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CLINICAL RESEARCH

Ignorance of cardiovascular preventive measures is associated with all-cause and cardiovascular mortality in the French general population

La méconnaissance des mesures de prévention cardiovasculaire est associée avec la mortalité totale et cardiovasculaire en population française

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KEYWORDS
Cardiovascular mortality;
Low-risk population;
Risk factors;
Risk prediction algorithm

Summary
Background. — Cardiovascular disease (CVD) is the primary cause of premature death in Western countries.
Aim. — To assess the effect of patient ignorance of CVD risk modifiers on mortality.
Methods. — We studied 4930 men and women in primary prevention, who consulted at the Department of Preventive Cardiology of a university hospital in France from 1995 to 2011. Questionnaires on socioeconomic level, medical history, cardiovascular risk factors, knowledge of CVD, drug intake, lifestyle and dietary recommendations, and adherence to treatments were administered by trained medical staff. Vital status (cause and date of death, in patients who died) was obtained through the French National Database. Multivariable predictive relationships with total mortality were evaluated using the Cox proportional hazards model.

Abbreviations: CI, confidence interval; CVD, cardiovascular disease; HDL, high-density lipoprotein; HR, hazard ratio; LDL, low-density lipoprotein.

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Results. — Mean follow-up was 8.6 years; 123 deaths, including 31 cardiovascular deaths, were recorded. Overall, 1305 patients (26%) were ignorant of CVD preventive measures; their mean age (53 years) was similar to that of the non-ignorant population, but most were men with a low educational level, a higher body mass index and significantly more cardiovascular risk factors (diabetes, hypertension). The ignorant group's lifestyle did not conform to cardiovascular guidelines, with less physical activity and more frequent inappropriate diet and smoking. All-cause and cardiovascular mortalities were higher among these patients. In the multivariable analysis, after adjusting for age, sex, smoking status, diabetes, hypertension, body mass index and educational status, ignorance of CVD preventive measures remained significantly associated with all-cause mortality (hazard ratio 1.93, 95% confidence interval 1.31—2.83; $P < 0.01$).
Conclusion. — Ignorance of cardiovascular risk modifiers was significantly associated with all-cause mortality in a general French population.

MOTS CLÉS
Mortalité cardiovasculaire ;
Population à bas risque ;
Facteurs de risque ;
Algorithme de prédiction du risque

Résumé
Contexte. — Les maladies cardiovasculaires représentent la première cause de mortalité prématurée dans les pays développés.
Objectif. — Nous avons évalué l'effet de la méconnaissance du risque cardiovasculaire sur la mortalité.
Méthodes. — Nous avons étudié 4930 femmes et hommes en prévention primaire qui ont consulté de 1995 à 2011 dans le service de cardiologie préventive d'un hôpital universitaire français. Des questionnaires portant sur le niveau socio-économique, la connaissance des maladies cardiovasculaires, l'hygiène de vie et les recommandations diététiques, les antécédents médicaux, la prise de médicaments, l'observance et les facteurs de risque cardiovasculaire ont été administrés par un médecin entraîné. Le statut vital (causes et date du décès) a été obtenu à partir de la base nationale des décès. Une analyse multivariée évaluant la mortalité totale a été réalisée en utilisant un modèle de Cox.
Résultats. — Le suivi moyen des 4930 patients a été de 8,6 ans et 123 décès (incluant 31 décès cardiovasculaires) ont été enregistrés. Un total de 1305 sujets (26 %) ne connaissent aucune mesure de prévention cardiovasculaire. Leur âge était similaire (53 ans) au reste de la population mais ces sujets étaient plus souvent des hommes avec un niveau d'éducation relativement bas, un indice de masse corporelle plus élevé et significativement plus de facteurs de risque cardiovasculaire (diabète, hypertension). Leur mode de vie n'était pas conforme aux recommandations cardiovasculaires, avec moins d'activité physique et plus souvent une diététique inappropriée et plus souvent tabagiques. Les mortalités totale et cardiovasculaire étaient plus élevées parmi les sujets ne connaissant pas les mesures de prévention cardiovasculaire. Lors de l'analyse multivariée, après ajustement pour l'âge, le sexe, le tabagisme, le diabète, l'hypertension artérielle, l'indice de masse corporelle et le niveau d'éducation, l'absence de connaissance des mesures de prévention cardiovasculaire est associée significativement à la mortalité totale (*hazard ratio* 1,93, IC95 % 1,31—2,83 ; $p < 0,01$).
Conclusion. — La méconnaissance des mesures qui modifient le risque cardiovasculaire est significativement associée à la mortalité totale en population française.

Background

Progress in pharmacological and interventional treatments and in preventive medicine has led to a decrease in the consequences of cardiovascular disease (CVD) in terms of mortality and morbidity [1]. Prevention accounts for a major part of this progress: the reduction in major cardiovascular risk factors, such as tobacco use, arterial hypertension and dyslipidaemia, is estimated to account for more than 50% of the decrease in cardiovascular deaths [1,2]. There is, however, still plenty of room for improvement, as a large proportion of patients do not follow lifestyle advice and dietary prescriptions, and do not achieve their therapeutic objectives [3]. The combination of underuse of therapeutic

education and unsatisfactory adherence to recommended CVD prevention measures continues to take its toll on mortality.

The effect on mortality of adherence to lifestyle and dietary recommendations and treatments has been widely studied [4—8]. On the other hand, the role of knowledge of preventive measures for CVD has received little attention [9]. Yet, understanding the disease is of primary importance in preventive medicine, notably to ensure better adherence; this is one of the main aims of therapeutic education [10]. In cardiology, knowledge of the disease seems even more important because, beyond preventive measures, recognising the warning signs of myocardial infarction, for example, and knowing how to manage them can be life saving.

Our aim was to study knowledge of primary preventive measures for CVD in the general population, and its relationship with all-cause and cardiovascular mortality.

Methods

Patient population

We conducted a prospective cohort study that included 6956 apparently healthy asymptomatic men and women. Participants were included between November 1995 and December 2011 in the Department of Preventive Cardiology of our teaching institution (Toulouse University Hospital, Toulouse, France). The patients were either self referred or referred by their primary care physician or cardiologist for cardiovascular risk assessment, management of cardiovascular risk factors or routine ambulatory screening for CVD [11—15]. Patients with a history of coronary heart disease (International Classification of Disease, 9th revision, codes 410.0 to 414.9), stroke (codes 433.0 to 438.9 except 437.3 to 437.7), atherosclerosis (codes 440.0 to 440.9) or aneurysms (codes 441.0 to 442.9) were excluded. Vital status on 31 December 2011 was obtained for each patient through the national database that records all deaths occurring in the French population each year (Répertoire national d'identification des personnes physiques [RNIPP]) [16]. Authorization to use these data was obtained in accordance with French law (Commission nationale de l'informatique et des libertés [CNIL]).

Questionnaires and measurement of clinical variables

At baseline, extensive questionnaires were completed by trained medical staff during an interview with the patient. The physician carrying out the interview ensured good understanding of the questions. Information on exposures was collected at baseline only. Data concerning socioeconomic level, medical history, cardiovascular risk factors, lifestyle habits and drug intake were recorded. Patients were asked to bring their latest drug prescription to the inclusion visit. In particular, ignorance of CVD was defined by the question: ''In your opinion, are there any precautions that can be taken to avoid a heart disease such as myocardial infarction?''. The answer was quoted ''No'' if the patient was unable to give the name of a classical risk factor or to propose any lifestyle measures. Educational level was defined by the highest diploma obtained by the patient: a diploma lower than the high school diploma (education until age 18 years) was considered as a low educational level. All drugs taken during the 2 weeks preceding the visit were recorded. Family history of premature CVD (before the age of 55 years in the father or 65 years in the mother) was recorded. People who currently smoked or who had stopped for less than 3 years were considered as current smokers. Height, weight and arterial blood pressure (mean of two measurements performed with a standard sphygmomanometer in a seated position after at least 5 minutes of rest) were measured by the medical staff according to standardized protocols. Body mass index was calculated as weight divided by height squared (kg/m^2). Diabetes was defined as diabetes treated with oral antidiabetic agents or insulin; dyslipidaemia was defined as dyslipidaemia treated with statins; and hypertension was defined as hypertension treated with antihypertensive drugs. For those patients requiring dietary measures (for hypertension, diabetes or dyslipidaemia), adherence to the diet was assessed by the question ''Do you follow a diet for your hypertension/diabetes/cholesterol?''.

Laboratory methods

Blood samples were taken after at least 10 hours of overnight fasting. Serum total cholesterol and triglycerides were measured by enzymatic assays (Boehringer, Mannheim, Germany). High-density lipoprotein (HDL) cholesterol was measured after sodium phosphotungstate-magnesium chloride precipitation of apolipoprotein B-containing lipoproteins. Low-density lipoprotein (LDL) cholesterol was determined by the Friedewald formula when triglycerides were below 4.6 mmol/L (400 mg/dL) [17]. Glucose concentrations were measured using a conventional enzymatic method based on hexokinase-glucose-6-phosphate dehydrogenase.

Statistical analysis

Statistical analysis was performed on STATA statistical software, version 11.2 (STATA Corporation, College Station, TX, USA).

First, we described the baseline characteristics of the patients and compared these characteristics by outcome occurrence, comparing patients who remained alive (on 31 December 2011) with patients who died during follow-up. Qualitative variables were compared between groups using the χ^2 test or Fisher's exact test when necessary. Student's *t* test was used to compare the distribution of quantitative data; the Mann—Whitney *U* test was used when the distribution departed from normality or when homoscedasticity was rejected. Following the same method, we then compared baseline characteristics of patients according to their ''ignorant'' versus ''non-ignorant'' status.

Survival was also analysed, with events being cases of death. Hazard ratios (HRs) for mortality and 95% confidence intervals (CIs) were assessed using a Cox model. The independent variables initially introduced in the survival model were all variables associated with mortality in the univariate analysis with a P-value < 0.10. A backward analysis was then applied until only variables significantly and independently associated with mortality ($P < 0.05$) remained. The proportional-hazard assumption was tested for each

covariate by ''log-log'' plot method curves (−ln[−ln(survival)]), for each category of nominal covariate, versus ln(analysis time). None of the assumptions could be rejected. The same survival analysis was conducted with the cases of cardiovascular death as events.

To evaluate the causal effect of ignorance on mortality, and to reduce bias caused by confounding variables, a propensity score matching analysis was conducted [18]. We first estimated a propensity score including all the baseline characteristics of the patients. The balancing property of the propensity score was tested. All variables leading to an unbalanced property of the propensity score were excluded, and a new propensity score was calculated until the balancing property was satisfied. Ignorant patients were matched one-to-one with non-ignorant patients using the nearest neighbour method, defining a matched cohort (ignorant versus non-ignorant). We conducted the same survival analysis, adding the propensity score as a new covariate in the global study population and in the matched cohort [19]. These analyses were successively conducted with all-cause mortality and cardiovascular mortality.

Results

General data

A total of 6956 patients visited the Department of Preventive Cardiology from November 1995 to December 2011. After excluding minors and patients with CVD at inclusion, as well as patients who returned to the same department on several occasions, we reached a total of 4930 patients who were followed up until 31 December 2011 (Fig. 1).

The mean age of the 4930 patients was 53 years and 59% were men (Table 1). During the mean follow-up of 8.6 years, 123 deaths (including 31 cardiovascular deaths) were recorded. The other main cause of death was cancer (49%). Other causes (trauma, suicide, infectious disease, chronic obstructive pulmonary disease) represented 26% of all deaths. The patients who died were older (55 ± 11 vs 53 ± 11 years; $P < 0.01$) and most were men (86% vs 59%; $P < 0.01$); a higher percentage had a low educational level (78% vs 62%; $P < 0.01$) and there was a higher proportion of diabetic patients (15% vs 5%; $P < 0.01$). The patients who died also had less favourable blood pressure and lipid profiles, with a mean systolic blood pressure of 146 ± 20 mmHg (vs 136 ± 18 mmHg; $P < 0.01$) and an LDL cholesterol concentration of 4.37 ± 1.21 mmol/L (vs 3.99 ± 1.18 mmol/L; $P < 0.01$).

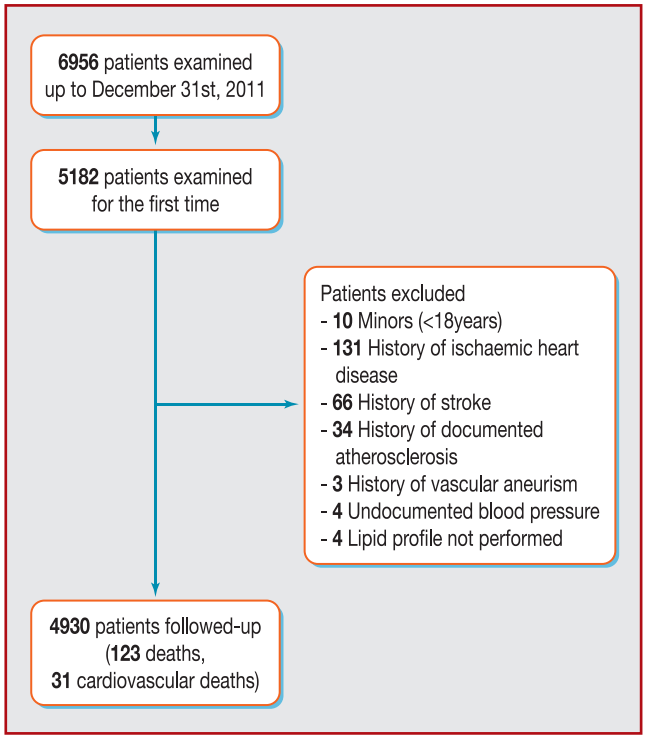

Figure 1. Flow chart.

Lifestyle data

Deceased patients were more likely to have been smokers (41% vs 25%; $P < 0.01$), and their mean body mass index (27 ± 5 kg/m^2) was higher than that of patients who remained alive (26 ± 5 kg/m^2; $P = 0.04$) (Table 1).

The percentage of excess alcohol consumers (> 20 g/day for a man or > 10 g/day for a woman) was higher among patients who died (40% vs 29%), whereas there were more moderate consumers among patients who remained alive (44% vs 36%). There was no significant difference in physical activity.

Among the patients who needed to follow a diet, those who did not follow a diet were proportionally more numerous among the patients who died, but the difference was not significant (44% vs 35%; $P = 0.16$).

Data relating to knowledge

Overall, 1305 patients (26%) gave a negative answer to the question: ''In your opinion, are there any precautions that can be taken to avoid a heart disease such as myocardial infarction?'' (Table 1). Ignorance was greater among the patients who died (40% vs 26%; $P < 0.01$).

When categorizing patients according to their knowledge of preventive measures of CVD (Table 2), ignorant patients were more generally men (62% vs 59%; $P = 0.014$) with a low educational level (75% vs 58%; $P < 0.01$). Age did not significantly differ between the two groups. Ignorant patients presented more frequently with conventional cardiovascular risk factors such as diabetes (9% vs 4%; $P < 0.01$) and hypertension (25% vs 18%; $P < 0.01$). A family history of CVD did not result in significantly better knowledge (13% positive family histories in ignorant patients vs 15% in non-ignorant patients; $P = 0.11$). Ignorant patients had higher systolic blood pressure (137 ± 19 mmHg vs 135 ± 17 mmHg; $P < 0.01$), higher triglyceride concentrations (2.03 ± 2.00 vs 1.65 ± 1.59 mmol/L; $P < 0.01$) and lower HDL cholesterol concentrations (1.35 ± 0.41 vs 1.43 ± 0.43 mmol/L; $P < 0.01$). On the other hand, their LDL cholesterol concentrations were lower (3.89 ± 1.21 vs 4.04 ± 1.17 mmol/L; $P < 0.01$).

In ignorant patients, we found the basic markers reflecting poor adherence to lifestyle and dietary recommendations: more smokers (30% vs 24%; $P < 0.01$), more frequent total absence of physical activity (33% vs 23%; $P < 0.01$), higher body mass index (27.0 vs 25.7; $P < 0.01$) and,

Table 1 General study population, overall and according to vital status.

	All ($n = 4930$)	Alive ($n = 4807$)	Deceased ($n = 123$)	P
Age (years)	53 ± 11	53 ± 11	55 ± 11	< 0.01
Men	2927 (59)	2821 (59)	106 (86)	< 0.01
Educational level < high school completion	3095 (63)	2999 (62)	96 (78)	< 0.01
Family history of premature CVD	723 (15)	708 (15)	15 (12)	0.43
Tobacco use	1248 (25)	1198 (25)	50 (41)	< 0.01
Diabetes	255 (5)	237 (5)	18 (15)	< 0.01
Hypertension	981 (20)	952 (20)	29 (24)	0.30
Dyslipidaemia	1323 (27)	1298 (27)	25 (20)	0.10
Body mass index (kg/m²)	26 ± 5	26 ± 5	27 ± 5	0.04
Systolic blood pressure (mmHg)	136 ± 18	136 ± 18	146 ± 20	< 0.01
Diastolic blood pressure (mmHg)	82 ± 9	82 ± 9	86 ± 10	< 0.01
Pulse pressure (mmHg)	54 ± 13	54 ± 13	60 ± 15	< 0.01
Total cholesterol (mmol/L)	6.17 ± 1.29	6.15 ± 1.30	6.46 ± 1.35	0.01
LDL cholesterol (mmol/L)	4.00 ± 1.19	3.99 ± 1.18	4.37 ± 1.21	< 0.01
HDL cholesterol (mmol/L)	1.41 ± 0.42	1.41 ± 0.42	1.29 ± 0.38	< 0.01
Triglycerides (mmol/L)	1.75 ± 1.72	1.75 ± 1.73	1.79 ± 1.22	0.79
Alcohol				< 0.023
No alcohol consumption	1370 (28)	1340 (28)	30 (24)	
Consumption < 20 g/day for men, < 10 g/day for women	2140 (43)	2087 (44)	44 (36)	
Consumption > 20 g/day for men, > 10 g/day for women	1420 (29)	1371 (29)	49 (40)	
Physical activity				0.59
No regular physical activity	1256 (25)	1220 (25)	36 (29)	
Light physical activity every week	2641 (54)	2577 (54)	64 (52)	
Intense physical activity for ≥ 20 minutes, one to two times/week	837 (17)	820 (17)	17 (14)	
Intense physical activity for ≥ 20 minutes, > three times/week	186 (4)	180 (4)	6 (5)	
Diet				0.16
Diet not followed	761 (35)	736 (35)	25 (44)	
Diet followed	1404 (64)	1372 (65)	42 (56)	
Ignorance of CVD preventive measures	1305 (26)	1256 (26)	49 (40)	< 0.01

Data are expressed as mean ± standard deviation or number (%). CVD: cardiovascular disease; LDL: low-density lipoprotein; HDL: high-density lipoprotein.

when applicable, less frequent adherence to a diet (46% vs 31%; $P < 0.01$).

Effect on all-cause mortality and cardiovascular mortality

All-cause mortality and cardiovascular mortality were higher among ignorant patients, at 3.75% (vs 2.04%; $P < 0.01$) and 1.00% (vs 0.50%; $P = 0.050$), respectively. In the multivariable analysis, after adjustment for age, sex, tobacco use, diabetes, hypertension, LDL concentration and educational level, ignorance remained associated with excess risk of all-cause mortality (HR 1.93, 95% CI 1.31—2.83; $P < 0.01$) and cardiovascular mortality (HR 2.15, 95% CI 1.01—4.61; $P = 0.050$) (Table 3).

As this was an observational study, a propensity score was calculated to reduce potential confounding factors. The propensity to be ignorant versus non-ignorant was determined by initially including all the basic characteristics of the patients, and then excluding the variable ''physical activity'' in order to satisfy a balanced propensity score. This propensity score was used to obtain a sample composed of two matched groups (ignorant versus non-ignorant). We thus obtained a sample of 1302 ignorant patients matched with 1302 non-ignorant patients (76 deaths, including 21 cardiovascular deaths). In the multivariable analysis, after adjustment for age, sex, tobacco use, diabetes, hypertension, LDL concentration, educational level and propensity score, ignorance remained associated with an excess risk of all-cause mortality (HR 2.25, 1.41—3.59; $P < 0.01$). When the multivariable analysis was repeated on the matched sample only, after adjustment for age, sex, tobacco use, diabetes, hypertension, LDL concentration and educational level, ignorance remained associated with an excess risk of all-cause mortality (HR 2.27, 1.42—3.63; $P < 0.01$).

With regard to cardiovascular mortality, after adjustment for the same covariates and for the propensity score, the excess risk related to ignorance was no longer significant

Table 2 General study population categorized according to status (ignorant versus non-ignorant).

	Non-ignorant ($n = 3625$)	Ignorant ($n = 1305$)	*P*
Age (years)	53 ± 11	53 ± 12	0.10
Men	2115 (59)	812 (62)	0.014
Educational level < high school completion	2113 (58)	982 (75)	< 0.01
Family history of premature CVD	549 (15)	174 (13)	0.11
Tobacco use	855 (24)	393 (30)	< 0.01
Diabetes	142 (4)	113 (9)	< 0.01
Hypertension	654 (18)	327 (25)	< 0.01
Dyslipidaemia	992 (27)	331 (25)	0.16
Body mass index (kg/m²)	25.7 ± 4.8	27.0 ± 5.1	< 0.01
Systolic blood pressure (mmHg)	135 ± 17	137 ± 19	< 0.01
Diastolic blood pressure (mmHg)	82 ± 9	82 ± 9	0.56
Pulse pressure (mmHg)	53 ± 13	55 ± 14	< 0.01
Total cholesterol (mmol/L)	6.19 ± 1.29	6.08 ± 1.31	< 0.01
LDL cholesterol (mmol/L)	4.04 ± 1.17	3.89 ± 1.21	< 0.01
HDL cholesterol (mmol/L)	1.43 ± 0.43	1.35 ± 0.41	< 0.01
Triglycerides (mmol/L)	1.65 ± 1.59	2.03 ± 2.00	< 0.01
Alcohol			< 0.01
No alcohol consumption	935 (25)	499 (35)	
Consumption < 20 g/day for men, < 10 g/day for women	1724 (46)	487 (35)	
Consumption > 20 g/day for men, > 10 g/day for women	1098 (29)	421 (30)	
Physical activity			< 0.01
No regular physical activity	832 (23)	424 (33)	
Light physical activity every week	1952 (54)	689 (53)	
Intense physical activity for ≥ 20 minutes, one to two times/week	680 (19)	157 (12)	
Intense physical activity for ≥ 20 minutes, > three times/week	157 (4)	29 (2)	
Diet			< 0.01
Diet not followed	498 (31)	263 (46)	
Diet followed	1103 (69)	301 (54)	

CVD: cardiovascular disease; LDL: low-density lipoprotein; HDL: high-density lipoprotein.

(HR 2.36, 0.93—5.95; $P = 0.07$). Repeating the same analysis only on the matched sample, after adjustment for age, sex, tobacco use, diabetes, hypertension, LDL concentration and educational level, yielded a similar result (HR 2.39, 0.95—6.05; $P = 0.07$).

Discussion

This study has demonstrated the high prevalence of ignorance of preventive measures for CVD in the general population (26% of patients), and its effect on all-cause and

Table 3 Effect of ignorance on all-cause mortality and cardiovascular mortality.

	Number of patients	HR	95% CI	*P*
All-cause mortality[a]	4930	1.93	1.31—2.83	< 0.01
All-cause mortality[b]	4930	2.25	1.41—3.59	< 0.01
All-cause mortality[c]	2604	2.27	1.42—3.63	< 0.01
Cardiovascular mortality[a]	4930	2.15	1.01—4.61	0.050
Cardiovascular mortality[b]	4930	2.36	0.93—5.95	0.07
Cardiovascular mortality[c]	2604	2.39	0.95—6.05	0.07

CI: confidence interval; HR: hazard ratio.
[a] Multivariable analysis on the general study population (4930 patients) adjusted for age, sex, tobacco use, diabetes, hypertension level, low-density lipoprotein concentration and educational level.
[b] Multivariable analysis on the general study population (4930 patients) adjusted for the same covariates and for the propensity score.
[c] Multivariable analysis on the matched sample (1302 ignorant patients and 1302 non-ignorant patients) adjusted for the same covariates.

cardiovascular mortality (HRs of 1.93 and 2.15, respectively, in multivariable analysis). The study has also outlined the profile of the ignorant patient: male, with a low educational level and presenting with cardiovascular risk factors (diabetes, tobacco use, hypertension). Age or family history of CVD did not seem to improve knowledge of preventive measures.

In our work, the principal cardiovascular risk factors (age, sex, diabetes, tobacco use, LDL cholesterol concentration and systolic arterial pressure) and the usual lifestyle risk factors (excess weight, alcohol consumption) were associated with mortality. These results are in agreement with the major epidemiological studies on preventive cardiology [4,6,8]. Interestingly, we again observed more frequent moderate alcohol consumption in patients who remained alive (44% vs 36%) and more frequent excessive consumption in deceased patients (40% vs 29%), and has already been reported [20]. Non-adherence to a diet (35% in the general population; 46% in ignorant patients vs 31% in non-ignorant patients; $P < 0.01$) was similar to that in other studies [3]. Although the effect of non-adherence to lifestyle and dietary recommendations on mortality has been widely studied, as far as we are aware the effect of ignorance of preventive measures of CVD on mortality has been studied very little [9].

In our sample, the prevalence of ignorance of cardiovascular diseases is high (26%), and is similar to that in previous works. A few studies have assessed cardiovascular disease knowledge among the general population. A study by Ford and Jones [21], based on data from 1985, showed that education was the strongest predictor of cardiovascular disease knowledge. The most recent works on the subject were national studies, which analysed the knowledge of cardiovascular risk factors in patients with myocardial infarction [22,23]. In these studies, only 28—42% of the sample had a good knowledge of cardiovascular risk factors. A study in the USA [24] showed that more than 10% of the general population did not know that chest pain or discomfort is a symptom of heart attack. Similar data can be found in neurology, where the knowledge of stroke risk has been studied extensively. Stroebele et al., in a systematic review [25], found that the majority of the studies had shown that only 60—86% of the population could name at least one stroke risk factor (ranging from 60% in a Spanish study to 80—86% in two studies in the USA), and 23—32% of the population were unable to name at least one of the warning signs of stroke (from 23% in an Indian study to 32% in a German study).

Patients' lack of knowledge of disease in general is a concept that is known and used in therapeutic education. However, its effect on mortality has been little studied and, to our knowledge, this study is the first to show an association between ignorance of CVD and total mortality, even after adjustment for educational level. In cardiology, knowledge of the disease seems of primary importance, as beyond adherence to lifestyle and dietary recommendations, the patient needs to know the main warning signs of myocardial infarction or an episode of heart failure (e.g. chest pain, breathlessness, weight gain, oedema, palpitations) and what must be done (call for aid, emergency consultation). Ignorance appears to be logically associated with mortality, which was confirmed by this study.

Clinical consequences

CVD is still a burden, with high morbidity and mortality rates that need to be reduced. The American Heart Association 2020 goal is to reduce deaths from CVD and stroke by 20%. The World Health Organization's primary goal is a 25% relative reduction in the incidence of premature mortality resulting from non-communicable diseases, including CVD [26,27].

Even if public health programme implementation is challenging, ignorance is in itself a risk factor, and so must be taken into account to achieve these goals. The principal clinical consequence of this study is to further encourage therapeutic education of the patient, with particular attention paid to knowledge of the disease. The profile of the ignorant patient is that of a man with diabetes or high blood pressure and a low educational level. We need to seek ways to improve knowledge in these patients, who are already overexposed in other domains [28]. Prevention needs to be reinforced at an individual level, using an approach adapted to the patient's understanding. Collective prevention campaigns must also be accessible and comprehensible to this particular audience. It was noteworthy that in the multivariable analysis, and specifically after adjustment for educational level, ignorance was still associated with all-cause mortality. Nevertheless, a high educational level does not obviate the need for appropriate medical information.

Study limitations

The principal limitation of this study is the definition of ignorance of preventive measures for CVD. To limit bias, ignorance was evaluated using the same questionnaire administered by the same experienced physician in the Centre for the Detection and Prevention of Atherosclerosis, who consistently ensured proper understanding of the questions. Coherent results were obtained, with ignorant patients having a higher rate of non-adherence to elementary precautions (regarding tobacco use, physical activity and adherence to a diet) and a higher prevalence of the consequences (higher systolic blood pressure, higher triglyceride concentration). Thus, these findings seem to endorse the study method.

This type of study also carries the risk of bias through confounding factors. We attempted to reduce their number by multivariable analysis adjusted for the most important factors, notably educational level, and by the use of a propensity score.

Another limitation of this study is the small number of events, notably cardiovascular events, which leads to lack of power, and may explain why the effect of ignorance on cardiovascular mortality did not reach significance after adjustment for the propensity score.

This study was also carried out in a single country (France) and is a single-centre study. The study sample may be considered as being at higher risk of CVD than the general population. However, this sample has previously been validated as being close to the general French population, notably with a similar life expectancy [11].

Conclusion

In our study, ignorance of preventive measures for CVD was significantly associated with all-cause mortality. The profile of the ignorant patient is that of a man with a low educational level, with tobacco, hypertension or diabetes. Particular attention must be given to these patients in terms of therapeutic education.

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Disclosure of interest

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The other authors declare that they have no competing interest.

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