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Modified Algorithm for the Risk of Coronary Heart Disease Estimation

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ABSTRACT

Introduction: Determination of the overall risk of coronary disease, enables the health professionals for planning the intensity of preventive action. **Aim:** The aim of this study is that by the results obtained using a modified algorithm with tables adopted by the European Society of Cardiology demonstrate the possibilities for assessment of the risk of coronary heart disease degree, for application to the targeted individual or risk factors groups. **Material and methods:** The study was conducted as a retrospective, prospective and controlled (included two groups of 200 respondents). **Results:** By comparing the presence of risk factors according to the representation of groups of diseases, or myocardial infarction, results showed that the European and SCORE table have significantly lower levels of risk factors, or those with sustained myocardial infarction are ranked in groups of low and present risk in relation to our algorithm which patients with myocardial infarction ranked as high and pronounced degree of risk. Results showed that the European and SCORE table significantly reduce the levels of risk or the persons with heart failure have been ranked in the group of low and present risks in relation to our algorithm which patients with coronary insufficiency ranked as pronounced degree of risk. **Conclusion:** Determination of the overall risk of coronary disease, enables the health professionals for planning the intensity of preventive action. The activities of primary prevention of risk factors, or already resulting disease, may be helpful in assessing the reduction in economic costs in healthcare, both due to lower morbidity, and reducing the total cost of treatment of patients with coronary disease.
Key words: coronary heart disease, risk factors, algorithm.

1. INTRODUCTION

Atherosclerosis is a chronic inflammatory reaction of the vascular wall in response to dyslipidemia and endothelial distress involving the inflammatory recruitment of leukocytes and the activation of resident vascular cells. Atherosclerosis is a prerequisite for the development of pathological changes in the coronary blood vessels. Atherothrombotic cardiovascular disease is a leading cause of death and disability not only in rich countries but globally and, as such, has a large economic and public health impact (2). A lot of studies is conducted that have analyzed the risk factors which lead to the formation of atherosclerosis changes in the blood vessels. Many years of testing revealed a large number of risk factors, which are set based on monitoring of each risk factors responsible for the occurrence of coronary heart disease, combined or individual, which led to the formation of various guidelines of the European Cardiology Association and the American Association of Cardiologists (3, 4, 5).

The Framingham study as a largest longitudinal epidemiological study of coronary disease in the world, based on the concept of the risk factors estimate, is the basis for the treatment of patients, and thus lowering the incidence of coronary artery disease (Pitt B. 1999).

The complex etiology of coronary heart disease is connected to smoking, high blood pressure, high levels of fat and sugar in the blood, increased body weight, stress and lack of physical activity (5,6). The age, gender and family history, greatly complicate the risks for developing the disease (HF Epstein, 1995). Despite many limitations, distribution and frequency of the heart and blood vessels diseases are analyzed on the basis of mortality statistics data and the results obtained after the WHO MONICA Project (Multinational Monitoring of Trends and Determinants in Cardiovascular Disease) covering a population from 35 to 64 years in 35 countries of the world.

In industrialized countries, heart and blood vessels diseases make up one-third to one-half of all deaths (33% in France and 39% in Japan up to 48% in England and Wales and 52% in Finland) (Tolonen H 2005). An important shift in the primary prevention of coronary heart disease is an attempt to observe all risk factors that contribute to the creation and development of atherosclerotic changes in blood vessels as well as the mutual interaction of various risk factors.

2. AIM

The aim of this study is that by the results obtained using a modified algorithm with tables adopted by the European Society of Cardiology demonstrate the possibilities for assessment of the risk of coronary heart disease degree, for application to the targeted individual or risk factors groups.

3. MATERIAL AND METHODS

The study was conducted as a retrospective, prospective and controlled. Included are two groups of 200 respondents (experimental and control group) at approximately same age, socio–economic conditions and provided health care.

The modified algorithm for risk of cardiovascular disease estimation

The modified algorithm for risk of cardiovascular disease estimation involves grading of differences on the basis of the intensity within the four groups:

- Without presence of risk,
- Risk is present,
- Expressed risk,
- High risk expressed,

In all patients is estimated absolute risk, by summing the points score for the presence of risk factors, so that all the participants are divided into four groups:

1. Low risk for coronary heart disease, 0 points
2. Present risk for coronary disease, 1- 3 points
3. Pronounced risk for coronary disease, 4–6 points
4. High risk for coronary disease, 7–9 points

After this the total risk score for developing coronary disease in all patients was determined according to two tables (the *European Table for Coronary Risk* from 1998 and European Heart Score system (Systematic Coronary Risk Evaluation)).

4. RESULTS

The results show that there is low risk in 20% of respondents, is present in 50% of respondents, and expressed in 20% of respondents. Highly expressed risk was seen in 10% of respondents. According to the European Tables estimate of coronary risk by testing a sample of healthy respondents show that low level of risk has 58% of healthy respondents, present risk in 37%, expressed risk in 4% and expressed high risk in 1% of healthy subjects. Comparison of the risk assessment results of according to the European Table for both groups, the results show that respondents with coronary heart disease have a higher risk score in the group present, expressed and expressed high risk compared to healthy respondents who have a higher presence of "low risk score".

The new European Table for Risk (SCORE) includes: systolic blood pressure, cholesterol values, cigarette smoking, age and gender. Risk assessment by Score table shown that among patients suffering from coronary heart disease in low-risk group there was 35% respondents, present risk has 20%, expressed risk 25%, and highly expressed 10% of the respondents.

According to the new European Table for risk (SCORE) the results of the risk assessment showed that among healthy respondents the low level of risk was present in 57% of the respondents, present risk has 34%, expressed risk 6% and expressed high risk 3% of healthy respondents.

According to SCORE tables for risk assessment by comparing the results of two research groups have shown that a higher percentage of risk groups have patients with expressed (25%: 6%) and a high risk (10%: 3%), while in group of healthy respondents a higher percentage have the low risk (57%: 20%), and present risk (34%: 20%). When we compared the results of risk assessment by groups of European and SCORE table we got the results showing that by about same percentage are represented groups according to risk and of course higher risk have patients in the group of expressed and expressed high risk, while in the group of low risk is present a higher percentage of healthy respondents. In this study is also used modified algorithm that includes following of nine risk factors: age, hereditary factors, high blood pressure, elevated blood cholesterol, elevated blood sugar, exercise habits, smoking, BMI, and the ratio of the volume of abdominal obesity and hip circumference. Assessment of coronary risk by our modified algorithm in patients with coronary heart disease showed that low risk has only 3% of respondents, a high percentage 9%, while 43% belongs to the group of present risk and 44% to expressed risk. Assessment of coronary risk by modified algorithm in healthy subjects show that low risk has 5% of respondents, present risk 66%, 28% expressed and highly expressed 1% of respondents. According to our modified risk assessment algorithm comparison of results in two research groups have shown that a higher percentage of risk groups have patients with pronounced (OR=2.0) and a highly expressed risk (OR=9.1), while in healthy respondents group was higher percentage with low and present risk. However, when we compared levels

of risk for coronary disease development in both groups, according to these three tables, we obtained the results that in the group with present and expressed risk there is a higher percentage representation as a result of inclusion of more risk factors in calculation in relation to the European Table and Score Table, and on the other hand the presence of risk in the healthy population is much higher in our population than the population of the EU countries for who these tables are adapted. By comparing the presence of risk factors according to the representation of groups of diseases, or myocardial infarction, results showed that the European SCORE table have significantly lower levels of risk factors, or those with sustained myocardial infarction are ranked in groups of low and present risk in relation to our algorithm which patients with myocardial infarction ranked as high and pronounced degree of risk (Figure 1).
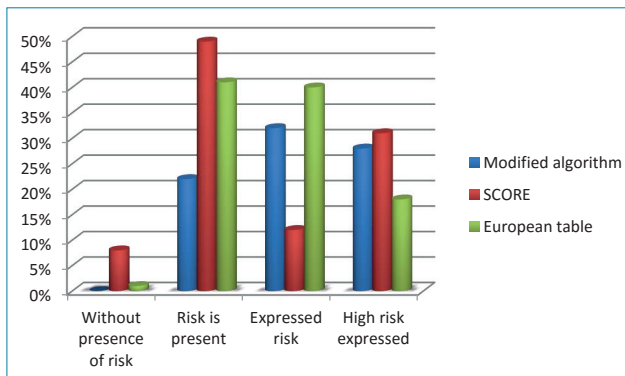

Figure 1. Comparison of the results of the risk assessment according to all three tables among patients with myocardial infarction

When we compared the presence of risk groups according to the representation of diseases groups, or, coronary insufficiency, the results showed that the European and SCORE table significantly reduce the levels of risk or the persons with heart failure have been ranked in the group of low and present risks in relation to our algorithm which patients with coronary insufficiency ranked as pronounced degree of risk (Figure 2).
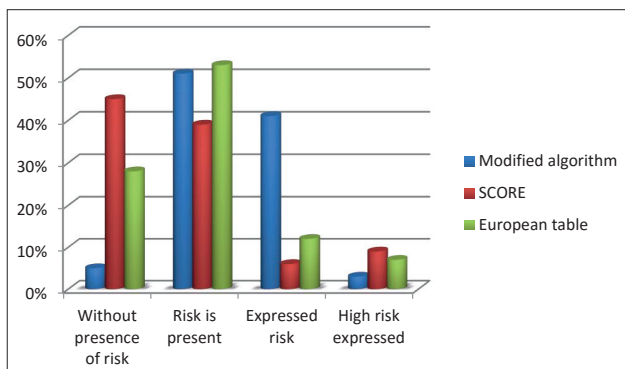

Figure 2. Comparison of the results of the risk assessment according to all three tables in relation to the patients with coronary insufficiency

Overall assessment of coronary risk–the proposal of modified algorithm

Level of qualification:		
Place of residence:		
Sex:	**m**en	Woman
1. Age:	**no** <50g.	**yes** 50g.>
2. smoking:	**no**	**yes**
3. family history of coronary artery disease:	no	**yes**
4. blood pressure	**no** < 139/40mmHg	**yes** >140/40mmHg
5. cholesterol:	**no** < 5,5 mmol/l	**yes** > 5,6 mmol/l
6. blood sugar:	**no** < 6,0 mmol/l	**yes** > 6,1 mmol/l
7. BMI :	**no** < 25 kg/m^2	**yes** >25 kg/m^2
8. the ratio of waist / hips:	m. **yes** >1,0 **no** < 0,9	w **yes** > 0,9 , **no** < 8, 9
9. physical activity:	**no** < 30 min. per day	**yes** > 30 min. per day

Table 1. The proposal for the assessment of coronary risk

After the conducted study, by review of the data received, was made the risk assessment for all asymptomatic respondents older than 35 years if there is a positive family history of early coronary disease, elevated blood lipids, that smoke, have high blood pressure, with increased BMI, present symptoms of coronary disease and diabetes (Table 1 and 2).

5. DISCUSSION

In our study is used a modified algorithm that includes follow up of nine risk factors: age, hereditary factors, high blood pressure, elevated blood cholesterol, elevated blood sugar, exercise habits, smoking habits, BMI, the ratio of the volume of abdominal obesity and hip circumference. When we investigate all nine risk factors results showed that the prevalence of standard risk factors: high blood pressure (SD=4.5), the level of blood sugar (OR=3.1), smoking (OR=2.0), cholesterol (OR=1.9), obesity (OR=1.8), lack of physical activity (OR=1.7), waist-hip ratio in women (OR=1.3), waist-hip ratio men (OR=1.6) was higher in patients with coronary disease, compared to the control group.

The main risk factors are present high blood pressure, elevated blood sugar, smoking, elevated cholesterol levels in the blood, which was confirmed in INTER-HEALTH study emphasizes just these five risk factors (Yusuf S.2005). Also, the studies of other authors confirm our research because they stated that among patients with coronary heart disease, at least one of the four conventional risk factors–smoking, elevated blood sugar, elevated blood pressure, elevated blood lipids, were present in 84.6% of women and 80.6% of men (Umesh N 2003). Once we have determined the presence of risk factors, their degree of influence on the occurrence of coronary disease and regardless of the fact that some risk factors have not yet found their place in certain tables, but our experience shows that there is the need to include all known and easily measurable risk factors in the assessment of the overall risk. The studies of various authors have shown that in order to identify risk factors and assess absolute short-term (ten years) and long-term risk of coronary heart disease is the first step in the primary prevention and we know that certain risk factors can be eliminated, and the other alleviated, thus slowing

Risk present	Expressed risk	highly expressed risk
1 – 3 points	4 -6 points	7-9 points
Smoking: cessation of use, family support, participation in a rehabilitation program, supportive therapy	Smoking: cessation of use, family support, participation in a re-habilitation program, supportive therapy	Smoking: cessation of use, family support, participation in a rehabilitation program, supportive therapy
Blood pressure control: the goal is to reduce pressure below 135/85 mmHg.	Blood pressure control : the goal is to reduce pressure below 135/85 mmHg.140 / 90mmHg>, drug therapy,	Blood pressure control : the goal is to reduce pressure below 135/85 mmHg.140 / 90mmHg> drug therapy,
Weight control BMI <25 kg/m2	Weight control BMI <25 kg/m2	Weight control BMI <25 kg/m2
Reduce abdominal fat layout	Reduce abdominal fat layout	Reduce abdominal fat layout
Waist circumference below 88 cm women, men below 100 cm	Waist circumference below 88 cm women, men below 100 cm	Waist circumference below 88 cm women, men below 100 cm
Increase physical activity	Increase physical activity	Increase physical activity
Control the cholesterol reduce and restrictions on the fat and salt intake	Control the cholesterol reduce and restrictions on the fat and salt intake, drug therapy–statins	Control the cholesterol reduce and restrictions on the fat and salt intake, drug therapy–statins
Blood sugar control, periodic care and control reassessment of risk and a review after 3-6 months	Blood sugar control, periodic care and control, drug therapy reassessment of risk and a review after 2 months	Blood sugar control, periodic care and control, intensive intervention An alternative drug therapy, constant attention and supervision, reassessment of risk and a review after 1 month

Table 2. According to the score take preventive measures

down the progression of the disease, delay occurrence of clinical events and improve prognosis (Isles CG, 2000).

When we compared the results of the risk assessment to the European Table of both groups, the results show that people with coronary artery disease have higher risk score in the group of present risk (50%: 39%), expressed risk (20%: 4%) and a highly expressed risk (10%: 1%) relative to healthy respondents who have more present low risk score (20%: 1%).

Assessment of coronary risk by our modified algorithm in patients with coronary heart disease showed that low risk is present in only 3% of respondents, highly expressed risk 9% while with present risk there is 43% and 44% have expressed risk. Assessment of coronary risk by modified algorithm in healthy subjects show that low risk has 5% of respondents, present risk 66%, 28% expressed and highly expressed 1% of respondents.

According to our modified risk assessment algorithm for comparing results of two research groups have shown that a higher percentage of risk groups have patients with expressed (45%: 28%) highly expressed risk (9%: 1%), while in healthy subject's greater percentage has a group of low (5% 2%) and the present risk (66%: 43%).

When we compared the presence of risk groups by the representation of groups of diseases, or myocardial infarction, results showed that the European and SCORE table significantly reduce the levels of risk, and those with sustained myocardial infarction are ranked in groups of low, present risk in relation to our algorithm that patients with myocardial infarction ranked as under high and expressed degree of risk. Our research has shown that in a group of healthy participants we have 2x higher present risk and risk 4,5x higher estimated risk in relation to the European table and 7x higher estimated risk in relation to the SCORE table.

This is confirmation of the prevalence of risk factors in the general population in our country and coincides with the information from neighboring countries. However, in people who have suffered coronary heart disease, the results obtained by measuring risk factors show that at high risk for developing the disease results were equal to other tables. But the group with expressed risk in patients with coronary heart disease shows 2x higher value in relation to the European table and SCORE table.

Because we see that in the group of healthy respondents, the group with expressed risk have 4,5x and 7x higher representation in comparison with comparative tables used, it confirms our thesis that the use of modified algorithm is extremely important for our region, as it allows us to significantly earlier identify a group of risk patients in need of reduction, so that the obvious risks of developing coronary disease are reduced and eliminated. By including more risk factors for coronary disease is certainly significant and leads to a more accurate assessment of coronary risk, in relation to the European table, the table SCORE, in our study we included a family history of the disease, sedentary lifestyle, obesity and the waist-hip ratio. Similar results were obtained in PROCAM study based on a large cohort study of the population of Europe, which recommended the inclusion of HDL cholesterol as one of the most important cardiovascular risks (Assmann Gerd 2005). Thanks to the continuous implementation of prevention programs, researching and active search for people with an increased risk for coronary disease reduction and the elimination of risk factors, changing lifestyles and the use of therapeutic–pharmacological measures have significantly reduced the trend of morbidity and mortality from coronary heart disease in developed countries (Raljević 2007).

6. CONCLUSION

Determination of the overall risk of coronary disease, enables the health professionals for planning the intensity of preventive action, or when dietary advice should be more specific, when physical activity should be more individualized, when drugs should be prescribed, dose adjustment or introduce a combination for the risk factors control. The conclusion is that by providing con-

tinuous implementation of prevention programs, at all levels of health care, by research and the active search for people at risk for coronary artery disease, continuous implementation of the reduction and elimination of risk factors, changing lifestyles, and the use of therapeutic–pharmacological measures, will significantly reduce the trend of morbidity and mortality from coronary heart disease in our area. The activities of primary prevention of risk factors, or already resulting disease, may be helpful in assessing the reduction in economic costs in healthcare, both due to lower morbidity, and reducing the total cost of treatment of patients with coronary disease.

Authors contribution: Senad Pesto: substantial contribution to acquisition of data, substantial contribution to analysis and interpretation of data, drafting the article. Mirsad Rahimic: substantial contribution to conception and design, substantial contribution to acquisition of data, substantial contribution to analysis and interpretation of data. Muris Pecar, Sabina Prevljak and Edin Begic: substantial contribution to acquisition of data, substantial contribution to analysis and interpretation of data. Izet Masic and Senad Pesto: substantial contribution to conception and design, final approval of the version to be published.

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