The perception and knowledge of cardiovascular risk factors among medical students

Aim To assess perceptions, knowledge, and awareness of cardiovascular disease (CVD) risk factors among medical students (freshmen and graduating students).

Methods A descriptive cross-sectional survey based on an anonymous self-administered questionnaire was conducted in 2008 on 443 medical students – 228 freshmen on their enrollment day and 214 students on the day of their final exam at the University of Zagreb School of Medicine, Croatia.

Results The perception and knowledge of some CVD risk factors, e.g., dyslipidemia, arterial hypertension, and metabolic syndrome as well as of lipid-lowering therapy important for CVD prevention was significantly better among graduating students but was still not sufficient. Only 66% of graduating students reported that they would prescribe lipid-lowering therapy to high risk patients. Disappointingly, many graduating students were smoking (30.4%) and had low-awareness of obesity as an important CVD risk factor.

Conclusion These results suggest an urgent need to improve medical students’ knowledge of obesity and low physical activity as important CVD risk factors and of the methods for increasing low high-density lipoprotein-cholesterol and for smoking cessation. All this provides a rationale for modifying the university core curriculum to include more information concerning these issues.

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Although over the past 25 years death rates of cardiovascular diseases (CVDs) have been decreasing in most northern and western European countries and the USA, they have been increasing in most central and eastern European countries and are still the number one cause of death in Europe, responsible for 48% of all deaths (1).

CVD has multiple risk factors, the most important being dyslipidemias, high blood pressure (BP), smoking, overweight and obesity, low physical activity, diabetes, and metabolic syndrome (2). Almost all of them are modifiable, suggesting that most of CVDs are preventable (3).

Perceptions, knowledge, and awareness of CVD risk factors among medical students have not yet been studied and there are no data on how they change during medical education or how successful medical education is in increasing the awareness of the need for prevention in cardiology. Since knowledge and perception of these risk factors is very important for medical students and young physicians, the aim of this PERCRO-STUD (PERception of cardiovascular risk factors by CROatian medical STUDents) cross-sectional survey was to assess the perceptions, knowledge, and awareness of CVD risk factors in medical students.

METHODS

An anonymous self-administered questionnaire with 25 multiple choice questions composed for the purposes of this survey (web-extra material) was answered by all 228 students entering the University of Zagreb School of Medicine on their enrollment day in 2008, as well as by 214 students on the day of their final graduation exam in July and September 2008. This second group consisted of all the students who took their final graduation exam. So, two different generations were interviewed, one at the beginning and one at the end of their medical education. The questionnaire involved numerical information (eg, “What is the recommended level for total plasma cholesterol in mmol/L in subjects without coronary heart disease?” or “What is the recommended blood pressure for subjects with high risk for cardiovascular diseases in mmHg?”) or conversion of non-numerical data to a numerical format by the use of ranking scales (eg, “Rank on a scale of 1 to 10 cardiovascular risk factors listed below according to their relevance beginning with number 1 for the most relevant to number 10 for the least relevant.”). A very similar questionnaire containing 80% of the same questions was validated on general population of Croatia (4). The study and the questionnaire were approved by the Ethics Committee of the University of Zagreb School of Medicine.

Collected data were described by frequencies and percentages. Ranking order of risk factors, obtained by the use of rating scales, was assessed by median values and for equal medians by mode values. Chi-square statistics, or two-sided Fisher exact test when appropriate, were used to assess the association of certain questionnaire items. Data analysis was performed by statistical software R, version 2.10.1 (5).

RESULTS

The proportion of women among 228 freshmen was 69.3% and among 214 graduating students it was 65.3%. A total of 71.9% freshmen knew their blood pressure (BP) but only 13.6% knew their total plasma cholesterol (TC). Of graduating students, 91.6% knew their BP ($\chi_1^2 = 28.234; P < 0.001$) and 40.2% their TC ($\chi_1^2 = 40.101; P < 0.001$). Only 14% of freshmen were smokers and 0.9% were past smokers, while 30.4% of graduating students were smokers and 4.7% were past smokers ($\chi_2^2 = 25.525; P < 0.001$) (Table 1).

Both groups of students perceived cancer as the most feared disease (Table 1). However, freshmen ranked AIDS second and CVD third and graduating students ranked CVD second and AIDS was significantly much less feared ($P < 0.001$, two-sided Fisher exact test).

Freshmen perceived CVD as the leading cause of death and cancer and traffic accidents as the second. Graduating students significantly more often perceived CVD as the leading cause of death and significantly less often cancer and traffic accidents ($P < 0.001$, two-sided Fisher exact test).

Significantly more graduating students than freshmen reported either good or partial knowledge of the last Joint European Guidelines on CVD Prevention ($\chi_3^2 = 80.658, P < 0.001$). Still, 45.3% of graduating students did not answer correctly on the question about the Joint European Guidelines goal value for TC for clinically healthy persons. The same was true for the question on high density lipoprotein (HDL)-cholesterol, to which only half of the graduate students answered correctly ($\chi_5^2 = 115.065; P < 0.001$), as well as for the question on BP, where also only half of the students knew the target values for high-risk subjects ($\chi_3^2 = 27.932; P < 0.001$). Most of graduate students reported that they would prescribe lipid-lowering medications.
### Table 1. Medical students' answers at the beginning and at the end of their education

<table>
<thead>
<tr>
<th>Disease/Category</th>
<th>Beginning of Education</th>
<th>End of Education</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Most feared disease:</strong></td>
<td></td>
<td></td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>cancer</td>
<td>139 (61.0%)</td>
<td>143 (66.8%)</td>
<td></td>
</tr>
<tr>
<td>cardiovascular diseases</td>
<td>31 (13.6%)</td>
<td>46 (21.5%)</td>
<td></td>
</tr>
<tr>
<td>AIDS</td>
<td>44 (19.3%)</td>
<td>16 (7.5%)</td>
<td></td>
</tr>
<tr>
<td>liver diseases</td>
<td>7 (3.1%)</td>
<td>3 (1.4%)</td>
<td></td>
</tr>
<tr>
<td>lung diseases</td>
<td>4 (1.8%)</td>
<td>1 (0.5%)</td>
<td></td>
</tr>
<tr>
<td>no answer</td>
<td>3 (1.3%)</td>
<td>5 (2.3%)</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>228 (100.0%)</td>
<td>214 (100.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Leading cause of death is:</strong></td>
<td></td>
<td></td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>traffic accidents</td>
<td>39 (17.1%)</td>
<td>9 (4.2%)</td>
<td></td>
</tr>
<tr>
<td>cancer</td>
<td>39 (17.1%)</td>
<td>8 (3.7%)</td>
<td></td>
</tr>
<tr>
<td>cardiovascular diseases</td>
<td>148 (64.9%)</td>
<td>196 (91.6%)</td>
<td></td>
</tr>
<tr>
<td>AIDS</td>
<td>0 (0.0%)</td>
<td>1 (0.5%)</td>
<td></td>
</tr>
<tr>
<td>liver diseases</td>
<td>1 (0.4%)</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
<tr>
<td>no answer</td>
<td>1 (0.4%)</td>
<td>0 (0.0%)</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>228 (100.0%)</td>
<td>214 (100.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Smoking habits:</strong></td>
<td></td>
<td></td>
<td>&lt;0.001†</td>
</tr>
<tr>
<td>smokers</td>
<td>32 (14.0%)</td>
<td>65 (30.4%)</td>
<td></td>
</tr>
<tr>
<td>non-smokers</td>
<td>194 (85.1%)</td>
<td>138 (64.5%)</td>
<td></td>
</tr>
<tr>
<td>past smokers</td>
<td>2 (0.9%)</td>
<td>10 (4.7%)</td>
<td></td>
</tr>
<tr>
<td>no answer</td>
<td>0 (0.0%)</td>
<td>1 (0.5%)</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>228 (100.0%)</td>
<td>214 (100.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Knowledge of Joint European Guidelines on CVd Prevention (2):</strong></td>
<td></td>
<td></td>
<td>&lt;0.001†</td>
</tr>
<tr>
<td>very good</td>
<td>8 (3.5%)</td>
<td>18 (8.4%)</td>
<td></td>
</tr>
<tr>
<td>partial</td>
<td>51 (22.4%)</td>
<td>126 (58.9%)</td>
<td></td>
</tr>
<tr>
<td>no knowledge at all</td>
<td>95 (41.7%)</td>
<td>29 (13.6%)</td>
<td></td>
</tr>
<tr>
<td>just heard about it</td>
<td>73 (32.0%)</td>
<td>39 (18.2%)</td>
<td></td>
</tr>
<tr>
<td>no answer</td>
<td>1 (0.4%)</td>
<td>2 (0.9%)</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>228 (100.0%)</td>
<td>214 (100.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Guidelines (2) goal value for total cholesterol in apparently healthy subjects:</strong></td>
<td></td>
<td></td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>&lt;5 mmol/L</td>
<td>83 (36.4%)</td>
<td>117 (54.7%)</td>
<td></td>
</tr>
<tr>
<td>&lt;5.2 mmol/L</td>
<td>91 (39.9%)</td>
<td>79 (36.9%)</td>
<td></td>
</tr>
<tr>
<td>&lt;6.5 mmol/L</td>
<td>34 (14.9%)</td>
<td>9 (4.2%)</td>
<td></td>
</tr>
<tr>
<td>&lt;7.8 mmol/L</td>
<td>4 (1.8%)</td>
<td>2 (0.9%)</td>
<td></td>
</tr>
<tr>
<td>no answer</td>
<td>16 (7.0%)</td>
<td>7 (3.3%)</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>228 (100.0%)</td>
<td>214 (100.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Guidelines-recommended value for high-density lipoprotein-cholesterol in women (2):</strong></td>
<td></td>
<td></td>
<td>&lt;0.001†</td>
</tr>
<tr>
<td>&lt;0.9 mmol/L</td>
<td>11 (4.8%)</td>
<td>4 (1.9%)</td>
<td></td>
</tr>
<tr>
<td>&gt;0.9 mmol/L</td>
<td>25 (11.0%)</td>
<td>33 (15.4%)</td>
<td></td>
</tr>
<tr>
<td>&gt;1 mmol/L</td>
<td>34 (14.9%)</td>
<td>55 (25.7%)</td>
<td></td>
</tr>
<tr>
<td>&lt;1 mmol/L</td>
<td>49 (21.5%)</td>
<td>5 (2.3%)</td>
<td></td>
</tr>
<tr>
<td>&gt;1.2 mmol/L</td>
<td>34 (14.9%)</td>
<td>105 (49.1%)</td>
<td></td>
</tr>
<tr>
<td>&lt;1.2 mmol/L</td>
<td>42 (18.4%)</td>
<td>3 (1.4%)</td>
<td></td>
</tr>
<tr>
<td>no answer</td>
<td>33 (14.5%)</td>
<td>9 (4.2%)</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>228 (100.0%)</td>
<td>214 (100.0%)</td>
<td></td>
</tr>
<tr>
<td><strong>Guidelines-recommended blood pressure for high-risk subjects (2):</strong></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

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*P-values less than 0.05 indicate statistical significance.*
therapy to all the high-risk patients (66%), which is much more than among freshmen, only 10% of whom would prescribe such a treatment ($\chi^2 = 216.540, P < 0.001$).

When asked to rank the factors that increase the CVD risk, graduating students least commonly reported excessive alcohol intake and physical inactivity but ranked obesity much lower than freshmen (Figure 1). Smoking was ranked equally by both groups.

The knowledge on metabolic syndrome was significantly better among graduating students than among freshmen ($\chi^2 = 190.018; P < 0.001$). However, although the knowledge of the possibilities for raising the low HDL-cholesterol was significantly better among graduating students than among freshmen ($\chi^2 = 48.793; P < 0.001$), still half of the graduating students reported that they would advise their patients only to decrease dietary saturated fat of animal origin to achieve this.
Much more graduating students than freshmen reported that they would prescribe combined lipid-lowering therapy ($\chi^2 = 153.520; P < 0.001$). A total of 28.5% of graduating students believed that they had not learned enough about risk factors for CVD.

**DISCUSSION**

This study showed that perception and knowledge of some CVD risk factors was significantly better among graduating students than among freshmen but was still not sufficient. Freshmen’s knowledge and attitudes did not differ much from those of other young people of their age (6). It was better than, for example, the knowledge of students of Michigan high schools, who although rated accidents as the greatest perceived lifetime health risk, identified CVD as the greatest cause of death (6). However, it was about the same as the Croatian general population’s knowledge about causes of death (4).

Although the knowledge on CVD risk factors in our students, as expected, was significantly better at the end of university medical education, the results of this survey suggest insufficient awareness of CVD risk factors and indicate an urgent need for an improved promotion of CVD prevention during medical education. This might be a problem of the curriculum, which comprises mandatory courses in family medicine, epidemiology, and public medicine as well as internal medicine, during which students have only about 4 hours of lectures, 6 hours of seminars, and 12 hours of practicals and clinical audits on CVD risk factors and prevention. However, they discuss CVD risk factors in a number of other clinical audits. Despite the fact that most of graduating students believed they were familiar with last Joint European guidelines on CVD prevention (2), too many of them did not know the target values for TC, HDL-cholesterol, and BP, and only 64.5% reported that they would prescribe lipid-lowering therapy to high-risk subjects. Therefore, if medical education is like this, it is not surprising that several recent studies have shown a failure to achieve the recommended risk factor targets in patients with CVD and those without CVD but with CVD risk factors not only in Croatia but in many other European countries (7-12).

A very disturbing fact is that many students were smoking at the end of their medical education in spite of sufficient knowledge about harmful effects of smoking (14% vs 30.4%). This is in accordance with the data from two Spanish surveys. One of them showed that 27% of final year medical students were smokers and 32.54% of them had started smoking during their medical studies (13). The other showed that the prevalence of smokers among Spanish medical students increased between the first study year and the beginning of the third year from 20% to 31% (14). A survey performed in 2010 on students of four Italian medical schools showed that they had limited knowledge about tobacco dependence, how to treat it, and the critical role of the physician in promoting smoking cessation (15).

Similarly disappointing is graduating students’ low awareness of obesity as an important CVD risk factor. Namely, recent data show that the prevalence of obesity is increasing and reaching epidemic proportions, particularly in the high-risk group of patients with CVD all over Europe and that management of excessive body weight, which is at the moment inadequate, should be given the highest priority (16).

It is encouraging that graduating students had relatively good knowledge on metabolic syndrome and atherogenic dyslipidaemia characterized by low HDL-cholesterol and elevated triglycerides. These are typically encountered in high-risk patients with metabolic disorders like diabetes and/or obesity, which have an increasing prevalence but are largely under-diagnosed and under-treated (17-19). In fact, their knowledge of HDL-cholesterol was not much worse than the knowledge of Croatian general practitioners and/or family doctors, although this was also not satisfactory (20). However, students’ knowledge on increasing low HDL-cholesterol was clearly not sufficient. Another en-
couraging finding is graduating students’ quite positive at-
titude toward combined lipid-lowering treatment consist-
ing of two or more different lipid-lowering drugs, which
was feared by many physicians until very recently, mainly
because of adverse effects (21).

The major limitation of the study is that it compared two
different generations of students, so no clear conclusion
about the success of medical education can be made. For
this purpose, the same population of medical students
should be evaluated at the beginning and at the end of their
education.

Based on the results presented, it could be concluded that
university medical education on CVD prevention, at least in
Croatia, must be substantially improved and should in-
clude strategies to increase not only knowledge but also
perception of modifiable risk factors for CVD and strategies
to reduce or eliminate them. Particular attention has to be
paid to increase students’ knowledge about obesity and
low physical activity as important CVD risk factors, but also
to the methods for increasing low HDL-cholesterol and
smoking cessation. To achieve this, the core curriculum
should be modified to include more information about
these issues.

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management, and interpretation of the results as well as writing the manu-
script. ZS participated in planning the survey, data management, and inter-
pretation of the results as well as writing the manuscript. ET-R participated
in planning the survey, data management and interpretation of the results
as well as writing the manuscript.

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tions that might have an interest in the submitted work in the previous 3
years; no other relationships or activities that could appear to have influ-
ened the submitted work.

References

1 Reiner Ž, Tedeschi-Reiner E. Atherosclerosis – a paradox of
doi:10.1016/S1567-5688(06)81854-4
2 Graham I, Atar D, Borch-Johnsen K, Boysen G, Burel G, Cifkova R,
et al. European guidelines on cardiovascular disease prevention
hjr.0000277983.23934.e9
3 Reiner Ž. How to improve cardiovascular diseases prevention
doi:10.1016/j.numecd.2009.06.006
4 Reiner Ž, Sonicki Z, Tedeschi-Reiner E. Public perceptions of
cardiovascular risk factors in Croatia: The PERCRO survey.
ypmed.2010.09.015
5 Development Core Team R. A language and environment
Computing; 2009.
6 Vanhecke TE, Miller WM, Franklin BA, Weber JE, McCullough PA.
Awareness, knowledge, and perception of heart disease among
hjr.0000112718.83663.9e
7 Reiner Z, Mihatov S, Milicic D, Bergovec M, Planinic D. Treatment
and secondary prevention of ischemic coronary events in Croatia
hjr.0000183910.59741.96
8 Kotseva K, Wood D, De Backer G, De Bacquier D, Pyorala K,
Kell U. Cardiovascular prevention guidelines in daily practice: a
comparison of EUROASPIRE I, II, and III surveys in eight
doi:10.1016/S0140-6736(09)60330-5
Z, et al. EUROASPIRE III. Management of cardiovascular risk
factors in asymptomatic high-risk patients in general practice:
cross-sectional survey in 12 European countries. Eur J Cardiovasc
HJR.0b013e3283383f30
10 Prugger C, Keil U, Wellmann J, de Bacquier D, de Backer G,
Ambrosio GB, et al. Blood pressure control and knowledge of
target blood pressure in coronary patients across Europe: results
doi:10.1586/09739637.2011.593262
11 Bergovec M, Reiner Z, Milicic D, Vracko C. Differences in risk
factors for coronary heart disease in patients from continental
and Mediterranean regions of Croatia. Wien Klin Wochenschr.
2008;120:684-92. Medline19116710 doi:10.1016/s0040-6390(08-
0)00282-0
12 Bergman Markovic B, Vrdoljak D, Krnjačević K, Vučak J, Kern
differences in cardiovascular risk factors in Croatian population.
cmj.2011.52.566
13 Mas A, Nein I, Barrueco M, Cordero J, Guillen D, Jimenez-Ruiz
C, et al. Smoking habits among sixth-year medical students in
doi:10.1016/S0140-6736(04)56040-1
14 Nerin I, Guillen D, Mas A, Crucelaegui A. Evaluation of the
influence of medical education on the smoking attitudes of future