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# Agreement between cardiovascular risk calculators in hypertensive patients

*Concordância de calculadoras de risco cardiovascular em hipertensos*

*Concordancia entre calculadoras de riesgo cardiovascular en pacientes hipertensos*

## ABSTRACT

**Objective:** To compare the agreement between cardiovascular risk stratification tools applied to non-diabetic hypertensive patients. **Methods:** This is an observational, cross-sectional, quantitative, and retrospective study based on document review. Cohen's Kappa coefficient was used to assess agreement between the scores proposed by the hypertension guidelines of the municipality of Fortaleza and those of the Brazilian Society of Cardiology. **Results:** The weighted Kappa was 0.437, indicating moderate agreement between the calculators. The municipal instrument tended to classify a greater number of individuals as very high risk, possibly due to the inclusion of variables not considered by the Brazilian Society of Cardiology tool. **Conclusion:** These findings highlight the need to develop and validate regional protocols that consider the specific characteristics of the local population.

**Keywords:** *Cross-sectional Studies; Primary Health Care; Risk Assessment; Heart Disease Risk Factors; Hypertension.*

## RESUMO

**Objetivo:** Comparar a concordância entre as ferramentas de estratificação do risco cardiovascular aplicadas a pacientes hipertensos não diabéticos. **Métodos:** Trata-se de estudo observacional, transversal, quantitativo e retrospectivo, baseado em revisão documental. Utilizou-se o coeficiente Kappa de Cohen para análise de concordância entre os escores propostos pelas diretrizes de hipertensão do município de Fortaleza e da Sociedade Brasileira de Cardiologia. **Resultados:** O Kappa ponderado foi de 0,437, indicando concordância moderada entre as calculadoras. Observou-se

tendência do instrumento municipal em classificar maior número de indivíduos como de muito alto risco, possivelmente pela inclusão de variáveis não contempladas pela Sociedade Brasileira de Cardiologia. **Conclusão:** Os achados reforçam a necessidade de desenvolvimento e validação de protocolos regionais, considerando as especificidades da população local.

**Palavras-chave:** *Estudos Transversais; Atenção Primária à Saúde; Medição de Risco; Fatores de Risco de Doenças Cardíacas; Hipertensão.*

## RESUMEN

**Objetivo:** Comparar la concordancia entre las herramientas de estratificación del riesgo cardiovascular aplicadas a pacientes hipertensos no diabéticos. **Métodos:** Se trata de un estudio observacional, transversal, cuantitativo y retrospectivo, basado en revisión documental. Se utilizó el coeficiente Kappa de Cohen para evaluar la concordancia entre los puntajes propuestos por las directrices de hipertensión del municipio de Fortaleza y de la Sociedad Brasileña de Cardiología. **Resultados:** El Kappa ponderado fue de 0,437, indicando concordancia moderada entre las calculadoras. Se observó una tendencia del instrumento municipal a clasificar a un mayor número de individuos como de muy alto riesgo, posiblemente debido a la inclusión de variables no consideradas por la herramienta de la Sociedad Brasileña de Cardiología. **Conclusión:** Estos hallazgos resaltan la necesidad de desarrollar y validar protocolos regionales que consideren las características específicas de la población local.

**Descriptores:** *Estudios Transversales; Atención Primaria de Salud; Medición de Riesgo; Factores de Riesgo de Enfermedad Cardíaca; Hipertensión.*

## INTRODUCTION

Blood pressure control is one of the most essential and best-regulated physiological functions in the human body, aiming to maintain adequate flow to vital organs and ensure the homeostasis necessary to sustain life. According to Porth and Matfin<sup>1</sup>, Blood Pressure (BP) is a dynamic variable whose fluctuations occur throughout the day, adjusting to different daily conditions and factors. When pressure levels remain persistently elevated, exceeding preset limits for a given population, Systemic Arterial Hypertension (SAH) is characterized, a chronic non-communicable disease (NCD), associated with environmental, socioeconomic, and genetic factors, and with high morbidity and mortality.<sup>2</sup>

According to the Global Report on Hypertension<sup>3</sup>, about 33% of the world population between 30 and 79 years of age has SAH, and more than 10 million annual deaths are attributed to complications arising from clinical decompensations associated with this pathology. In Brazil, in 2019, the prevalence of SAH in the same age group was 45%, surpassing the global average. In addition, the 2023 Telephone Survey of Risk and Protective Factors for Chronic Diseases (VIGITEL) indicated a prevalence of 27.9% of SAH in Brazilian state capitals, with the highest rate among women (29.3%). At the same time, the same study pointed out that Fortaleza presented a prevalence of (24.8%; 95%CI 20.9 - 28.6), ranking seventh when compared to the Northeastern capitals, ahead of only Teresina (23.8%; 95%CI 20.1 - 27.5) and São Luís (19.2%; 95%CI 15.7 - 22.7).<sup>4</sup>

Although SAH generally does not manifest symptoms in the early stages, its progression without appropriate treatment can lead to serious consequences, causing damage to the structure and functioning of vital organs. Thus, hypertension is one of the main risk factors for the development of cardiovascular diseases (CVD), such as heart failure, stroke (cerebrovascular accident, CVA), and chronic kidney disease (CKD).<sup>2</sup>

Given the high prevalence of SAH and its close relationship with mortality and disability associated with CVD, in 2013, with the objective of meeting the World Health Organization (WHO) proposal to reduce cardiovascular mortality, the Brazilian Society of Cardiology (BSC) published the I Brazilian Guideline for Cardiovascular Prevention (I BSC Guideline), which guides the systematic estimation of the CVR of hypertensive patients throughout the country. This calculation is defined as the estimation of the risk of developing acute cardiovascular events within 10 years.<sup>5</sup>

Also in this document, the BSC adopted the global risk score (GRS), an instrument developed by the Framingham study, as the main tool for this objective.<sup>6</sup> The GRS classifies individuals into low (GRS < 5% in men and women), intermediate (GRS 5 to < 20% in men, GRS 5 to < 10% in women, patients with diabetes without subclinical atherosclerotic disease or risk stratifiers), high

(GRS > 20% in men, GRS > 10% in women, subclinical atherosclerosis, abdominal aortic aneurysm, chronic kidney disease, elevated low-density lipoprotein – LDL - cholesterol), and very high risk (significant coronary, cerebrovascular, or peripheral vascular atherosclerosis, with more than 50% obstruction, whether or not presenting clinical symptoms).<sup>5</sup>

In addition to this instrument, there are several other validated ones, including the Reynolds Risk Score (RRS), Systematic Coronary Risk Estimation (SCORE), QRISK3, and HEARTS. According to Malta and collaborators<sup>7</sup>, although most calculators use similar risk factors (such as gender, age, ethnicity, socioeconomic conditions, and prevalence of diseases), the particularities of each population may lead to differences in the weights assigned to the factors and in the outcomes obtained.

In 2016, only three years after the publication of the I BSC Guideline, the Municipal Health Department of Fortaleza launched the Clinical Guidelines: Hypertension, a document that directs the multidisciplinary care of hypertensive patients throughout the municipality. One of the objectives of the document is the strengthening of actions related to the risk stratification of these patients. The instrument set forth in this guideline was attached to the electronic medical record used in primary health care (PHC) in Fortaleza (FastMedic®), quickly accessible to all professionals.<sup>8</sup>

Despite the availability of different tools for cardiovascular risk stratification, it is still not sufficiently clarified whether the instruments used in Fortaleza's PHC produce equivalent classifications in hypertensive patients. As these tools incorporate distinct variables and criteria, the same patient may be placed in different risk categories, with possible repercussions on the preventive conduct adopted. In this context, evaluating the agreement between the instruments is relevant to qualify clinical decision-making and contribute to the development of protocols appropriate to the characteristics of the local population. Thus, this study aimed to compare the agreement between the cardiovascular risk stratification tools applied to non-diabetic hypertensive patients.

## METHODS

This is an observational, cross-sectional, quantitative, retrospective, and documentary study, carried out through the review of medical records of patients with SAH, in the absence of diabetes mellitus (DM), followed at the João Hipólito Primary Health Care Unit (PHCU), located in the Dias Macedo neighborhood, in the capital of Ceará.

Patients aged 30 years or older were included (since the BSC instrument uses this as the minimum age for CVR stratification) and with a diagnosis of SAH. Those who presented systolic blood pressure (SBP)  $\geq 140$  mmHg and/or diastolic blood pressure  $\geq 90$  mmHg, in two different measurements at the office, were considered hypertensive.<sup>2</sup>

Patients with a concomitant diagnosis of DM were excluded (since, according to the Fortaleza guidelines, these should be stratified by the CVR calculator for diabetics<sup>9</sup>); those whose hypertension diagnosis recorded in FastMedic® could not be confirmed; and patients with insufficient information for the application of the two stratification instruments.

The eligible population consisted of 1,157 patients with SAH, without DM, and aged 30 years or older, registered in the FastMedic® system in the territory of the João Hipólito PHCU. From this total, 293 medical records were randomly selected. The sample size was determined by sample calculation for finite populations.<sup>10</sup>

Data collection took place between November and December 2023, through obtaining clinical and laboratory information recorded in FastMedic®. The following variables were analyzed: sex, age, smoking, statin use, family history of premature atherosclerosis, body mass index (BMI), SBP, DBP, total cholesterol, LDL-cholesterol, HDL-cholesterol, triglycerides, fasting glucose, and cardiovascular risk category assigned by each instrument. For the descriptive analysis, patients with a BMI between 25 and 29.9 kg/m<sup>2</sup> were considered overweight, those with a BMI  $\geq 30$  kg/m<sup>2</sup> were considered obese, and those with SBP  $\geq 180$  mmHg and/or DBP  $\geq 110$  mmHg were considered to have stage III SAH.<sup>2</sup>

For the stratification proposed by the 2019 Updated Cardiovascular Prevention Guideline of the Brazilian Society of Cardiology, the GRS was calculated from the variables sex, age, HDL-cholesterol, total cholesterol, treated systolic blood pressure, smoking, and presence of diabetes mellitus. As the study population was composed exclusively of non-diabetic hypertensive patients under treatment, systolic blood pressure was considered treated in all calculations, while the diabetes mellitus variable was absent. In patients using statins, the correction factor provided by the guideline was applied to total cholesterol.<sup>5</sup>

In the instrument of the Clinical Guidelines: Hypertension of the municipality of Fortaleza, the classification was determined by the blood pressure stage and by the presence and quantity of cardiovascular risk factors. Among the criteria considered by the instrument, the following were used in this study: sex, age, smoking, triglycerides, LDL-cholesterol, HDL-cholesterol, family history of premature cardiovascular disease, fasting glucose, and obesity defined by the body mass index. The presence of diabetes mellitus was not considered, due to the exclusion criteria adopted.<sup>8</sup>

Each patient had their cardiovascular risk classified as low, intermediate, high, or very high by the calculator proposed in the Update of the Cardiovascular Prevention Guideline of the BSC<sup>5</sup> and by the instrument present in the Clinical Guidelines: Hypertension of the municipality of Fortaleza.<sup>8</sup>

The data were tabulated and analyzed in the Statistical Package for the Social Sciences (SPSS), version 30. In the descriptive analysis, quantitative variables were presented through means and standard deviations, while

categorical variables were presented through absolute and relative frequencies. To evaluate the agreement between the risk categories assigned by the two instruments, the weighted Cohen's Kappa coefficient was used. The values were interpreted as follows: values  $\leq 0$  indicated agreement by chance; between 0.01 and 0.20, slight agreement; between 0.21 and 0.40, fair; between 0.41 and 0.60, moderate; between 0.61 and 0.80, substantial; and between 0.81 and 1.00, almost perfect.<sup>11-14</sup>

The project was approved by the Research Ethics Committee of the Centro Universitário Christus, linked to the CEP/CONEP system, under Opinion no. 6,556,289 and CAAE no. 75802523.3.0000.5049, in accordance with CNS Resolution no. 466/2012. Data collection was started only after ethical approval.

## RESULTS

The sample was composed of 293 individuals. Of this total, 192 people (65.5%) were female and 101 (34.5%) were male. The sample was divided into three age groups, of which the most expressive was that of individuals aged 65 years or older, corresponding to 35.5% (104); followed by the age group between 55 and 64 years, with 33.1% (97); and lastly individuals under 55 years, with 31.4% (92). The minimum age was 32 years and the maximum 97 years, with a mean of 59.9 (SD = 12.7) (Tables 1 and 2).

**Table 1** – Clinical-laboratory profile of non-diabetic hypertensive patients treated at a Primary Health Care Unit in Fortaleza, Ceará.

| Quantitative Variables   | Mean  | Standard Deviation |
|--------------------------|-------|--------------------|
| Age (years)              | 59.9  | 12.7               |
| BMI (kg/m <sup>2</sup> ) | 29.4  | 6.35               |
| SBP (mmHg)               | 137.0 | 19.0               |
| DBP (mmHg)               | 82.0  | 12.3               |
| LDL-cholesterol (mg/dL)  | 110.9 | 40.66              |
| HDL-cholesterol (mg/dL)  | 45.5  | 10.66              |
| Triglycerides (mg/dL)    | 169.8 | 102.73             |
| Fasting Glucose (mg/dL)  | 94.8  | 11.25              |

**Source:** Own authorship. **Note:** LDL = Low-density lipoprotein; HDL = High-density lipoprotein; BMI = Body mass index; SBP = Systolic blood pressure; DBP = Diastolic blood pressure.

Of the patients evaluated, 118 (40.3%) were classified, at the time, as obese and 105 (35.8%) as overweight. During the analysis, 17 (5.8%) individuals were found with pressure values consistent with stage III SAH.

The lipid profile presented by the study participants was composed of hypertriglyceridemia (triglycerides > 150 mg/dl) 46.1% (135); total cholesterol greater than or equal to 200 mg/dl 61.8% (181); LDL - cholesterol between 101 - 189 mg/dl 52.2% (153); and LDL - cholesterol greater than or equal to 190 mg/dl 4.8% (14). Seventy-nine (27%) participants were identified with fasting glucose

(FG) in the pre-diabetes stage (between 100 and 125 mg/dL) and three (1%) with FG above 125 mg/dL (Table 1).

Regarding the clinical-epidemiological variables, 29 (9.9%) participants were smokers, 128 (43.7%) used statins, and eight (2.7%) had a family history of premature atherosclerosis (Table 2).

**Table 2** – Clinical-epidemiological profile of non-diabetic hypertensive patients treated at a Primary Health Care Unit in Fortaleza, Ceará.

| <b>Variáveis Categóricas</b> | <b>n</b>        | <b>%</b> |
|------------------------------|-----------------|----------|
| <b>Categorical Variables</b> | <b>Quantity</b> | <b>%</b> |
| Sex                          |                 |          |
| Male                         | 101             | 34.5     |
| Female                       | 192             | 65.5     |
| Smoking                      |                 |          |
| Yes                          | 29              | 9.9      |
| No                           | 264             | 90.1     |
| Statin Use                   |                 |          |
| Yes                          | 128             | 43.7     |
| No                           | 165             | 56.3     |

**Source:** Own authorship.

When performing the cross-analysis between the variables Cardiovascular risk stratification of the Brazilian Society of Cardiology and Cardiovascular risk stratification of the Municipal Health Department of Fortaleza, correspondence was observed only in the classification of 190 individuals, of whom one was stratified as low risk, 34 as intermediate risk, 129 as high risk, and 26 as very high risk. Through the congruence analysis between the two stratification instruments, a weighted Kappa result (with linear weights) of 0.437 was observed, evidencing a moderate agreement between the two calculators (Table 3).

**Table 3** – Agreement between the cardiovascular risk stratification tools.

| <b>Resultado da comparação</b> | <b>n</b> | <b>%</b> |
|--------------------------------|----------|----------|
| <b>Comparison result</b>       | <b>n</b> | <b>%</b> |
| Agreement in low risk          | 1        | 0.3      |
| Agreement in intermediate risk | 34       | 11.6     |
| Agreement in high risk         | 129      | 44.0     |
| Agreement in very high risk    | 26       | 8.9      |
| Total agreement                | 190      | 64.8     |

**Source:** Own authorship.

## DISCUSSION

The congruence analysis between the two scores, performed through the Kappa index, resulted in moderate compatibility. Garcia and collaborators<sup>12</sup> found similar information, with the same study model, but conducted at the outpatient level, in the South of the country. In this research, Garcia and collaborators evaluated the uniformity of the Framingham score (FS) with the

QRISK-2, a score originating in the United Kingdom, which uses information from databases fed by medical consultations carried out within the scope of that country's National Health Service, reaching a Kappa value of 0.519, that is, moderate congruence.

Andrade and collaborators<sup>15</sup>, in 2024, evaluated the symmetry between the FS and the HEARTS program calculator (a version that employs BMI instead of laboratory data) in PHC patients, in the city of São João del-Rei, Minas Gerais, with less encouraging results. Unlike Garcia and collaborators, Andrade and collaborators found a Kappa evidencing minimal agreement between the scales (0.06), a fact that allows for the possibility of different and, therefore, questionable clinical conducts. This makes us think that, although HEARTS constitutes an excellent proposal for an instrument aimed at PHC, due to the possibility of stratification in the absence of laboratory tests, which are often unavailable in some contexts, the minimal agreement limits its application, a factor that evidences the need for validation of this tool in the Brazilian territory.

The score proposed by the Municipal Health Department of Fortaleza, like the GRS, uses information on cardiovascular risk factors (CVRF), target-organ damage (TOD), and associated clinical conditions (ACC). However, it values pressure levels more emphatically, especially in the case of stage III SAH (SBP  $\geq$  180 mmHg and/or DBP  $\geq$  110 mmHg). In addition, it includes BMI, abdominal circumference values, LDL-cholesterol (LDL), and triglycerides, data that are not included in the BSC calculator. It is therefore understood that this calculator has more factors that can be used to make up the very high risk stage, a fact that may justify the difference between the frequency of individuals classified in this level of stratification: 44 individuals by the Clinical Guidelines: Hypertension of Fortaleza instrument and 26 individuals by the GRS used by the BSC; in addition to the difference in the number of patients with high risk, with 163 patients by the calculator of the capital of Ceará and 183 by the BSC tool.

As in large-scale studies, internal validation of this instrument was performed by network professionals linked to primary care (generalist professionals, focal and non-focal specialists) and external validation by representatives of the Ceará regional branches of the Brazilian medical societies of cardiology and endocrinology, in addition to representatives of the local universities. This fact, although it does not guarantee total representativeness of the population of Fortaleza, makes this instrument closer to the local reality.<sup>8</sup>

The differences observed between the instruments must also be interpreted considering the period of elaboration and the updates of the respective guidelines. In 2019, the BSC published an update of the guideline cited here, incorporating new data and advances in scientific knowledge, such as the inclusion of the glomerular filtration rate (GFR) in the calculation of cardiovascular risk, information on subclinical atherosclerosis, and the identification of the clinical manifestations of CVD.<sup>5</sup> It is worth noting that some of the data cited were already present in the Fortaleza guideline since 2016.<sup>8</sup>

The results found in this research are similar to studies of a national nature, with an epidemiological design presenting a higher prevalence of people over 60 years of age and female individuals. In a study conducted in the PHC of the state of Paraná<sup>16</sup> on the analysis of CVR stratification in hypertensive patients, a population mostly composed of older adults was also observed. According to Cesário and collaborators<sup>17</sup>, this is justified by the national demographic trend of aging, a factor that would also justify the greater presence of high and very high CVR strata, since age is a non-modifiable risk factor. The greater demand for and use of health services by women were also observed by Cobo and collaborators.<sup>18</sup>

Finally, it is important to emphasize that CVR stratification has as one of its main purposes the identification of patients who benefit from non-pharmacological and pharmacological measures in the primary and secondary prevention of atherosclerotic disease, especially the use of statins. Such medications make up the cardiovascular prevention measures and contribute to the control of the morbidity and mortality associated with cardiovascular diseases.<sup>5</sup>

This study presents as limitations the retrospective and documentary design, subject to the availability and quality of the information recorded in the medical records, and its conduction in a single PHCU, which limits the generalization of the results to other populations. In addition, cardiovascular outcomes over time were not evaluated, so the agreement analysis does not allow determining which of the instruments presents greater predictive capacity.

## FINAL CONSIDERATIONS

The comparison between the cardiovascular risk stratification instruments in this study demonstrated moderate agreement between the Brazilian Society of Cardiology algorithm—used nationwide—and the protocol developed for the municipality of Fortaleza, which was the central focus of this study. The instrument of the Municipal Health Department of Fortaleza showed a greater tendency to classify individuals as being at very high risk because it includes parameters that differ from those used in the BSC stratification.

These divergences may lead to different therapeutic approaches, particularly regarding the indication and prescription of statins for the primary and secondary prevention of cardiovascular diseases. Therefore, it is important to encourage the development and validation of regional protocols that address the specific characteristics of the local population.

Cardiovascular risk stratification is a fundamental tool in Family and Community Medicine and in the monitoring of individuals within the territory, as it enables the identification of vulnerable groups eligible for health promotion and disease prevention actions, thereby optimizing resource management in Primary Health Care.

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#### Author Contributions

**Project administration:** HPL; **Formal analysis:** ACSS, LAAHS, HPL; **Conceptualization:** HPL; **Data curation:** HPL; **Investigation:** ACSS, LAAHS, HPL; **Methodology:** HPL; **Writing – review and editing:** ACSS, LAAHS, HPL; **Writing – original draft:** ACSS, LAAHS; **Supervision:** HPL.

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