Original articles

Individuals' cardiovascular risk profile projected by family doctors and individuals' knowledge of cardiovascular risk factors: a challenge for primary prevention. The cardiovascular risk prevention project "Help Your Heart Stay Young"

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Coronary artery disease; Epidemiology; Prevention; Risk factors.

Background. **Whether the practice of family doctors of assessing individuals' cardiovascular risk profile improves individuals' knowledge of risk factors in primary prevention has not been established. Accordingly, we evaluated patients' knowledge of cardiovascular risk factors and lifestyle in healthy subjects whose family doctors provided individual cardiovascular risk score.**

Methods. **Subjects who visited their family doctor in a time frame of 3 months, who accepted to fill-in a simple questionnaire measuring their knowledge of cardiovascular risk factors and of non-pharmacological interventions able to reduce cardiovascular risk were evaluated.**

Results. **Fifty-one family doctors were involved. The study sample comprised 4239 subjects (mean age 56 ± 9 years, 62% women) in primary prevention. They were classified by their family doctors, based on the Framingham algorithm, as being at low (< 10%; 45.7% of subjects), medium (10-20%; 38.7% of subjects) or moderate-to-high (> 20%; 15.6% of subjects) cardiovascular risk. The prevalence of obese subjects (40, 48, and 49%, respectively) and of heavy smokers (≥ 20 cigarettes/day; 26, 30, and 34%) increased from the low to the moderate-to-high risk group (both $p < 0.05$). The proportion of subjects unaware of personal history of arterial hypertension (5, 6, and 9%) and that of subjects who were unaware of history of elevated cholesterol levels (10, 11, and 12%, both $p < 0.01$) increased with higher cardiovascular risk score. The proportion of subjects self-reporting blood pressure > 135/85 mmHg, but self-reporting being normotensive (30, 50, and 52%), and the proportion of subjects who referred cholesterol levels > 200 mg/dl among those who self-referred not to have elevated cholesterol levels (13, 25, and 31%) increased both with cardiovascular risk category ($p < 0.001$). The proportion of subjects who were unaware of their personal history of diabetes was similar in the cardiovascular risk groups. The prevalence of low educational level was higher (56, 58, and 62%, $p < 0.01$) and the level of knowledge of non-pharmacological remedies to cardiovascular risk factors (63, 61, and 59%, $p < 0.01$) was lower in higher cardiovascular risk score group. Subjects aged < 55 years showed similar lack of knowledge about cardiovascular risk factors and the proportion of heavy smoking was as high as in the group of older participants.**

Conclusions. **In cardiovascular primary prevention, the projection of higher individuals' risk profile by family doctors was not paralleled by an increase in individual's knowledge of major cardiovascular risk factors and of lifestyle interventions able to reduce the cardiovascular risk.**

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Cardiovascular disease (CVD) is among the most important causes of morbidity, mortality and disability in economically developed countries and the global burden of CVD is likely to worsen in the next 20 years[1]. CVD mortality is declining in Western countries but the CVD incidence is not[2], revealing that an improvement in diagnosis and treatment essentially reduces CVD mortality[2-4]. The role of the main CVD risk factors is well documented; these parameters can be used to predict the likelihood of future CVD events at individual level[5]. However, whether in primary CVD prevention the effort of family doctors (FDs) to quantify global CVD risk is related to higher individuals' knowledge of exposure to CVD risk factors and higher at-

titude to be aware of simple non-pharmacological intervention able to reduce CVD risk, has not been investigated. This aspect may be crucial in primary prevention since the majority of people who die of CVD have no symptoms considered worth treating[6].

In Italy, primary care is covered by the National Health System and carried out by FDs under a national contract. Therefore, in the Italian Health System, FDs represent the fist line of interaction with the general population for fee-free consultation, diagnosis, treatment of CVD risk factors. We thought that this condition is particularly favorable to attempt to estimate the effectiveness of the CVD risk reduction, messages "*broadcasted"* by generalists *before* the onset of clinical signs of CVD.

Accordingly, in the present study, we assessed the level of knowledge of CVD risk factors in healthy individuals whose FDs calculated global CVD risk score.

Methods

Subjects. The study sample comprised subjects who visited their FD's for any reason during a time frame of 3 months. The "Help Your Heart Stay Young" project was launched in September 2001 targeting individuals of both genders, aged 40-65 years, both in primary and secondary CVD prevention, living in the urban area of Naples, Italy[7,8]. Individuals were recruited through a pool of 51 FDs, general practitioners working for the National Health System, members of the Italian Society of General Practitioners, who volunteered to join the project, had electronic database recording their patients' medical history and information related to their practice. Italian residents are entitled to choose a FD for unlimited general medical care free of charge. At the study entry, participants were required to give their informed consent. A simple self-administered questionnaire on risk factors was given to the participants while in the waiting room[7,8]. FDs gave the questionnaire to all subjects who attended their office during a time frame of 3 consecutive months. FDs were blind to the results of the patients' questionnaires.

All FDs joining the project participated in a training section aimed at standardizing data collection procedures and received a written memorandum and a software to calculate the global CVD risk based on the Framingham scoring system (the reference system in Italy at that time)[5]. Quantitative data (cholesterol level, blood pressure, smoking habit) assessed within 6 months prior to the enrolment visit were allowed. FDs were asked to provide the CVD risk score for each participant, and when unable to do so, they were requested to indicate the information that was missing in their database.

In the questionnaire participants were asked to provide information on their socio-economic status (education, occupation), lifestyle (tobacco and alcohol use, physical activity), personal and family history of CVD and risk factors[7,8]. In addition, 11 questions focused on the level of knowledge of major CVD risk factors. Of the global cohort of participants enrolled by January 2003 (n = 7950), 7% were excluded because referred CVD (myocardial infarction, angina, revascularization procedure, stroke). Additional 3089 subjects were excluded because their FDs could not provide quantitative CVD risk score, and 50 subjects did not report their age on the questionnaires; this yielded 4239 subjects suitable for the present study, classified by FDs as being at low (< 10%/10 years), medium (10-20%/10 years) and moderate-to-high (> 20%/10 years) cardiovascular risk. Compared to subjects included in our analyses, those excluded due to lacking CVD risk score were younger (53 vs 56 years), thinner (body mass index 25 vs 26 kg/m^2), slightly more frequently men (41 vs 38%), and self-reported lower blood pressure (131/80 vs 134/82 mmHg), less frequently declared to have no high-school diploma (54 vs 51%), but more frequently declared to be smokers (44 vs 39%) (all $p < 0.05$); they also declared less frequently to be unaware of whether they had hypertension (5 vs 10%) or diabetes (4.6 vs 6.1%), but more frequently declared to be unaware of whether they had high cholesterol levels (21 vs 11%) (all $p < 0.05$); no between-group difference was found in terms of average score to the questionnaire evaluating individual's knowledge of CVD risk factors (mean values 61% in both groups).

Statistical analysis. Data in the tables are reported as percent or mean and standard error of the mean, in parenthesis. The χ^2 analysis was used to assess whether proportions differed between the three groups identified on the basis their global CVD risk. For continuous variable, the analysis of variance, with *post-hoc* Sheffé test was used to measure the differences between CVD risk groups. With regard to discrete variables, a series of logistic regressions were employed to evaluate the main effects and interactions of CVD risk category and age strata (< 55 or ≥ 55 years) for each dependent variable. For continuous variables, the 2-way analysis of variance was used to evaluate the main effects and interactions of CVD risk score and gender, as well as CVD risk score and age strata. Logistic regression analysis was used to assess independent correlation of indicator variables for unawareness of arterial hypertension status, of elevated cholesterol levels, and of being diabetic. Similarly, independent correlates of unawareness of blood pressure levels within hypertensives, and independent correlations of heavy smoking within smokers were evaluated by logistic regression analyses. Multiple linear regression analysis was used to evaluate independent correlates of higher score on the questionnaire evaluating the knowledge of CVD risk factors. For all tests, a two-tailed p value of < 0.05 was used to reject the null hypothesis.

Results

In part by definition, the proportion of risk factors increase with increasing CVD risk category, and risk factors tend to coexist (mean age 51 ± 9, 58 ± 7, 63 ± 7 years; self-reported systolic and diastolic blood pressure 128/79 ± 16/10, 137/83 ± 16/10, 143/85 ± 18/9 mmHg; proportion of males 22, 44, 68%; proportion of smokers 29.5, 42.6 and 45.5%, all $p < 0.01$) (Table I). However, among the CVD risk factors that were not included in the CVD risk score defined by the FD, the proportion of overweight (body mass index 25.0-29.9 kg/m^2), of mildly obese subjects (body mass index 30-34.9 kg/m^2) also increased with higher CVD risk score, whereas the prevalence of moderate-to-severe obesity (body mass index ≥ 35 kg/m^2) was substantially constant across the three CVD risk groups. The proportion of subjects who were unaware of their personal history of arterial hypertension or elevated cholesterol levels also increased with higher CVD risk score. Among subjects who declared to have normal cholesterol levels, the proportion of those who actually reported a recently estimated cholesterol level > 200 mg/dl was high and actually increased with CVD risk category. Similarly, among subjects who declared to be normotensive, the proportion of those who actually referred blood pressure levels > 135/85 mmHg was surprisingly high and also increased with CVD risk category. The proportion of subjects who were unaware of whether or not they had diabetes was constant across the three CVD risk score groups, reaching approximately 11% of subjects in the moderate-to-high CVD risk. Among smokers, the proportion of subjects smoking ≥ 20 cigarettes/day was largest in the group with the highest CVD risk. The proportion of subjects with relatively low education levels also tended to increase with higher CVD risk. This trend paralleled an individual's poorer knowledge of CVD risk factors and simple non-pharmacological remedies to them.

Age, cardiovascular risk score and awareness of risk factors. We re-analyzed the cohort subdividing each CVD risk score group by age < 55 or ≥ 55 years (Table II). The proportion of males was higher in the younger age stratum in the low and medium CVD risk score groups (both $p < 0.01$), and was between 3/5 to 4/5 of both age strata in the highest CVD risk group. The proportion of overweight was elevated in the CVD risk groups, and increased in particular with older age and CVD risk category. Specifically, the proportion of mild obesity increased across the CVD risk groups in both age strata, whereas the proportion of moderate-to-severe obesity increased stepwise with higher CVD risk only in those with age < 55 years. The proportions of subjects who were unaware of their personal history of high-cholesterol levels, or hypertension or diabetes increased across the CVD risk groups with no significant impact of age strata. Moreover, within subjects who declared to have normal cholesterol levels, the proportion of those who actually referred cholesterol levels > 200 mg/dl increased with greater CVD risk score in both age strata. Similarly, among subjects who declared being normotensive, the proportion of those who actually referred blood pressure levels > 135/85 mmHg was higher with greater CVD risk in both age strata. It was relevant to find that smokers were more

Table I. Cardiovascular risk category and awareness of risk factors.

	Cardiovascular risk score (%)			p
	< 10	10-20	≥ 20	
Patients (n = 4239)	1936 (45.7%)	1642 (38.7%)	661 (15.6%)	
Overweight (%)	39.9	47.5	49.3	< 0.001
Mild obesity (%)	10.7	15.7	18.0	< 0.001
Moderate-to-severe obesity (%)	3.8	3.6	3.0	NS
Unaware of total cholesterol (%)	9.8	10.7	11.6	< 0.03
Self-reported no high-cholesterol level				
Cholesterol levels > 200 mg/dl (%)	13	25	31	< 0.001
Unaware whether hypertensive or not (%)	4.7	5.9	8.6	< 0.01
Self-reported no hypertension status				
Blood pressure ≥ 135/85 mmHg (%)	30	50	52	< 0.001
Unaware whether diabetic or not (%)	8.8	9.7	10.6	NS
Smokers				
< 10 cigarettes/day (%)	38	32	28	< 0.01
10-20 cigarettes/day (%)	36	38	39	NS
≥ 20 cigarettes/day (%)	26	30	34	< 0.01
No high-school diploma (%)	55.6	58.2	62.2	< 0.01
Evaluation of the awareness of cardiovascular risk factors:				
% of correct answers	62.9 ± 0.44	61.1 ± 0.51*	58.9 ± 0.89*§	< 0.01

Data are expressed as percentages or mean ± SEM. * $p < 0.05$ vs group with < 10% cardiovascular risk; § $p < 0.05$ vs group with 10-20% cardiovascular risk.

Table II. Cardiovascular risk score and awareness of risk factors: analyses by age strata.

	Cardiovascular risk score (%)						p	
	< 10		10-20		≥ 20		Age	Age and risk groups
	Age < 55 years (n=1294; 66.8%)	Age ≥ 55 years (n=642; 33.2%)	Age < 55 years (n=517; 31.5%)	Age ≥ 55 years (n=1125; 68.5%)	Age < 55 years (n=74; 11.2%)	Age ≥ 55 years (n=587;88.8%)		
Males (%)	27.6	12.0	60.5	36.6	73.0	67.7	< 0.001	NS
Overweight (%)	38.3	43.4	50.2	45.4	46.6	48.7	< 0.02	< 0.02
Mild obesity (%)	9.4	13.4	17.7	14.9	21.9	18.0	< 0.003	< 0.01
Moderate-to-severe obesity (%)	4.1	2.6	3.8	3.6	6.8	2.2	NS	NS
Unaware of total cholesterol (%)	9.9	9.5	9.3	11.7	16.2	13.1	NS	NS
Self-reported no high-cholesterol level								
Cholesterol > 200 mg/dl (%)	12	16	21	26	28	32	NS	NS
Unaware of whether hypertensive or not (%)	4.7	4.9	5.5	6.2	12.2	9.6	NS	NS
Self-reported hypertension status								
Blood pressure ≥ 135/85 mmHg (%)	25	42	54	47	62	52	NS	NS
Unaware of whether diabetic or not (%)	8.0	9.6	8.2	10.6	10.8	11.6	NS	NS
Smokers (%)	37	15	63	34	67	56	< 0.001	NS
< 10 cigarettes/day (%)	36	47	26	37	31	27	NS	NS
10-20 cigarettes/day (%)	37	28	39	37	29	40	NS	NS
≥ 20 cigarettes/day (%)	27	26	35	26	40	33	NS	NS
No high-school diploma (%)	49.8	65.3	54.1	60.2	58.3	60.4	< 0.001	< 0.01
Evaluation of the knowledge on cardiovascular risk factors: % of correct answers	62.8 ± 0.58	62.9 ± 0.81	62.9 ± 0.81	60.3 ± 0.62	60.3 ± 2.37	58.8 ± 0.85	NS	NS

Data are expressed as percentages or mean ± SEM.

prevalent among the younger subjects in both CVD risk score < 10% or 10-20% (both $p < 0.001$). No significant interaction of age and CVD risk category was seen with regard to the number of cigarettes smoked per day. Older age tended to be associated with higher proportion of low educational level in all CVD risk groups especially in the first two CVD risk groups, whereas the between-age difference was no longer significant in the highest CVD risk group. No interaction was seen between CVD risk category and age-strata with regard to the level of individual's knowledge of CVD risk factors and simple non-pharmacological remedies to them.

Multivariate analysis. As shown in multivariate analyses adjusted for gender (Table III), older age independently predicted a higher frequency of lack of knowledge of personal history of arterial hypertension or diabetes, but showed no significant relation to lack of knowledge of elevated cholesterol levels. While age did not show significant relation with the frequency of lack of knowledge of blood pressure levels within those who self-reported hypertension, interestingly, among subjects who self-reported dyslipidemia, older age was actually associated with less frequent unawareness of cholesterol levels; similarly, within smokers, older age was independently associated with lower frequency of heavy smoking. Nevertheless, older age also predicted lower score form the questionnaire on knowledge of CVD risk factors.

Interestingly, a low educational level (no high-school diploma) independently predicted lower frequency of lack of knowledge of hypertensive status, but higher likelihood of unawareness of personal history of elevated blood cholesterol levels. However, among subjects who self-reported hypertension, a low educational level was not associated with the frequency of individuals who were aware of their blood pressure levels. A low educational level independently predicted higher frequency of unawareness of cholesterol levels among those who self-reported dyslipidemia, and higher frequency of heavy smoking (among smokers), and also independently predicted a lower score on the questionnaire evaluating individual's knowledge of CVD risk factors. No independent relations were found between education and unawareness of being diabetic or not.

Discussion

In the present study, we analyzed a cohort of 4239 subjects without history of CVD, extracted from a random pool of those who visited their FDs, and whose FDs were able to provide a CVD risk score based on the Framingham algorithm, the reference CVD risk scoring system at the time of our investigation. As a surrogate and raw indicator of the efficacy of the practice of FDs to contribute to CVD risk reduction, through individuals' knowledge of risk factors and compliance to lifestyle modification, expectations were that with higher CVD risk category calculated by FDs, individuals would have shown a profile of greater knowledge of personal history of exposure to CVD risk factors, and attitude to be informed on the importance of controlling them by lifestyle modifications (i.e. body weight needs to be controlled and reduced, eating habits affect body weight and cholesterol levels, physical activity should be performed regularly, cigarette smoking must be completely stopped). This is because the variables used to define a raw profile of the awareness and compliance of the participants to CVD risk reduction programs, not formally structured in a specific and experimental trial, are not part of the equation used to calculate the CVD score, but conceptually linked to them, with the exception of the smoking habit. In contrast, the individual's level of knowledge of CVD risk factors was substantially lower at higher CVD risk category defined by FDs, along with the prevalence of low educational levels, a potential marker for low socio-economic status. In fact, the striking results of our study were that the prevalence of overweight and obesity, the prevalence of subjects smoking > 20 cigarettes/day, and of those who were unaware of whether they had diabetes or hypertension, actually increased with increasing CVD risk score.

Table III. Gender-adjusted multivariate analysis.

	Lack of knowledge of					Smoking ≥ 20 cigarettes/day	Knowledge of CV risk factors***
	Arterial hypertension status	Elevated cholesterol levels	Being diabetic	Blood pressure levels*	Cholesterol levels**		
Age	1.02/year (1.007-1.04)	NS	1.01/year (1.001-1.03)	NS	0.96/year (0.93-0.99)	0.99/year (0.98-0.999)	-0.04
No high-school diploma	0.73 (0.56-0.95)	1.27 (1.03-1.56)	NS	NS	2.2 (1.3-3.7)	1.26 (1.007-1.58)	-0.12

All analyses were adjusted for gender. Data are statistically significant adjusted odds ratios and 95% confidence intervals, or statistically significant adjusted standardized correlation coefficients with regard to the relation of age and educational level to the score from the questionnaire on knowledge of cardiovascular (CV) risk factors and simple non-pharmacological remedies to them. * among hypertensive subjects; ** among dyslipidemic subjects; *** questionnaire score.

Moreover, among subjects who declared to be normotensive, the proportion of those who actually reported blood pressure levels > 135/85 mmHg also increased with CVD risk category, as increased the proportion of those who declared to have normal lipid profile but reported recently evaluated cholesterol levels > 200 mg/dl. No specific age-CVD risk category interaction was seen in our study. However, it is worth noting that the group of subjects aged < 55 years had similar if not worse CVD risk burden than the group of older participants, as suggested by the high number of cigarettes/day smoked and the elevated proportion of subjects with moderate-to-severe obesity.

Clinical implications. The scenario of our cross-sectional study has potentially severe clinical implications, first of all for the known relations of CVD risk factors, including obesity which is not accounted for by the Framingham algorithm, with the likelihood of subclinical CVD[9-15] – known powerful and independent predictors of CVD events[5,16]. The relevance of modifiable risk factors as predictors of CVD has been recently reinforced, suggesting that they can explain up to 90% of the future CVD events in populations[17]. Moreover, a recent work on coronary atherosclerosis clearly and directly demonstrated that coronary plaques progress in subjects with not sufficiently reduced low-density lipoprotein levels and those who do not stop smoking[18]. Not surprising, therefore, the area in which our survey was conducted is characterized by higher CVD mortality compared to the Italian average[19]. Moreover, in a different population-based sample from the same Italian region, several negative trends have been described with regard to increased prevalence of smokers among adolescents and women, a low attitude to physical activity, an increasing incidence of arterial hypertension, type 2 diabetes, hypercholesterolemia and overweight[20]. These trends are somewhat comparable to those in other industrialized areas, and may reflect a rapid transition from a rural to a urbanized lifestyle, eating behaviors and socio-economic culture[21,22].

Therefore, it is troubling that in our study sample, the prevalence of heavy smokers, obese individuals, subjects unaware of their cholesterol levels or diabetes, hypertension, actually increased rather than decreasing with higher CVD risk score calculated by FDs. Since the survey was performed on subjects who visited their FDs who had data to calculate individual CVD risk score, these findings may suggest that subjects either do not perceive the CVD risk factors or are not compliant with recommendations for non-pharmacological primary prevention to reduce CVD risk, or both. Alternatively, our findings suggest that the efficacy of the practice of FDs in primary prevention was suboptimal with regard to primary prevention targets. We cannot exclude that the professional background of FDs, who are potentially more focused on treating diseases, may have constituted a biased approach to healthy subjects in primary prevention, especially those in the younger age. Interestingly, in fact, those who were excluded from the analysis because they had no CVD risk estimated by their FDs were younger, thinner, and had a lower self-reported blood pressure level than those included in the analysis. Recently, in a large survey in Northern Italy, it was highlighted that general practitioners have a low attitude to record risk factors[23]. However, the FDs involved in our survey included those with electronic record of their patients, accepted a verification of their practice, were subjected to National Health System cost verifications, and were previously involved in developing clinical guidelines for general practice. These characteristics actually reveal physicians' attitude to optimize their practice. Indeed, the average of participants with CVD risk computed in our study is well above than the average reported in other studies[23-26].

Whit regard to the FDs involved in primary prevention, other factors may be involved in the dynamic of communication/management of CVD risk factors at individual level. The UK system experience shows how high can be the burden of clinical management of coronary heart disease risk and how difficult is to reach the target set[27]. Lack of time and prescription costs have been indicated as the major problems in preventing fully successful implementation of guidelines in general practice[28]. Giving these results, the likelihood that FDs succeed in influencing lifestyle and eating behaviors may be less than expected, as already suggested in a different experience in secondary prevention[29].

Individuals' receptivity and primary prevention targets. Ideally, subjects should be fully aware of their CVD risk and actively involved in CVD risk management to reach possible targets[30]. There is evidence that a patient-targeted approach to consultation in primary care may benefit patients without leading to anxiety[31], but whether this applies also to primary prevention on a large scale is unclear[32]. In secondary CVD prevention, individuals may be more motivated and aware of the risk of CVD[33], whereas in primary prevention it is more likely that unawareness of the importance of CVD risk factors and lack of compliance to lifestyle modifications are among the major problems[28]. It may be difficult to fully involve subjects in primary prevention or clearly explain the kind of CVD risk. For instance, Italy is one of the countries where by law, cigarette packages must bear a clear and strong warning on the fact that smoking is a threat for health. Nevertheless, in our study, the proportion of heavy smokers was higher in groups at higher CVD risk, especially among subjects in the young age. To this extent, population-based strategies to fight smoking habit, improve information on food calories, salt and saturated fat contents, and invest on the knowledge about their use, in order to fight high blood pressure and cholesterol levels and

overweight may be crucial steps to reduce CVD risk in population. Of note, in our previous investigation in a group of subjects in secondary prevention extracted from the same population source as the sample analyzed in the present report, we found that smoking habit, and in particular heavy smoking, was significantly diffused as it was overweight and overt obesity[8]; in addition, 66% of the sample in secondary prevention had a lower educational level. In the present study, approximately 16% of the sample was at risk of experiencing a major CVD event within 10 years from the date of assessment. On the other hand, the sample in secondary prevention represented approximately 7% of the entire study population[7], and their mean age was approximately 60 years, whereas the mean age of the group in primary prevention in the highest CVD risk category was 63 years. Those findings may lead to a number of considerations: a survival effect may be responsible at least in part for the relatively low prevalence of subjects in secondary prevention and their younger age compared to those in primary prevention; while the Framingham CVD risk projection system may overestimate the real CVD risk in the Italian population, in our population sample, overweight and obesity, substantially associated with a low educational level, may add further and significantly to the real risk profile in our population.

A low educational level, a condition that accounts for, at least in part, the impact of low socio-economic status from the epidemiological point of view, independently predicted higher frequency of lack of knowledge of elevated cholesterol levels, and higher frequency of subjects unable to report a cholesterol level among those who self-reported high blood lipid levels. A low educational level independently predicted heavy smoking among smokers, and lower score from the questionnaire on CVD risk factors and non-pharmacological remedies to them. The question then is whether these subjects simply do not perceive their CVD risk, or whether they care less about CVD prevention, and the reason for this. Interestingly, however, a low educational level was associated with a lower prevalence of unknown history of hypertension. It is difficult to interpret this finding. However, we may speculate that because subjects pay no fee for a clinical evaluation, including blood pressure measurement, but pay for cholesterol level assessment, subjects with a low educational level are most likely to be in the low socio-economic stratum, are more likely aware of their blood pressure levels but ignore cholesterol level or the relevance of obesity. Then, this finding reveals an important information, because in a state-based Health System such as the Italian one, the cost burden supported by the Community of hospitalizations for CVD is likely to be much higher than that of cholesterol level assessment. On the other hand, we should emphasize that smoking has a cost, and the associations of a low educational level, low socio-economic status and heavy smoking reveal a sociologic dynamic that should be faced at social level to be most likely cost-effective.

Study limitations. In the present study, we did not technically assess the "awareness" of CVD risk in individuals, but their knowledge of CVD risk factors. Moreover, at the moment, we cannot assess whether subjects who declared to be normotensive, or not to have high cholesterol levels or diabetes, actually had normal blood pressure, cholesterol and glucose levels in the FDs' database. In addition, the source of data comprised subjects who visited their FDs and therefore, extrapolation of our findings to the general population may need caution, and all the information is based on voluntary self-report without validation independent of the participants, including self-reported previous CVD disease. The latter, in particular, may easily result in an underestimation of the CVD prevalence in the population. However, such a possibility makes our findings even more relevant. Moreover, in 41% of the subjects who declared to be free of CVD, FDs did not have full data in their database to assess CVD score. Compared to subjects included in our analyses, those excluded due to lacking CVD risk score were younger, thinner, had lower self-reported blood pressure, less frequently declared to be unaware of personal history of hypertension or diabetes. Therefore, it appears that FDs may have been less compulsive to obtain full data for quantitative assessment in subjects who were clearly at a lower global CVD risk, primary because there were younger and thinner. In fact, the most frequently missing data was the cholesterol level. Quantitative CVD assessment has a cost, and subjects and FDs may have simply and spontaneously assumed that the action was not cost-effective. Nevertheless, it is unlikely that incorporating this part of the cohort would have changed our findings.

In conclusion, in CVD primary prevention, the projection of higher individuals' risk profile by FDs was not paralleled by an increase in individual's knowledge of CVD risk factors and of lifestyle modifications able to reduce the CVD risk. Therefore, quantitative assessment of CVD risk by FDs may not result in the expected beneficial reduction of CVD events if individuals are not sufficiently and actively involved in risk reduction programs.

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