Cardiovascular Risk Assessment of Bulgarian Urban Population: Cross-sectional Study

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Aim To assess the total cardiovascular risk of the Bulgarian urban population.

Methods A representative sample of Bulgarian urban population (n = 3810, response rate 68.3%) from five Bulgarian cities was inlcuded in a cross-sectional observation study performed in the period 2005-2007. A detailed cardiovascular risk assessment was performed by general practitioners and a total 10-year risk of a fatal cardiovascular event was estimated according to the European Systematic Coronary Risk Evaluation (SCORE, HeartScore®).

Results There were 48.7% of participants in the high risk group (SCORE≥5%), 24.3% aged 45-54 and more than half aged 55-64 years. Nearly a quarter of the sample had a total cardiovascular risk of over 10% (SCORE≥10%), whereas 10.1% of the sample had excessively high cardiovascular risk (SCORE≥15%). In the 65-75 age group, the prevalence of men with excessively high risk was 46.6%, compared with 6.0% in women ($P < 0.001$). Most of the main cardiovascular risk factors were slightly increased or borderline in comparison with clinical thresholds.

Conclusions Cardiovascular risk is high in a large proportion of Bulgarian urban population, especially in men aged over 65. These findings indicate that a comprehensive national strategy and program for management of cardiovascular diseases is urgently needed. The SCORE method can be well implemented if a higher threshold for a high risk group is defined and smaller target population is planned for extensive and expensive high risk preventive measures.

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Cardiovascular diseases are the major health and economic problem for the Bulgarian population, accounting for more than 60% of all-cause mortality in the last two decades (1,2). Some of the reasons for this lie in the increasing burden of preventable cardiovascular risk factors and their insufficient and ineffective control, especially in primary health care (3). An urgent and comprehensive preventive strategy and joint actions of physicians, scientists, and politicians are needed to reverse the negative trends and improve the population health status.

The 2003 and 2007 European Guidelines on Cardiovascular Disease Prevention in Clinical Practice promote the use of cardiovascular risk assessment and its adaptation to national specificities as an easy and efficient tool for population risk screening and subsequent decision-making for national cardiovascular prevention strategies (4,5). This approach has been widely discussed recently among Bulgarian epidemiologists and clinicians. Several studies were conducted (6-8) and many European guidelines were translated to promote higher prevention activity in inpatient and outpatient care (9,10). The pocket version of the 2003 and 2007 European Guidelines on Cardiovascular Diseases Prevention was translated, distributed, and recommended by the Bulgarian Society of Cardiology for use in daily clinical practice. However, none of these recommendations was adapted to the national demographic, risk, health system, social and economic reality, and neither were any incentives introduced for the physicians to follow. There is still no national strategy for chronic disease prevention in Bulgaria or any comprehensive, long-term national cardiovascular diseases preventive program. In order to develop such a program and approve it financially, evidence from a large-scale, representative population studies is needed, as well as a wide professional consensus.

This study is a part of a larger research project that assessed the total management of cardiovascular diseases in Bulgaria, comprising cardiovascular disease risk assessment, emergency and hospital care management, and patient compliance and satisfaction with treatment. We present the first stage of the project, which includes the results of the assessment of the total cardiovascular disease risk in Bulgarian urban population, according to the European guidelines (4,5). Our main aims were to determine the current main risk factors for cardiovascular diseases in the Bulgarian urban population; to assess the total cardiovascular risk using the Systematic Coronary Risk Evaluation (SCORE) calculator (4,5); and to discuss the relevance of the proposed high-risk threshold of 5% for the development and financing of a national cardiovascular disease prevention strategy and intervention program.

Participants and methods

Participants

Using a simple random sampling method, we selected 45 to 50 participants from each of the general practitioner (GP) practice in five Bulgarian cities, participating in the project. The initial sample consisted of 5500 participants (Table 1). To be included in the study, the participants had to be aged between 25 and 74 years; have a permanent residence in the respective city; and have a history of at least one risk factor for cardiovascular diseases (eg, smoking, increased blood cholesterol, and in-

Table 1. General practitioners' (GP) practices and participants selected for the study

	GP practices		Participants		
City	registered	selected	selected	examined	analyzed
Sofia	667	48	2290	1923	1602
Plovdiv	205	21	996	815	653
Varna	219	20	944	772	616
Bourgas	136	13	612	519	451
St. Zagora	125	14	658	569	488
Total	1352	116	5500	4598	3810
Response rate (%)				83.6	68.3

creased blood glucose level, as recommended by the 2007 European guidelines) (5). Exclusion criteria were already established atherosclerotic cardiovascular disease (myocardial infarction, coronary heart disease, angina pectoris, and others), type 2 and type 1 diabetes mellitus with microalbuminuria or pronouncedly high single risk factor, or having close relatives with premature atherosclerotic cardiovascular disease (5); pregnancy, and neoplasms.

All selected participants were invited by their GPs to perform a preventive medical examination. The participants underwent a standard preventive examination in accordance with the ethical approval for the nation-wide study of cardiovascular disease management in Bulgaria. There were 4598 people examined (participation rate, 83.6%). However, 788 participants were excluded due to newly found cardiovascular disease (n = 262) or presence of a pronouncedly high risk factor (n = 526) (Figure 1). The final analysis included 3810 participants (Table 1).

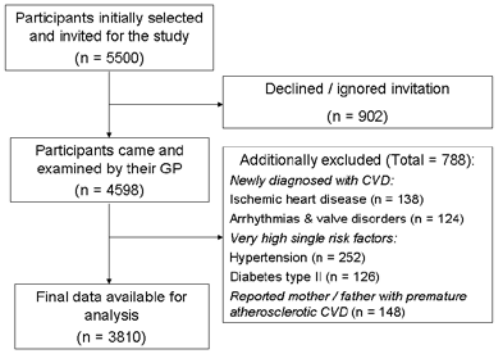

Figure 1. Flow of the participants through the study. Abbreviations: GP – general practitioner; CVD – cardiovascular diseases.

Study design

The cross-sectional observation study was conducted in the five Bulgarian cities – Sofia, Varna, Plovdiv, Stara Zagora, and Bourgas in the period 2005-2007. These cities were chosen because they are the largest cities in Bulgaria with the greatest number of general practices. The total number of GPs in the five cities was 1352 (Table 1), representing more than a quarter of all GPs working in the country and nearly half of those working in the cities. We selected 116 GP practices. In order to assure the same probability of each GP practice to be included into the sample, we applied probability proportional to size sampling. Probability proportional to size is a sampling technique where the probability of selecting a sampling unit (in this case – GP practice) is proportional to the size of the population, ie, the number of patients in the cities. Thus, bigger cities were represented by a larger number of participating GPs. The sampling procedure had the following steps: listing of all GP practices in the cities; calculation of the cumulative population of all patients in all practices; determination of the number of practices that should be selected – 116 and the total sample size of patients – 5500; division of the total number of all patients by the number of practices to obtain the sampling interval (SI); choosing a number between 1 and SI and the random start (RS) number; calculation of the series: RS; RS + SI; RS + 2SI; RS + 3SI; .....RS + 116SI; each of these 116 numbers corresponded to a GP practice on the list of practices. The GP practices selected were those for which the cumulative population contained the numbers in the series calculated. Thus, the number of participating GP practices was proportional to the number of citizens in each city.

GPs were instructed and trained to use the physical examination protocols and total risk assessment through a short course in every city. They performed a detailed cardiovascular risk factor assessment and estimated a total cardiovascular risk for each participant at a regular preventive check-up visit. The following groups of risk factors were assessed: biological (age, sex, height, weight, blood pressure, waist and hip circumference, serum lipids, blood glucose, family predisposition); behav-

ioral (diet, physical activity, smoking); social (education, profession, family status); and the total cardiovascular risk. The cardiovascular screening (risk factor measurement) was carried out according to a standardized protocol based on the international standards. To increase the validity of data, a random sample of 10 files, filled in by each GP, was revised by the chief investigator.

Total risk assessment measurement

Many cardiovascular risk factors, their interactions, and attributable burdens were identified, suggesting the assessment of the total cardiovascular diseases risk (11,12). The total 10-year risk of a fatal cardiovascular event was estimated using the Systematic Coronary Risk Evaluation (SCORE) (HeartScore®) method and the European high risk chart (13,14). The total risk assessment was performed by a specifically developed software application – CardioDB (Program for total risk assessment of cardiovascular diseases, 2005), which consisted of a standardized cardiovascular diseases risk assessment questionnaire (CardioDB, Version 1.0.0) and Scorecard, version 4.0.0.15 (electronic version of the SCORE high-risk chart). Each GP was asked to fill out the questionnaire, calculate the actual cardiovascular total risk of the individual, and create a database for follow-up examinations. The population stratification was performed according to the European guidelines (4,5) as follows: low risk for fatal cardiovascular diseases event in 10 years (SCORE≤1%); intermediate risk for fatal cardiovascular diseases event in 10 years (2%≤SCORE≤4%); high risk for fatal cardiovascular diseases event in 10 years (SCORE≥5%); relatively high risk for fatal cardiovascular diseases in 10 years (5%≤SCORE≤9%); very high risk for fatal cardiovascular diseases in 10 years (10%≤SCORE≤14%); and excessive risk for fatal cardiovascular diseases in 10 years (SCORE≥15%).

Statistical analysis

A computerized database was created using the Microsoft Excel 2003 program (Microsoft Corporation, Redmond, WA, USA). Sample size was determined using the Epi Info 2000 program (CDC, Washington DC, USA). For all measures, the distribution of results was presented as mean ± standard deviation and interquartile range. The level of statistical significance was set at $P < 0.05$. For comparison of total cardiovascular diseases risk in men and women and in different age groups, independent sample t test was used. The statistical methods used in the SCORE calculator, as well as the qualifying criteria, are described in details elsewhere (13). The participants aged 25-40 were extrapolated to the age 40, whereas the participants aged between 65 and 74 years were extrapolated to the age 65. Statistical analysis was performed with Statistical Package for the Social Sciences for Windows, version 13.0 (SPSS Inc., Chicago, IL, USA).

Results

Among the participants, 54.8% were women (Table 1). Most participants were in the age group 55-64 (39.97%). The higher number of people over the age of 55 (68.40%) and the lower number of men (45.2%) correspond to the demographic and age structure of the Bulgarian population in the study period (2). More than 60% of the participants were married and 90.8% had secondary and higher (university/college) education.

The mean and median values of most of the main cardiovascular disease risk factors were slightly increased or borderline, compared with clinical thresholds, with similar values in men and women (Table 2). Cardiovascular risk factors increased with age, although body mass

Table 2. Main cardiovascular risk factors and cardiovascular risk (SCORE) in the sample of Bulgarian urban population (n = 3810)*

Main cardiovascular risk factors and total risk	Interquatrtile range	Mean ± standard deviation		
		men	women	total
Age (years)	13.00	56.9 ± 9.8	59.5 ± 8.6	58.3 ± 9.3
BMI (kg/m^2)	5.00	28.0 ± 3.9	27.4 ± 4.9	27.7 ± 4.5
Systolic BP (mmHg)	28.00	152.4 ± 21.4	147.7 ± 20.5	149.8 ± 21.0
Diastolic BP (mmHg)	20.00	92.2 ± 12.1	88.9 ± 11.7	90.3 ± 11.8
Total C (mmol/L)	1.50	5.6 ± 1.4	5.7 ± 1.5	5.7 ± 1.5
LDL-C (mmol/L)	1.27	3.4 ± 1.1	3.5 ± 1.1	3.5 ± 1.1
HDL-C (mmol/L)	0.40	1.1 ± 0.4	1.1 ± 1.0	1.1 ± 0.4
SCORE (%)	7.00	9.1 ± 8.1	4.2 ± 3.9	6.4 ± 6.6

*Abbreviations and risk factor thresholds for healthy population: BMI – body mass index (<25 kg/m^2); BP – blood pressure (<140/90 mm Hg); Total C – total cholesterol (<5.00 mmol/L); LDL-C – low-density lipoprotein cholesterol (<3.00 mmol/L); HDL-C – high-density lipoprotein cholesterol (>1.00 mmol/L); SCORE – systematic coronary risk evaluation (SCORE<5%) (13).

Table 3. Main cardiovascular risk factors and total cardiovascular risk (SCORE) in the sample of Bulgarian urban population per age groups (n = 3810)*

Main cardiovascular risk factors and total risk	Mean ± standard deviation (age groups)				
	25-34	35-44	45-54	55-64	65-74
BMI (kg/m^2)	31.3 ± 5.51	27.5 ± 4.6	27.2 ± 4.3	27.9 ± 4.4	27.6 ± 4.5
Systolic BP (mm Hg)	159.0 ± 13.3	153.4 ± 20.0	148.7 ± 17.2	149.6 ± 22.0	149.9 ± 22.7
Diastolic BP (mm Hg)	92.2 ± 6.2	94.3 ± 11.7	90.3 ± 10.5	90.2 ± 12.1	89.3 ± 12.3
Total C (mmol/L)	5.0 ± 0.8	5.6 ± 1.4	5.5 ± 1.3	5.8 ± 1.5	5.6 ± 1.5
LDL-C (mmol/L)	3.2 ± 0.8	3.7 ± 1.0	3.7 ± 1.1	3.4 ± 1.1	3.3 ± 1.1
HDL-C (mmol/L)	0.9 ± 0.3	1.1 ± 0.4	1.1 ± 0.3	1.1 ± 0.4	1.1 ± 0.4
SCORE (%)	0.7 ± 0.5	1.7 ± 2.5	3.5 ± 3.8	7.1 ± 6.3	9.3 ± 7.7

*Abbreviations: BMI – body mass index; BP – blood pressure; Total C – total cholesterol; LDL-C – low-density lipoprotein cholesterol; HDL-C – high-density lipoprotein cholesterol; SCORE – Systematic Coronary Risk Evaluation (13).

Table 4. Cardiovascular risk stratification of the sample of Bulgarian urban population (n = 3810)

SCORE* (%)	No. (%) of participants
≤1	840 (22.1)
2-4	1116 (29.3)
5-9	927 (24.3)
10-14	512 (13.5)
≥15	415 (10.9)
Total	3810 (100)

*SCORE – Systematic Coronary Risk Evaluation (13).

index (BMI) and systolic and diastolic blood pressure were higher in age groups 25-34 and 35-44 than in older age groups (Table 3).

The prevalence of cardiovascular risk was very high in 48.7% of the participants, with a total cardiovascular risk of over 5% (Table 4), ie, according to the European recommendations, nearly half of participants was considered to be in the high risk group for a fatal cardiovascular event in the next 10 years. The risk continuously increased with age in both sexes. Most high-risk participants (SCORE≥5%) were in the groups aged over 45 years and especially over 55 years. High risk was present in 24.3% of the participants aged from 45 to 54 years and in more than half of the participants aged from 55 to 64 years (58.5%). There were no participants with high risk (SCORE≥5%) among those aged <35 years. Nearly a quarter (24.4%) of participants had the total cardiovascular disease risk over 10% (Table 4) and 10.9% of the sample had the total cardiovascular disease risk over 15%. This could be considered an appropriate size for a target group recommended for a high-risk primary prevention strategy. The SCORE stratification according to age and sex (Figures 2 and 3) was characterized by a low total cardiovascular risk in the age group 25-34 in both men and women (100% of the sample had SCORE≤1%). The total cardiovascular risk in men was significantly higher than that in women in the age groups 35-44 and 45-54 ($P < 0.001$ for both). In both age groups, there was higher prevalence of women with low risk (SCORE≤1%), while the prevalence of men with SCORE≥2 was increasing. Nearly half of the men aged 45-54 years (42.4%) had

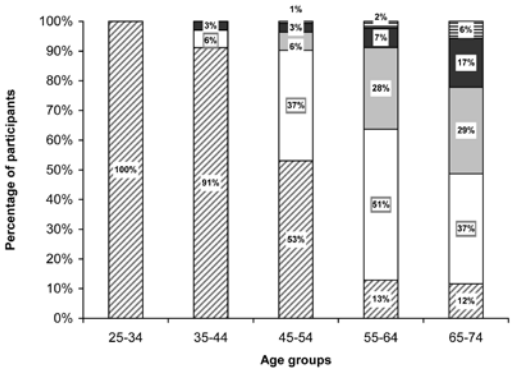

Figure 2. Total cardiovascular risk (SCORE – Systematic Coronary Risk Evaluation; ref. 13) in women. Horizontal-line bars, ≥15; closed bars, 10-14; gray bars, 5-9; open bars, 2-4; diagonal-line bars, ≤1.

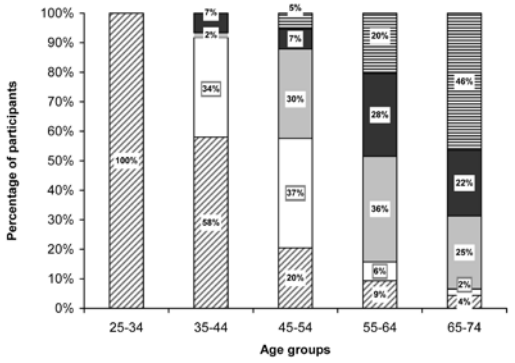

Figure 3. Total cardiovascular risk (SCORE – Systematic Coronary Risk Evaluation; ref. 13) in men. Horizontal-line bars, ≥15; closed bars, 10-14; gray bars 5-9; open bars, 2-4; diagonal-line bars, ≤1.

high total risk (SCORE≥5%). The sex differences in the age groups 55-64 and 65-74 were increasing. The global cardiovascular risk increased steeply in the age groups over 45. Only 6.6% of the men aged 65-74 had low and average total risk (SCORE<5%), while the percentage of participants with excessively high risk (SCORE≥15%) reached 46.6%, ie, nearly half of the men over 65 years had extremely high total risk of developing a fatal cardiovascular event in the next 10 years.

Discussion

Nearly half of the studied sample of Bulgarian urban population had high total cardiovascular risk (SCORE≥5%), according to the European guidelines on cardiovascular prevention. The cardiovascular diseases risk increased across age groups and was significantly higher in men than in women. Nearly one quarter of the studied sample had a total risk over 10%, and 10.1% of participants had SCORE≥15%. Mean values of most of the main cardiovascular diseases risk factors were slightly increased or borderline in comparison with clinical thresholds; values in men and women were similar.

For the purpose of our study, we assessed the urban population in the largest Bulgarian cities. We also chose the five cities because they had well-organized health infrastructure; better equipped GP practices with a direct link to a clinical laboratory; better availability and adherence of GPs (due to less traveling, patients living closer, and presence of nurse or GP assistant); almost full health insurance coverage of the population (almost all patients are insured and registered with a GP); higher education level (90.8% of the participants had higher than secondary education); information access; and employment rate; all of which suggested higher participation rate.

We chose the age interval 25-74 for the participants for several reasons, although the SCORE charts were restricted to the interval 40-65 years. First, this universal age stratification allowed us to compare the data gathered from this study with the data from previous Bulgarian and foreign studies. Another important issue is that the cardiovascular morbidity, mortality, and risk burden have shifted toward younger age, especially in men in our country in the last few years. Moreover, the participants who have at least one cardiovascular disease risk factor at younger age may be at higher relative risk for an event than those with no risk factors at later age. At the same time, people aged over 65 years in Bulgaria account for nearly 17% (2) of the population and continue to increase in number, so we considered they should be represented in the sample.

We realize that the used European calculator was based only on western European population samples and it would have been better if we had had a nationally derived coronary risk evaluation formula. However, developed on the basis of western European populations, the SCORE calculator (High risk chart) was already recommended by Bulgarian society of cardiology and considered an appropriate screening tool to be used in clinical practice. We performed our study as a first step in the development of a national SCORE calculator. Moreover, the overall cardiovascular diseases mortality in Eastern Europe (excluding Russia) is comparable with that in the Scandinavian countries, on the basis of which high risk SCORE chart had been developed (13). Therefore, it was considered a more appropriate instrument than the Framingham risk score, which is based on the American population and widely used in all European countries. However, in the light of the European guidelines, which recommend the development of national risk scores, the precision of the calculator (ie, whether it correctly estimates the current total risk in the Bulgarian population) is another important issue. To the best of our knowledge, this study is the first that provided at least partial population data in Bulgaria to assess the applicability of the SCORE calculator and European guidelines on the national level.

Our results seem very conclusive. A considerably high percentage of the studied population had a high total risk to develop a fatal cardiovascular event in the next 10 years, especially men. This result is consistent with the high cardiovascular disease death rate in the Bulgarian population, although it does not correspond to the relatively low levels of individual risk factors. The higher average risk score in men than in women also cannot be explained by the individual risk factor levels. This again confirms the already accepted thesis and recommendation that not only individual risk factors should be examined and treated, but also the total cardiovascular risk (11). High cardiovascular total risk in the productive age groups of 45-54 and 55-64 is most disturbing due to its negative economic and social impact. This finding also indicates there is "hidden morbidity" or the so-called "morbidity iceberg," as most of the examined people did not know their cardiovascular risk status and did not receive any treatment or lifestyle advice. All this allows for the conclusion that high total individual and population risk do exist and urgent measures are needed to manage it.

Our findings can also be discussed with regard to the three explicit objectives as set by the European guidelines on cardiovascular disease prevention in clinical practice (4,5). The first one is adaptation to national specificity. The regional and local differences in morbidity, mortality, and risk profile can be captured by a total risk assessment of the target population and development of a population-specific risk calculator. However, this is not the only element on which health policy decisions for prevention should be based. The health care resources available in the system, as well as the general socio-economic, environmental, and cultural background, have to be taken into account as well. Considering this, many European countries have already developed their own national cardiovascular risk score calculators (15,16). According to our data and the present health care and economic reality in Bulgaria (2,17), we consider that 5% is a far too low a threshold for a high-risk preventive strategy. Still lacking a national calculator, we propose a national threshold of 15% for Bulgaria, as more economically and politically reasonable for the Bulgarian population when using the European guidelines and SCORE calculator.

The second one is tool for prioritizing patients. The results from our study may be used

to adapt the European guidelines on cardiovascular diseases prevention to the present Bulgarian reality, if no national calculator and guidelines are developed. It is obvious from our results that the group of patients that would benefit from treatment could be larger than those whom the current budget can accommodate. This is the reason why an extensive risk stratification of the studied sample was performed, as we searched for a more reasonable threshold for patients who needed high-risk preventive activities. Nevertheless, total population screening is urgently needed to assess the risk burden of the Bulgarian population, create a database for the follow-up of high-risk individuals, and intensify the pharmacological and non-pharmacological preventive measures, especially in primary care. The final conclusion about an accepted prioritization threshold for nationally financed prevention program needs comprehensive population-representative studies and wide professional and political consensus. The third objective is development of a tool for counseling in clinical practice. The European guidelines are clearly recommended for direct use in clinical practice counseling. We question whether it was scientifically justified to include the risk charts of systematic coronary risk evaluation project in guidelines intended for implementation in a clinical setting before their validation in a contemporary context (18). This study made an important step toward national validation of the guidelines.

Our study has several limitations. There were no participants with high total cardiovascular risk in the age group 25-34, which may be due to the low number of participants in this age group. However, this age group is not even included in the SCORE chart. On the other hand, young participants with higher total risk can be warned and given preventive measures. Another limitation is that the study sample was selected only from the urban population in the largest Bulgarian cities and is not representative for the whole country. Nevertheless, considering the worse socio-economic status and health infrastructure and equipment and lower and slower access to primary and emergency care in distant regions and small villages, we believe that the results of a large-scale population-representative study would show even higher total risk for a larger percentage of the population.

In conclusion, total risk assessment is an essential starting point when considering primary preventive treatment for cardiovascular diseases. However, uncritical application of any risk score may mislead patients and health professionals. More epidemiological studies are needed to ensure that cardiovascular risk assessment is as accurate as possible for the group of patients to which it is applied (19). On the other hand, cardiovascular diseases epidemic in Bulgaria requires an immediate action and systematic and effective solution. Insufficient data for the development of a specific population-targeted risk assessment tool should not be an excuse for a lack of public and health policy activity addressing the problem. We believe that our findings may be used as a starting point for further development of population risk screening program.

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