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Original Article

Cardiovascular risk assessment in hypertensive patients

Elaine Amaral de Paula[1]
Rogério Baumgratz de Paula[2]
Darcília Maria Nagen da Costa[3]
Fernando Antonio Basile Colugnati[4]
Elenir Pereira de Paiva[3]

Objective: to assess cardiovascular risk by means of the traditional Framingham score and the version modified through the incorporation of emerging risk factors, such as family history of acute myocardial infarction, metabolic syndrome and chronic kidney disease. Method: participants were 50 hypertensive patients under outpatient treatment. The clinical data were collected through a semi-structured interview and the laboratory data from patients' histories. Results: it was verified that the traditional Framingham score was predominantly low (74%), with 14% showing medium risk and 12% high risk. After the inclusion of emerging risk factors, the chance of a coronary event was low in 22% of the cases, medium in 56% and high in 22%. Conclusions: the comparison between the traditional Framingham risk score and the modified version demonstrated a significant difference in the cardiovascular risk classification, whose correlation shows discreet agreement between the two scales. Lifestyle elements seem to play a determinant role in the increase in cardiovascular risk levels.

Descriptors: Hypertension; Risk Factors; Cardiovascular Diseases; Metabolic Syndrome X.

[1] Master's student, Faculdade de Medicina, Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brazil.
[2] PhD, Associate Professor, Faculdade de Medicina, Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brasil.
[3] PhD, Assocate Professor, Faculdade de Enfermagem, Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brazil.
[4] PhD, Collaborating Professor, Faculdade de Medicina, Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brazil.
[3] PhD, Adjunct Professor, Faculdade de Enfermagem, Universidade Federal de Juiz de Fora, Juiz de Fora, MG, Brazil.

Corresponding Author:
Elaine Amaral de Paula
Universidade Federal de Juiz de Fora. Faculdade de Medicina
Av. Eugênio do Nascimento, s/n
Bairro: Dom Pedro
CEP: 36038-330, Juiz de Fora, MG, Brasil
E-mail: elaineamp@hotmail.com

Introduction

The changes that occurred as from the post-industrial revolution period entailed consequences for the disease profile of the world population. As a result of technological advances, society has become increasingly sedentary. This fact contributed to the growing occurrence of chronic illnesses like obesity, type 2 diabetes, systemic arterial hypertension, conditions knowingly associated with increased cardiovascular risk[1].

In Brazil, cardiovascular illnesses rank first among the causes of death and represent almost one third of total deaths. In 2007, 308,466 deaths were due to diseases of the circulatory system. In 2009, 91,970 hospitalizations were registered in the Unified Health System (SUS) due to cardiovascular illness, resulting in a cost of R$ 165,461,644.33[2].

In this epidemiological transition context, in which the mortality and incidence of cardiovascular illness increased progressively, the Framingham study was started, aimed at knowing the risk factors and physiopathology associated with cardiovascular illnesses. This prospective and long-term study permitted the stratification of cardiovascular risk as the probability of a coronary event in the next ten years[3]. Since then, the Framingham score has shown to be a practical method for cardiovascular risk assessment in different populations.

This score assesses the risk for coronary artery disease over a ten-year period based on the following parameters: age, systolic blood pressure, total cholesterol, HDL cholesterol, smoking and anti-hypertensive treatment[4]. Based on the calculated risk, the individual can be classified as low, medium or high risk for the development of coronary artery disease, including fatal coronary death or non-fatal myocardial infarction.

The risk factors for coronary artery disease include modifiable lifestyle habits, such as smoking, dyslipidemias, obesity, sedentariness, diabetes, alcohol abuse, as well as non-modifiable characteristics like age, sex and family history.

Among the modifiable risk factors, arterial hypertension is considered the most important for ischemic diseases and cerebrovascular accident. In a randomized study of 3845 participants, with a mean age of 83 years, it was observed that a blood pressure drop from 161/84 mmHg to 144/78 mmHg reduced the risk of cerebrovascular accidents by 30% and that of cardiovascular events by 23%[5].

Smoking is another important modifiable risk factor. In smokers over 60 years of age, the risk of a cardiovascular event is twice as high when compared to non-smokers. Even worse, for individuals under 60 years of age, this risk is five times higher[6].

Besides cardiovascular risk, smoking is associated with a higher prevalence of chronic kidney disease (CKD). In an observational study that assessed 65,589 individuals during a period of 10.3 years, it was demonstrated that the risk of CKD is four and 3.3 times higher for current and former smokers, respectively, when compared to non-smokers[7].

The control of lifestyle-related factors, considering diet and physical exercise, is fundamental to prevent cardiovascular events. Atherogenic and hypercaloric diets trigger hypertension, diabetes, dyslipidemias, overweight and other abnormalities. Arterial hypertension is twice as frequent among diabetic than among non-diabetic patients[2]. Also, diabetes is one of the most important risk factors to determine coronary artery disease, so that the presence of this morbidity is considered a risk factor equivalent to infarction, that is, despite the absence of any cardiovascular sign, diabetics are classified under "high cardiovascular risk"[4].

According to the Framingham study, high levels of triglycerides and low HDL cholesterol increase the cardiovascular risk level[8]. Similarly, also based on data from the Framingham study, it is estimated that overweight is responsible for 26% of arterial hypertension cases in men and 28% in women; and for about 23% of coronary heart disease cases in men and 15% in women[9].

It should be highlighted, however, that the traditional Framingham score was elaborated in the 1950's and validated in the 1960's and 1970's, when the prevalence of overweight and obesity in the United States was a third of the current rate and acute myocardial infarction was more frequent among men. Since the 1980's, infarction has been more common among women and obesity has turned into a worldwide epidemic[10-11]. Therefore, this score may underestimate the cardiovascular risk in today's population[12].

Therefore, to increase the positive predictive value for coronary artery disease in the traditional

Framingham risk score, the addition of factors that suggest subclinical atherosclerotic illness was proposed, called emerging factors, including peripheral vascular disease, thickening of the intima-media wall of the carotid artery and calcium contents in coronary arteries, which contribute to an increase in cardiovascular risk levels, as they are markers of endothelial injury. In addition, the consideration of other factors was suggested for the sake of cardiovascular risk assessment: C-reactive protein, presence of the metabolic syndrome and traditional risk factors like a family history of premature coronary artery disease[4]. Similarly to this proposal, other risk factors were also added to the traditional Framingham score, called aggravating factors, such as left ventricular hypertrophy (LVH) via electrocardiography, microalbuminuria (30 to 300 mg/24h) and chronic kidney disease (plasma creatinine levels higher than 1.5 mg/dL or creatinine filtration below 60 mL/min)[13]. According to this proposal, the presence of one of these factors increases the risk score to the immediately superior level when compared to the findings resulting from the application of the traditional Framingham score[13].

Therefore, the question is raised whether cardiovascular risk assessment in hypertensive patients, through the incorporation of aggravating risk factors, would increase the chance of coronary events over a ten-year period. In view of the social and economic losses cardiovascular illnesses entail, the study of estimated coronary risks permits the implementation of more appropriate therapeutic measures and, consequently, the prevention of these events. The aim in this study was to assess the cardiovascular risk in hypertensive patients, using the traditional Framingham risk score in comparison with the score modified by the inclusion of emerging risk factors.

Methods

Cross-sectional, analytic and quantitative research, developed in the Interdisciplinary Group for Nephrology Studies, Research and Treatment at *Universidade Federal de Juiz de Fora* (NIEPEN - UFJF), location for the outpatient clinic of the Arterial Hypertension League, organized by the Nephrology Service at HU/CAS. This unit delivers multidisciplinary outpatient care exclusively to public health system (SUS) patients and is a member of the Arterial Hypertension League Department of the Brazilian Society of Hypertension. The team includes social service, nursing, medicine, nutrition and psychology professionals. The nursing team's activities in the League takes place in the waiting room, through nursing consultations, participation in the discussion of clinical cases and in scientific events.

The total population registered in the League between January/2009 and January/2011 consisted of 130 hypertensive patients. Eighty of them were interviewed between January and April 2011. After applying the inclusion and exclusion criteria, 50 individuals were selected to participate in the study. A post-hoc analysis of the sample power, considering a significance level of 0.05 and a prevalence rate of medium or high risk corresponding to 50% (which causes the greatest standard deviation), the sample power found corresponded to 82% for 50 patients and a sampling size with a minimum detectable effect of 40%. The study included male and female hypertensive patients, registered in the League, between 20 and 79 years of age, according to the Framingham risk table, conscious and oriented in time and space to answer the interview questions, with a properly completed patient history, including total cholesterol, HDL cholesterol, triglycerides, fasting glucose and creatinine, examined less than 12 months earlier, and who agreed to participate in the study.

The users monitored in the Hypertension League participate in periodical clinical assessments, following specific guidelines[2]. None of the patients refused to participate, but two patient histories contained no recent laboratory data, so that the participants were excluded. Also, diabetics, patients with a history of acute myocardial infarction, previous cerebrovascular accident or angina were excluded, as these conditions are considered equivalent risk factors[4], so that these patients are directly classified under high cardiovascular risk.

Individuals with systolic blood pressure (SBP) levels ≥ 140 and/or diastolic blood pressure (DBP) ≥ 90 mmHg were considered as uncontrolled hypertensive patients. Blood pressure levels were measured using the auscultation method, by a sole observer, using an aneroid sphygmomanometer placed at the height of the heart, with the right arm resting with the hand palm turned upwards and the elbow slightly flexed. The stethoscope was placed above the brachial artery.

Measures were obtained after the patient had remained seated for at least five minutes in a calm place. Systolic blood pressure was measured through the auscultation of the Korotkoff sound phase 1 (one), and diastolic blood pressure through the disappearance of the Korotkoff sound phase 5 (five). If the heartbeats continued until close to zero, the DBP can be determined by the muffling of the Korotkoff sound phase 4 (four)[2].

To analyze the cardiovascular risk level, the traditional Framingham risk scores[4] were adopted, as well as the scores modified by the inclusion of emerging risk factors[13]. For the traditional score, the following factors were assessed: age, sex, smoking, medication treatment for blood pressure, HDL and total cholesterol levels. To apply the modified Framingham risk score, the investigation of the family history of premature coronary artery disease was added to these factors and, among the so-called aggravating factors, the presence of metabolic syndrome and chronic kidney disease were selected[13]. In both scores, results below 10% were considered as low risk, between 10 and 20% as medium risk, and higher than 20% as high risk[4,13].

Individuals who denied regular exercising or ≤ 2 times per week, with a minimum duration of 30min. were considered as sedentary. The metabolic syndrome was diagnosed based on the presence of three or more of the following criteria: abdominal obesity, characterized by an abdominal circumference >102 cm for men and >88 cm for women; fasting glucose ≥110 mg/dL; triglyceride ≥150 mg/dL, HDL cholesterol levels <40 mg/dL for men and <50 mg/dL for women; SBP ≥130 mmHg or DBP ≥85mmHg or use of antihypertensive agents[4].

The presence of first degree relatives (father, mother, sibling, son or daughter) with acute myocardial infarction and/or cerebrovascular accidents at an age younger than 55 for men and younger than 65 for women was considered as a positive family history for premature cardiovascular disease[2].

Abdominal obesity was defined based on a waist circumference of 102 or more for men and 88 or more for women. The abdominal circumference was measured in centimeters, between the midpoint of the lowest rib and the iliac crest, with the help of a non-elastic metric tape[14].

Weight was measured on portable digital Welmy® scales, with a capacity of 150 kg. The hypertensive patients were weighted while standing on the platform, barefoot, wearing light clothing and standing erect with their arms along their body. Height was measured using a vertical Welmy® stadiometer, at a 90º angle from the scales platform. The body mass index (BMI) was calculated by applying the formula BMI= weight (kg)/ height per m². For normal BMI, overweight and obesity, the following were adopted: 18.5–24.5 kg/m², 25–29 kg/m² and ≥30 Kg/m², respectively. Patients who smoked at least one cigarette per day were considered as smokers. Glomerular filtration was estimated based on the serum creatinine dosage[15].

The variables selected for this study were pre-coded, stored in SPSS® (Statistical Package for the Social Sciences) version 15.0 and processed by applying exploratory statistical analysis: mean, standard deviation and frequency distribution. The relation between the variables was evaluated with the help of the Chi-square test and Student's t-test. The agreement between the traditional and modified Framingham risk scores was analyzed, using Cohen's Kappa statistics. To interpret the agreement level, the following criteria were adopted: a) <0 - poor; b) 0 to 0.20 - discreet; c) 0.21 to 0.40 - reasonable; d) 0.41 to 0.60 - moderate; f) 0.61 to 0.80 - substantial; g) 0.81 to 1.00 – almost perfect[16]. For all statistics, significance was set at 0.05, with a 95% confidence interval. Approval for the study was obtained from the Ethics Committee at the *Hospital Universitário de Juiz de Fora*, under Opinion 211/10.

Results

Fifty patients were assessed, 30% male and 70% female, with a mean age of 55 ± 16.5 (men) and 57 ± 11.2 (years). Most interviewees declared themselves "non white" (64%) as opposed to "white" (36%). Regarding the socioeconomic situation, 80% of the sample gained a monthly income between R$ 622 and 1866 *reais* (1-3 minimum wages), 10% had no education and 52% had finished primary education. Considering occupation, more than half (54%) of the population had retired due to age or invalidity and 46% of the sample were not retired, that is, they were autonomous, salaried and non-salaried workers. The blood pressure control rate corresponded to 40% in the sample.

Figure 1 describes the prevalence of the main risk factors. As shown, sedentariness was the most prevalent characteristic in the sample, while smoking was the least prevalent.

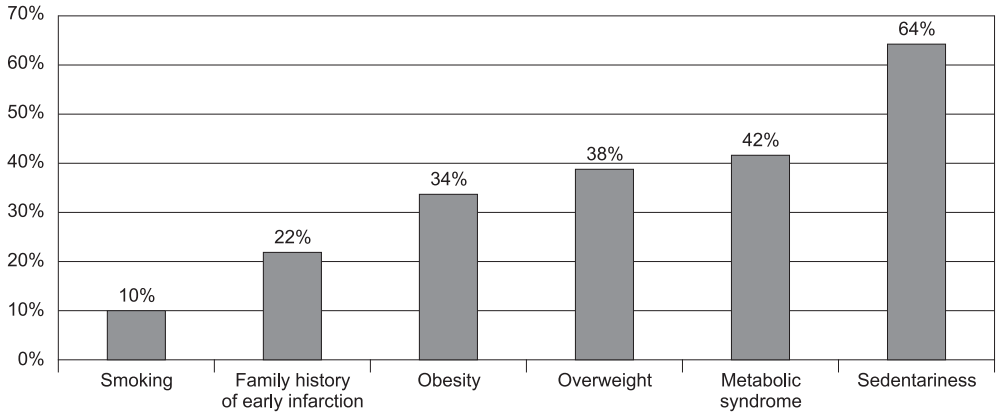

Figure 1 – Prevalence of main risk factors in the sample. Juiz de Fora, MG, Brazil, 2011

When the traditional Framingham score was applied, most individuals, that is, 37 (74%) showed low cardiovascular risk, seven (14%) medium risk and six (12%) high risk. ON the other hand, when considering some of the aggravating factors, metabolic syndrome was present in 21 (42%) patients, family history of infarction in 11 (22%) cases and reduced glomerular filtration in 11 (22%). After incorporating these criteria into the modified Framingham risk score, the cardiovascular risk was considered low in only 11 (22%) cases, medium in 28 (56%), and high in 11 (22%) patients.

Among the 37 hypertensive patients classified as low cardiovascular risk according to the traditional Framingham score, 11 continued with the same status after the application of the modified score (Group 1), while 26 were reclassified, that is, they changed from "low" to "medium" risk of a coronary event after the application of the modified Framingham score (Group 2). The baseline characteristics of these two groups are described in Table 1.

Table 1 – Cardiovascular status: anthropometric, clinical and biochemical markers in users attended in the Hypertension league. Juiz de Fora, MG, Brazil, 2011

Characteristics	Status		p (x^2 test)
	Standard (N=11)	Modified (N=26)	
Male	25%	22%	0.64
Female	75%	78%	0.64
Abdominal circumference*	25%	84.8%	0.026
Overweight/obesity	66.7%	76.9%	0.328
Triglycerides (mg/dl)*	0%	30.3%	0.266
Glucose (mg/dl)*	0%	11%	0.729
HDL cholesterol (mg/dl)*	25%	42.4%	0.461
Uncontrolled BP (mmHg)	25%	57.6%	0.242

*The percentage refers to values superior to the normal limit according to ATP III.
HDL – High-density lipoprotein; BP: blood pressure.

In comparison with Group 1, Group 2 revealed higher prevalence levels of abdominal obesity, corporal overweight or obesity, dyslipidemia, altered fasting glucose and blood pressure out of control. A significant difference was found between the two groups' abdominal circumference (p=0.026).

Thus, the comparison between the traditional and modified scores in a hypertensive population showed that the latter detected a larger number of individuals at medium and high risk when compared to the traditional Framingham score. Figure 2 demonstrates the cardiovascular risk classification according to the traditional and modified Framingham risk score, as well as the Kappa and p values for this comparison.

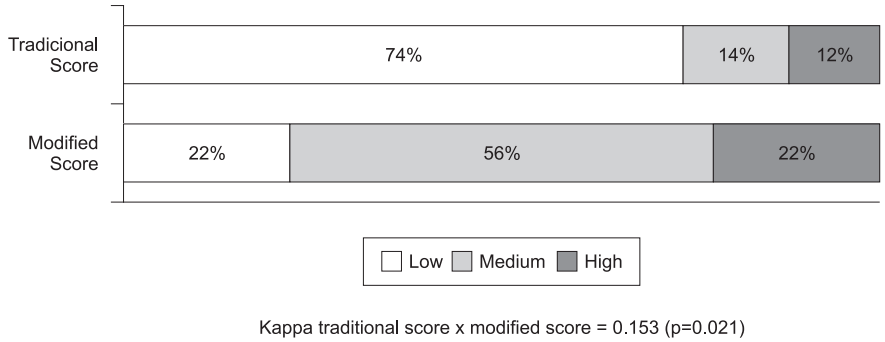

Figure 2 – Cardiovascular risk calculation according to traditional Framingham score and score modified by aggravating factors. Juiz de Fora, MG, Brazil, 2011

Discussion

The traditional Framingham score represents a landmark in the history of risk classification for cardiovascular disease since 1976, when the Framingham age was started[8]. Therefore, over the years, it was incorporated into different international guidelines and accepted as a cardiovascular risk assessment paradigm in several Brazilian guidelines[13,17].

In recent years, however, this score has received some criticism, especially related to its application in populations with emerging risk factors. In addition, this criterion loses effectiveness when applied in low or high-risk populations. In a systematic review of 27 studies, totaling 71,127 patients, it was demonstrated that the traditional Framingham score underestimated coronary artery disease forecasts in a high-risk population and, on the other hand, overestimated the estimated risk in a low-risk population[12]. This fact can be explained by the dynamic changes in habits and the set of factors that promote atherogenesis. Therefore, it will be difficult for a certain algorithm to estimate actual risks in different circumstances, places and times[18]. To give an example, the Framingham score, developed in the 1950's, does not correctly estimate the impact of the metabolic syndrome, which is considered an epidemic nowadays[19]. At that time, the world was going through the food scarcity of the second world war and, as the food industry advanced, more processed foods were offered and fast-food restaurants gained popularity.

In this context, the presence of microalbuminuria, chronic kidney disease, metabolic syndrome, family history of coronary disease and subclinical atherosclerosis were adopted as aggravating factors which, when present, increase the risk to the immediately superior category[13].

In this study, 50 hypertensive patients were assessed who were not diabetic, had no previous cardiovascular history and were receiving outpatient treatment. The mean age was 56 ± 12.7 years and most participants were women with a low socioeconomic level. In this sample, the prevalence of sedentariness and dyslipidemia was high and the control of hypertension low. Similar characteristics were found in population-based studies, possibly representing the Brazilian population[20].

Among the classical Framingham risk factors, age superior to 60 years is present in half of the sample, followed by lack of systolic blood pressure control, HDL cholesterol below acceptable limits, high total cholesterol and smoking, which were present in 46%, 44%, 32% and 10%, respectively. In a population of 385 hypertensive patients, with a sociodemographic profile similar to the present study, predominant characteristics also included elderly people (49.3%), hypercholesterolemia (28.6%) and smoking (16.5%)[21].

Based on these classical criteria, the estimated risk of coronary artery disease was predominantly low in the study sample, with 37 (74%) patients classified as low risk, seven (14%) as medium risk and six (12%) as high risk. This initially favorable picture, however, is not confirmed when other clinical characteristics are analyzed in the same and mainly elderly population, as 64.9% of the hypertensive patients at low risk of coronary artery disease were sedentary, 35.1% obese and 45.9% were diagnosed with the metabolic syndrome.

The inclusion of new cardiovascular risk factors was recommended based on the finding that changes in the population's epidemiological profile, such as the obesity epidemic and the metabolic syndrome, accelerate atherosclerotic disease. A recent study also showed

that chronic kidney disease is considered a risk factor equivalent to acute myocardial infarction, that is, the presence of this disease exposes the patient to a high cardiovascular risk, independently of the presence of other factors[22].

Hence, the low risk resulting from an assessment based on the traditional Framingham criteria only does not seem be comply with the reality, as this population presents factors that are knowingly related to a higher degree of cardiovascular risk.

In fact, when comparing the traditional and modified Framingham scores, out of 37 individuals classified as low risk (<10%) according to the traditional score, 26 were reclassified as medium risk (10%-20%) after the application of the modified score. According to Table 1, the most relevant characteristics for this rank change were corporal and abdominal obesity, which is one of the parameters used to define the metabolic syndrome.

The sedentary lifestyle represents an important cause of obesity. In fact, sedentariness was the most prevalent risk factor, present in 64% of the sample. This result is in accordance with other authors who observed low and moderate physical exercise in 80% of a sample of hypertensive patients[23]. Likewise, in a population-based study that assessed lifestyle-related risk factors for cardiovascular illnesses among adults in the South of Brazil, it was observed that sedentariness was the most prevalent risk condition (75.6%)[24].

Abdominal obesity showed a significant difference between groups 1 and 2 in the sample. Comparisons between the effectiveness of different cardiovascular risk prediction scores revealed that the traditional Framingham score underestimates the cardiovascular risk in a sample with abdominal obesity and dyslipidemia as the predominant characteristics, while the modified Framingham score improves the cardiovascular risk prediction[21].

Therefore, in this study, the comparison between the traditional and modified Framingham risk scores demonstrated a significant difference in the cardiovascular risk classification, whose correlation reveals a discrete agreement level between the two scales. In view of aggravating risk factors, the modified score increased the cardiovascular risk prediction in non-diabetic hypertensive patients without an earlier history of cardiovascular illness. Accordingly, based on traditional risk factor, the estimated cardiovascular risk can be underestimated and the adoption of emerging risk factors, mainly lifestyle-related criteria, can sensitize the cardiovascular risk estimation in this population.

Final Considerations

The use of the Framingham risk score modified by the inclusion of emerging risk factors and aggravating factors sensitized cardiovascular risk prediction in hypertensive patients when compared to the traditionally used score. Hence, cardiovascular risk detection in hypertensive patients should incorporate variables related to the lifestyle and the personal and family history of other chronic conditions related to atherosclerotic disease.

The high prevalence of modifiable risk factors for cardiovascular illnesses highlights nurses' responsibility and the role of public health policies in the prevention of cardiovascular problems.

Some observations are due regarding the study limitations. First, information from patient histories was used to outline their lipid profile, without knowing whether the place and recommendations needed for appropriate collection were standardized. Second, the researchers faced difficulties to confirm subclinical cardiovascular disease and equivalents through complementary exams. Also, the study was focused on cases at a sole institution with its own care characteristics, entailing limitations for the sake of generalization to other situations.

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