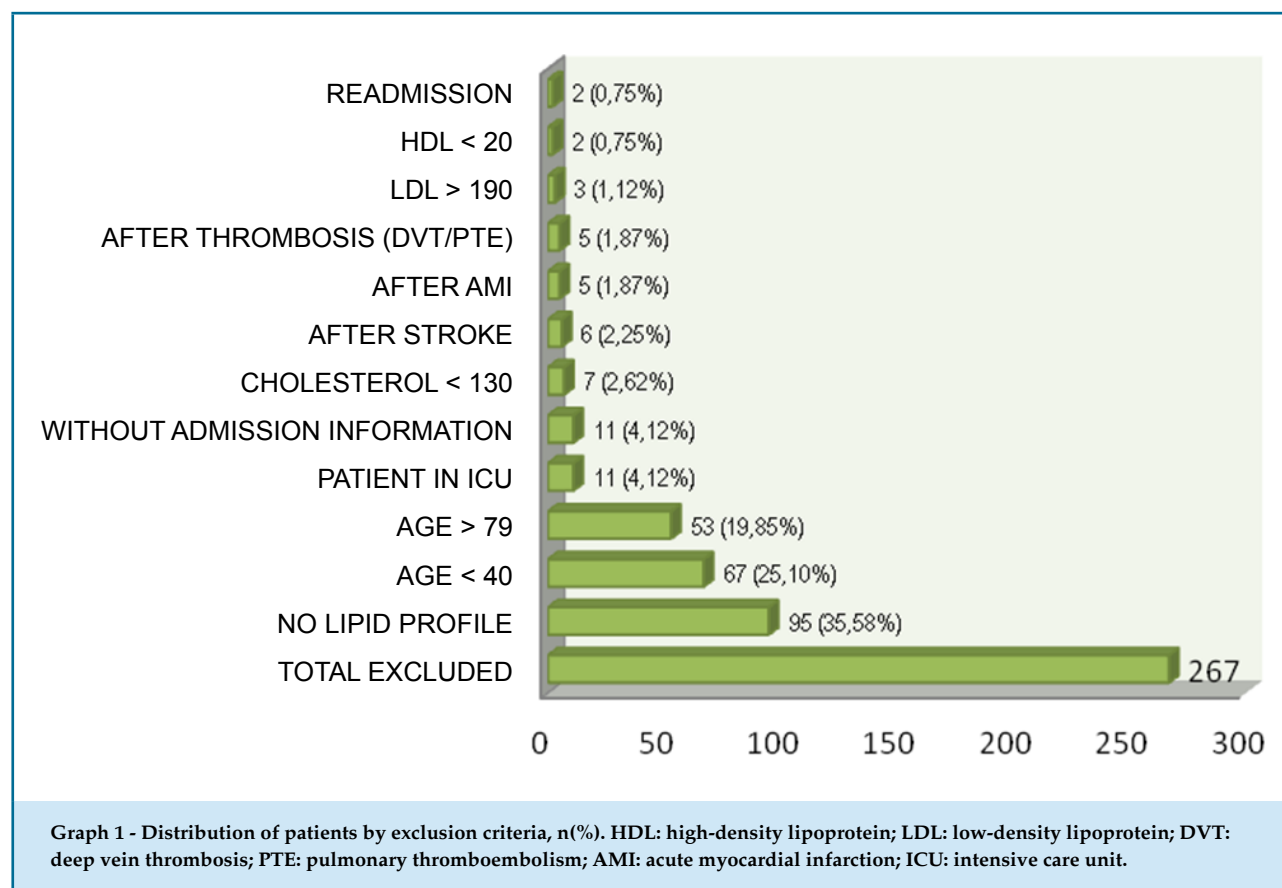


Table 1 - Characteristics of the study population				
Variables (%)	Total of patients (n = 72)	Men (n = 35)	Women (n = 37)	p value
Non-modifiable risk factors				
Age ≥ 60 years	51%	51%	51%	1.00
Age < 60 years	49%	49%	49%	1.00
Family history +	36%	29%	43%	0.039
DM	29%	23%	35%	0.061
Modifiable risk factors				
HBP	54%	37%	70%	0.00003
DLP	56%	69%	43%	0.00021
Smoking	38%	46%	30%	0.0197

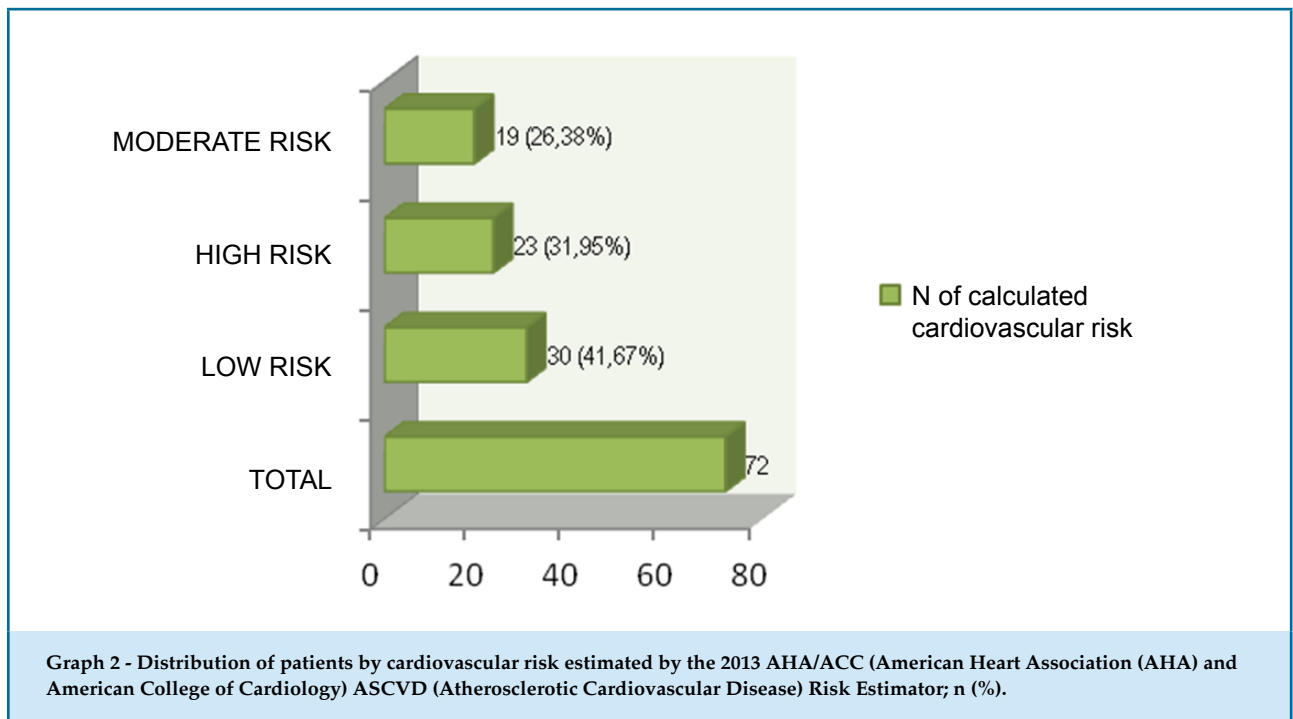
DM: diabetes mellitus; HBP: high blood pressure; DLP: dyslipidemia.

Family history has been considered and independent risk factor, especially if observed in first degree relatives aged younger than 55 years for men and 65 years for

women.<sup>12</sup> This factor, alone, increases cardiovascular risk by 40-60%.<sup>13</sup> In our study, however, we found no significant difference between the groups in the risk related to this variable.

Our findings were different from the statistics of the prevalence of risk factors in the Brazilian population described in a previous publication (VIGITEL)<sup>14</sup>. This may be explained by the lower number of participants and their characteristics – we included only hospitalized patients, who might be at considerable risk already.

In a study conducted in a family health center in Alagoas, the Framingham score was used to stratify 127 patients according to their cardiovascular risk; 11% of these patients were considered at high risk. Regarding the risk factors, 6.3% were smokers, 48.8% hypertensive, 19.7% diabetic and 43.1% dyslipidemic.<sup>15</sup> Another study carried out in a cardiology outpatient center of a university hospital in Porto Alegre showed that 36.5% of the patients had a moderate or high cardiovascular risk, and 83.8% of them were hypertensive, 30.7% diabetic and 26.4% dyslipidemic; 12% were smokers, and 86.8% of them had a FamH of CVD.<sup>16</sup> In addition, in a descriptive study performed at the cardiology



**Table 2 - Comparisons between the groups with high, moderate and low cardiovascular risk**

Variables (%)	High risk (n = 23)	Moderate risk (n = 19)	Low risk (n = 30)	CI	OR	p value
Non-modifiable risk factors						
Male sex	57%	63%	33%	1.274	0.9203 – 1.762	0.1777
Age ≥ 60 years	91%	63%	17%	7.628	3.999 – 14.549	< 0.0001
Age < 60 years	9%	37%	83%	0.1311	0.0687 – 0.2501	< 0.0001
DM	39%	37%	17%	1.423	1.035 – 1.957	0.0466
Family history +	35%	37%	37%	0.9435	0.6736 – 1.322	0.7994
Modifiable risk factors						
HBP	65%	68%	37%	1.420	1.009 – 1.999	0.0479
DLP	65%	47%	53%	1.519	1.079 – 2.140	0.0143
Smoking	48%	37%	30%	1.485	1.083 – 2.037	0.0169

CI: confidence interval; OR: odds ratio; DM: diabetes mellitus; HBP: high blood pressure; DLP: dyslipidemia.

outpatient department of Goiânia Emergency Hospital, 103 medical records of hypertensive patients were reviewed, and a frequency of 11% of dyslipidemic patients, 9% of diabetic, 8% of smokers, and 20% of patients with a FamH of CVD were reported. This illustrates the important association of the risk factors for the development of CVDs.<sup>17</sup>

Our study population were aged 43 years or more, with a maximum age of 79 years and median of 60 years. Among patients with a high cardiovascular risk, age ranged from 57 to 79 years (median 68 years). We found significantly relevant correlations of a high cardiovascular risk with age > 60 years and < 60 years, DM, HBP, dyslipidemia and smoking. Age

between 60 and 79 years was classified as a risk index, whereas age < 60 years as a protective index for CVDs for the development of CVD. The other factors (male and FamH of CVD) showed no statistically relevant correlations or confidence interval that indicate them as risk index for CVDs.

Our sample showed similar sex and age distribution between men and women, and a high prevalence of HBP in women and dyslipidemia in men. In the high risk group, age  $\geq$  60 years was the most prevalent risk factor, which is in accordance with the higher incidence of cardiovascular events at this age range in the Brazilian population.

The present study had some limitations in the collection of other data that would enable a better comparison of risk factors that were not analyzed in the ASCVD Risk Estimator, but were included in other risk score estimators, such as obesity and FamH of CVD.

A critical point of the ASCVD Risk Estimator is the ethnic definition for the 10-year risk calculation. This instrument considers two possible ethnicities for a reliable calculation – white and Afro-American. In case the answer “others” is chosen, a warning pops-up on the app screen saying that the estimated risks may be underestimated in American-Indian populations, and over- or underestimated in Asian- and Hispanic- and Americans.<sup>8</sup> Considering miscegenation in Brazil, and the difficulty in stratifying the population in white and non-white only, estimation of cardiovascular risk by the ASCVD Risk Estimator may be over- or underestimated. Although this does not nullify the usefulness of the instrument in the Brazilian population, caution is needed in interpreting these results and in individualized assessment of patients, since the Framingham score has not been validated in Brazil.

In addition to the 10-year risk and lifetime risk, the ASCVD risk estimator app also estimates these risks in patients with optimal risk factors, that is, patients with optimal values and conditions of the variables analyzed. This additional tool is of great value for the analysis of modifiable risk factors and their impact on final risk score. The present study showed that 52.2% of patients with a 10-year risk  $\geq$  20% had a risk < 10% with optimal risk factors, i.e., those classified as high cardiovascular risk by the 10-year risk estimation would have a low risk if they had well-controlled comorbidities including HBP, DM, dyslipidemia, reinforcing the importance of prevention and control of modifiable risk factors.

Investments on programs of control of chronic diseases, promotion of physical activity and balanced diet, and anti-smoking campaigns highlighting the risks for developing CVDs associated with smoking could contribute to reduce the number of individuals classified as high cardiovascular risk and prevent cardiovascular events.

## Conclusions

We concluded that patients with high cardiovascular risk represented approximately one third of the study population; age greater than or equal to 60 years was the main non-modifiable risk factor, and HBP and dyslipidemia were the most prevalent modifiable risk factor in the high risk group.

Also, this study evaluated the risk in patients with optimal risk factors and found that more than half of these patients would be classified as low risk, reinforcing the importance of the control of modifiable risk factors for the prevention of CVDs.

We still don't have a single protocol or score able to estimate the cardiovascular risk of all individuals in the same way, or that encompasses all risk factors involved in the pathophysiology of CVDs. Therefore, the physician must perform an individualized evaluation of patients and be updated on the best methods of disease prevention to improve current approaches.

## Author contributions

Conception and design of the research: Azevedo TA, Nucera APCS, Moreira MLV. Acquisition of data: Azevedo TA. Analysis and interpretation of the data: Azevedo TA, Nucera APCS, Moreira MLV. Statistical analysis: Azevedo TA, Nucera APCS, Moreira MLV. Writing of the manuscript: Azevedo TA, Nucera APCS, Moreira MLV. Critical revision of the manuscript for intellectual content: Azevedo TA, Nucera APCS.

## Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

## Sources of Funding

There were no external funding sources for this study.

## Study Association

This study is not associated with any thesis or dissertation work.

## Ethics approval and consent to participate

This article does not contain any studies with human participants or animals performed by any of the authors.

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