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ORIGINAL ARTICLE

Unemployment is associated with high cardiovascular event rate and increased all-cause mortality in middle-aged socially privileged individuals

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Abstract

Purpose To assess prospectively the association between employment status and cardiovascular health outcomes in socially privileged individuals.

Methods The incidence of fatal and non-fatal cardiovascular events and all-cause mortality rate were monitored during 12 years in a national sample of 5,852 French volunteers, aged 45–64 years, who were free of cardiovascular disease or other overt disease at baseline. The association between health outcomes and employment status was tested using Cox proportional modelling with adjustment for confounding factors.

Results Compared to randomly selected individuals, these volunteers were characterized by higher education level and socio-economic status and lower cardiovascular risk and mortality rate. A total of 242 cardiovascular events (3.5 events per 1,000 person-years) and 152 deaths from all causes (2.2 deaths per 1,000 person-years) occurred during follow-up. After adjustment for age and gender, both cardiovascular event risk [HR (95 % CI) 1.84 (1.15–2.83), $p = 0.01$] and all-cause mortality [2.79 (1.66–4.47), $p = 0.0002$] were increased in unemployed individuals compared to workers. These poor health outcomes were observed to the same extent after further adjustment for clinical, behavioural and socio-demographic characteristics of individuals at baseline [HR (95 % CI) 1.74 (1.07–2.72), $p = 0.03$ and 2.89 (1.70–4.69), $p = 0.0002$, respectively]. In contrast, neither cardiovascular event risk nor all-cause mortality was significantly increased in retired individuals compared to workers after adjustment for confounding factors.

Conclusions These results support the existence of a link between unemployment and poor cardiovascular health and suggest that this link is not mediated by conventional risk factors in middle-aged socially privileged individuals.

Keywords Social status · Cohort · Cardiovascular event risk · All-cause mortality · Unemployment

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Introduction

Over the last decades, the relationship between unemployment and poor health has attracted growing attention (Hammarstrom and Janlert 2005). The interest has increased even more with the worsening of the economic crisis in the last years (Astell-Burt and Feng 2013; Karanikolos et al. 2013). Yet the nature of this relationship is still a matter of debate (Jin et al. 1995). Many studies suggest that poor health is a direct or indirect consequence of unemployment and that this causal link is mediated by specific factors or behaviours (Hammarstrom 1994; Janlert 1997; Laitinen et al. 2002a; Martikainen 1990; Moser et al. 1987; Hammer 1997a). Some studies rather insist on an opposite causal link in which poor health increases the risk of unemployment (Bartley and Owen 1996; Bockerman and Ilmakunnas 2009; Claussen 1993; Jusot et al. 2008; Salm 2009), while others propose that poor health results from a deleterious social environment that also favours unemployment

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(Fergusson and Boden 2008; Hammer 1997b; Hoffmann et al. 2007; Leino-Arjas et al. 1999; Lundin et al. 2010; Montgomery et al. 1996; Morris et al. 1992). Whatever its nature, the relationship between unemployment and poor health is certainly influenced by the cultural and social context in which individuals live. For example, potential deleterious health effects of unemployment are likely to be reduced in countries with more generous social security systems (Bambra and Eikemo 2009; Gerdtham and Ruhm 2006; McLeod et al. 2012; Stuckler et al. 2009).

Several indicators of poor health have been associated with unemployment at the population and individual levels. A meta-analysis of prospective studies performed before 2009 shows that unemployment is associated with higher all-cause mortality at the individual level (Roelfs et al. 2011). Among the causes of death, the evidence for higher suicide rate and poorer mental health in unemployed individuals is strong (McKee-Ryan et al. 2005; Milner et al. 2013). The evidence for higher cancer mortality is equally convincing based on the analysis of the literature until 1997 (Lynge 1997) and on data subsequently reported for some types of cancer (Conway et al. 2010; Greenwood et al. 2003). By contrast, the evidence for higher cardiovascular morbidity and mortality in unemployed individuals remains conflicting. The analysis of data before 1997 is not conclusive (Weber and Lehnert 1997) and more recent studies are also contradictory, some describing an increased incidence of coronary heart disease (Dupre et al. 2012; Gallo 2012; Mejean et al. 2013) and stroke (Gallo et al. 2004; Gallo et al. 2006), while others report no increase (Gerdtham and Johannesson 2003; Yarnell et al. 2005) or even a decreased (Ruhm 2007) cardiovascular event risk.

The present study aims to test whether cardiovascular event rate is associated with employment status in a cohort of middle-aged socially privileged individuals free of overt disease at baseline, who lived in a relatively protective social environment corresponding to the French social security system. The approach used, which was originally fostered by the Framingham Heart Study (Mahmood et al. 2014), is based on the longitudinal follow-up of the cohort to identify risk factors predicting the incidence of cardiovascular events. The analyses benefited from a detailed phenotype available at the individual level for exploring potential confounding or mediating factors.

Materials and methods

The analyses were performed in a population of middle-aged volunteers selected throughout the metropolitan French territory between October 1994 and June 1995 (Hercberg et al. 2004). Among 79,976 candidates who originally volunteered, 21,481 returned a completed questionnaire and informed consent, and 14,412 were eligible on the basis of the absence of overt disease that could have threatened survival during follow-up (mainly established cardiovascular diseases and malignant cancers, respectively, coded as I00-I99 and C00-C97 in the 10th Revision of the International Classification of Diseases). After exclusion of the candidates falling outside the age range (35–64 years), 13,017 volunteers were finally enrolled in the cohort and followed until July 2007. The study received approval from the French medical ethics committee and the national committee for the protection of privacy and civil liberties.

At inclusion, volunteers completed socio-demographic questionnaires concerning their education, occupation, region and location of residence. They were also invited to attend a medical visit after overnight fasting. During this visit, blood sampling and clinical examination were conducted by trained investigators using standardized protocols in a mobile unit or in one of the 65 health centres that had been set up throughout the French territory (Hercberg et al. 1998). Blood pressure was measured once on each arm with a standard mercury sphygmomanometer and appropriate-sized cuff after 10 min of rest in a supine position. If mean systolic and diastolic pressures were below 160 and 100 mm Hg, respectively, they were used for the analyses. Otherwise, blood pressure was measured again on each arm after ten additional minutes of rest, and the lowest mean was retained for the analyses. Hypertension was defined as systolic pressure ≥140 mm Hg and/or diastolic pressure ≥90 mm Hg and/or use of antihypertensive medication. Body mass index was calculated with measured weight and height values, and obesity was defined as body mass index ≥30 kg/m^2. Venous blood sampling was performed in recumbent position, and all samples were sent to a laboratory that centralized biochemical measurements. Enzymatic methods were used to measure plasma total cholesterol and triglyceride levels and fasting glucose concentration (Hercberg et al. 1998). Dyslipidemia was defined as total cholesterol level ≥6.5 mmol/l and/or triglyceride level ≥2.2 mmol/l and/or use of hypolipidemic drugs. Diabetes was defined as fasting glucose concentration ≥7 mmol/l and/or use of antidiabetic drugs.

To assess daily food intakes, volunteers were requested to provide several 24-h dietary records (mean ± SD 3.9 ± 1.7) over a 1-year period using an instruction manual for the codification of over 900 food items and the estimation of portion size (Le Moullec et al. 1996). For the present analyses, food items were grouped into six main categories: fruits and vegetables (fruits, dried fruits, vegetables and pulses), dairy products (milk, yogurts and cheeses), meats (red meats, poultries and processed meats), fishes (fishes and seafood), breads and starchy foods (breads, pasta and rice, potatoes, cereals and flours) and convenience foods (sandwiches, pizzas, quiches, savoury pies, appetizers, cakes, pastries, puddings, croissants, biscuits, ice creams, chocolates and sweets). The records also included data on 37 alcoholic beverages for the assessment of alcohol consumption. Energy without alcohol intake was calculated from food consumption using a composition database specifically developed for this study (Hercberg 2005). Records with invalid data (energy intake <100 or >6,000 kcal/24 h) were excluded from the analyses (110 records removed from a total of 48,902).

During follow-up, volunteers were periodically asked to complete questionnaires reporting medication intake, health event, medical consultation and hospitalization. Once a possible adverse outcome was suspected, all relevant records including results of diagnostic tests and medical procedures were collected from the physicians and hospitals involved in the management of the outcome, or directly from the volunteers. An expert committee confirmed all events using imagery reports and/or combinations of clinical, biological and electrocardiographic criteria. At the end of follow-up, the vital status of volunteers and the causes of death were also verified in the national death registry in order to double-check the outcomes identified by the cohort investigators. Primary outcomes were major fatal and non-fatal cardiovascular events coded as I00-I99 in the 10th Revision of the International Classification of Diseases, cardiovascular mortality and all-cause mortality.

The analyses were performed after exclusion of volunteers with no information on health or death ($n = 276$) or occupational status ($n = 143$), potential under-reporters ($n = 59$) who had more than 1/3 of their dietary records reporting an energy intake <800 kcal/24 h (men) or <500 kcal/24 h (women) (Kesse-Guyot et al. 2011) and those with missing values in one or more of the confounding variables used for adjustment in multivariate models.

The profile of the 5,852 volunteers retained for the analyses was evaluated by comparing their characteristics with those of randomly selected individuals in the same age range (35–64 years). The comparison was performed separately for clinical and socio-demographic characteristics because none of the cohorts of randomly selected individuals included all these characteristics (French urban communities selected between 1994 and 1997 for the third MONICA study (Berard et al. 2011) and decennial health survey conducted in 2003 by the French National Institute of Statistics and Economic Studies (Lanoe and Makdessi-Raynaud 2005), respectively). Categorical variables were compared with Chi-square test (or Fisher's exact test when necessary), and Student's *t* test was used to compare continuous variables in univariate analyses. For the comparison of clinical characteristics, 954 women were randomly excluded from the cohort of volunteers to match the number of men, and the mortality rate was calculated over a 10-year follow-up period. For the comparison of socio-demographic characteristics, education was categorized into three levels (primary school, secondary school and university), occupation into eight socio-professional groups (upper management, middle management, white-collar, blue-collar, self-employed, retired, homemaker and unemployed), the region of residence into eight geographical areas that covered all French metropolitan regions [Paris area (Ile-de-France), north-west (Basse-Normandie, Haute-Normandie, Picardie, Nord-Pas-de-Calais), north-east (Alsace, Lorraine, Franche-Comté), west (Poitou-Charentes, Pays-de-la-Loire, Bretagne), centre-east (Champagne-Ardenne, Bourgogne, Centre), south-west (Limousin, Midi-Pyrénées, Aquitaine), Rhône-Alpes-Auvergne (Rhône-Alpes, Auvergne), Mediterranean coast (Languedoc-Roussillon, Provence-Alpes-Côte-d'Azur, Corse)] and the location of residence into three kinds [urban (any urban centre offering at least 5,000 jobs), peri-urban (any zone surrounding an urban centre or located away but with at least 40 % of its residents working in an urban centre) and rural (any other area)] (Bertrais et al. 2004).

The association between occupational status and health outcomes in the cohort of volunteers was analysed by Cox proportional hazard modelling. Two health outcomes were retained, i.e. fatal and non-fatal cardiovascular events and all-cause mortality. It was not possible to use cardiovascular mortality as an outcome because the number of cases was too low ($n = 35$) for an accurate risk assessment. Occupational status was classified into four categories: the worker group that included workers from upper and middle management, white and blue collars and self-employed, the retired group, the homemaker group and the unemployed group. However, testing the association was not possible in homemakers due to the very low number of health outcomes occurring in this group during follow-up (only eight cardiovascular events and four deaths). Multivariate analyses were performed by adjusting for various characteristics of volunteers at baseline: model 1 adjusted for gender and age, model 2 adjusted for gender, age and other biological variables (obesity, hypertension, dyslipidemia and diabetes), model 3 adjusted for gender, age, other biological variables and behavioural variables (smoking, alcohol consumption and dietary intakes), model 4 adjusted for gender, age, other biological variables, behavioural variables and socio-demographic variables (education, region and location of residence).

As a control, Cox modelling was also used to confirm the association between health outcomes and several clinical and behavioural characteristics of volunteers at baseline that are recognized cardiovascular risk factors: gender, age, obesity, hypertension, dyslipidemia, diabetes, smoking and alcohol consumption. Two types of multivariate models

Table 1 Clinical characteristics at baseline and 10-year mortality rate in volunteers compared to randomly selected individuals

	Volunteers	Randomly selected individuals	p
N	4,898	3,208	–
Men [n (%)]	2,449 (50.0)	1,595 (49.7)	0.82
Age (years)	49.9 ± 5.3	50.1 ± 8.2	0.18
Body mass index (kg/m^2)	24.5 ± 3.7	26.2 ± 4.6	<0.0001
Obesity [n (%)]	379 (7.7)	565 (17.6)	<0.0001
Systolic blood pressure (mm Hg)	124.9 ± 14.1	132.0 ± 19.0	<0.0001
Diastolic blood pressure (mm Hg)	80.4 ± 8.8	82.6 ± 11.6	<0.0001
Antihypertensive drug treatment [n (%)]	484 (22.1)	449 (14.0)	<0.0001
Hypertension [n (%)]	1,618 (33.0)	1,370 (42.7)	<0.0001
Plasma total cholesterol (mmol/l)	6.1 ± 1.0	5.9 ± 1.0	<0.0001
Plasma triglyceride (mmol/l)	1.1 ± 0.8	1.3 ± 1.1	<0.0001
Lipid-lowering drug treatment [n (%)]	354 (16.2)	323 (10.1)	<0.0001
Hypercholesterolaemia [n (%)]	1,747 (35.7)	1,126 (35.1)	0.62
Diabetes [n (%)]	233 (4.8)	382 (11.9)	<0.0001
All-cause mortality [n (%)]	120 (2.4)	156 (4.9)	<0.0001

Continuous variables are expressed as mean ± SD. The percentages in parenthesis for the categorical variables refer to the total number of individuals in each cohort. Univariate comparisons were performed with Fisher's exact test for categorical variables and with Student's t test for continuous variables

were applied for this purpose: models 1 adjusted for gender and age, models 4 adjusted for gender, age, other biological variables (obesity, hypertension, dyslipidemia and diabetes), behavioural variables (smoking, alcohol consumption and dietary intakes) and socio-demographic variables (education, occupation, region and location of residence).

Clinical, behavioural and socio-demographic characteristics of volunteers at baseline were compared across occupational groups by analysis of covariance (ANCOVA) tests (continuous variables) or logistic regression modelling (categorical variables). Two types of multivariate analyses were performed: tests or models p_1 adjusted for age and gender, tests or models p_4 adjusted for gender, age, other biological variables (obesity, hypertension, dyslipidemia and diabetes), behavioural variables (smoking, alcohol consumption and dietary intakes) and socio-demographic variables (education, region and location of residence).

Associations or differences were considered statistically significant when p value <0.05. All analyses were performed with the statistical discovery software JMP 11 (SAS, Cary NC).

Results

The comparison of clinical characteristics and 10-year mortality rate between volunteers and randomly selected individuals is reported in Table 1. Although the percentage of men and mean age are not different between the two groups of individuals, volunteers have lower mean body mass index and obesity rate, lower mean systolic and diastolic blood pressures and hypertension rate and lower diabetes rate. The situation is more complex for blood lipids as volunteers have lower mean triglyceride level but higher mean total cholesterol level, so that hypercholesterolaemia rate is not different between the two groups of individuals. Notably, the percentage of individuals treated by lipid-lowering or antihypertensive drugs is much higher in volunteers. Overall, all-cause mortality rate at 10 years is twice smaller in volunteers than in randomly selected individuals.

When the entire cohort of volunteers is taken into account for the comparison of behavioural and socio-demographic characteristics, the percentage of men is lower than in randomly selected individuals (Table 2). The volunteers have a much lower smoking rate, but a slightly increased percentage of alcohol drinkers. They are much more educated, their distribution across the French metropolitan territory is not identical to that of randomly selected individuals, and they live more often in an urban location and less frequently in a rural location. Upper and middle management are overrepresented while white and blue collars are vastly under-represented in volunteers. They are less often self-employed, retired or unemployed, but the percentage of homemakers is higher in comparison to randomly selected individuals.

In the cohort of volunteers (n = 5,852), a total of 242 cardiovascular events (3.5 events per 1,000 person-years) and 152 deaths from all causes (2.2 deaths per 1,000 person-years) occurred during follow-up (11.9 ± 0.1 years). The distribution of these health outcomes across occupational groups is shown in Table 3. Compared to the worker group, the unemployed group is associated with higher cardiovascular event risk and with increased all-cause mortality in all adjustment models. In contrast, the increase in cardiovascular risk and all-cause mortality in the retired group does not reach statistical significance whatever the adjustment model.

Table 2 Behavioural and socio-demographic characteristics of volunteers compared to randomly selected individuals

	Volunteers	Randomly selected individuals	*p*
N	5,852	13,920	–
Men [*n* (%)]	2,449 (41.8)	6,606 (47.5)	<0.0001
Age (years)	48.4 ± 6.3	48.3 ± 8.2	0.40
Smoking [*n* (%)]	762 (13.0)	3,939 (28.3)	<0.0001
Alcohol consumption [*n* (%)]	4,863 (83.1)	11,359 (81.6)	0.01
Education [*n* (%)]			
Primary school	1,214 (20.7)	3,823 (27.5)	
Secondary school	2,266 (38.7)	6,833 (49.1)	<0.0001
University	2,372 (40.6)	3,264 (23.4)	
Occupation [*n* (%)]			
Upper management	1,336 (22.8)	1,764 (12.7)	
Middle management	1,905 (32.5)	2,640 (19.0)	
White-collar	773 (13.2)	3,112 (22.3)	
Blue-collar	176 (3.0)	2,583 (18.6)	<0.0001
Self-employed	315 (5.4)	1,149 (8.2)	
Retired	525 (9.0)	1,480 (10.6)	
Homemaker	513 (8.8)	302 (2.2)	
Unemployed	309 (5.3)	889 (6.4)	
Region of residence [*n* (%)]			
Paris area	1,407 (24.0)	3,081 (22.1)	
North-west	587 (10.0)	2,796 (20.1)	
North-east	484 (8.3)	975 (7.0)	
West	1,564 (26.7)	1,492 (10.7)	<0.0001
Centre-east	481 (8.2)	1,649 (11.8)	
South-west	321 (5.5)	1,148 (8.2)	
Rhône-Alpes-Auvergne	475 (8.1)	1,110 (8.0)	
Mediterranean coast	533 (9.2)	1,669 (12.1)	
Location of residence [*n* (%)]			
Urban	3,786 (64.7)	8,157 (58.6)	
Peri-urban	1,075 (18.4)	2,215 (15.9)	<0.0001
Rural	991 (16.9)	3,548 (25.5)	

Continuous variables are expressed as mean ± SD. The percentages in parenthesis for the categorical variables refer to the total number of individuals in each cohort. Univariate comparisons were performed with Chi-square test (or Fisher's exact test when necessary) for categorical variables and with Student's *t* test for continuous variables

As a comparison point, the distribution of these health outcomes according to several clinical and behavioural characteristics of volunteers is reported in Table 4. As expected, cardiovascular event risk and all-cause mortality are higher in men and in volunteers over 50 years old whatever the adjustment model. Cardiovascular event risk is also higher in obese, hypertensive, dyslipidemic and diabetic volunteers as well as in smokers whatever the adjustment model. All-cause mortality is significantly increased in all adjustment models only in hypertensive volunteers and smokers. Cardiovascular event risk and all-cause mortality are not associated with alcohol consumption whatever the adjustment model.

The comparison of clinical, behavioural and socio-demographic characteristics of volunteers at baseline according to occupational groups is described in Table 5. Some differences are apparent between workers and unemployed volunteers: these latter have a lower proportion of men and an older age (mean ± SE adjusted with model 4 are 48.2 ± 0.2 vs. 49.9 ± 0.4 years, respectively), and they drink more alcohol and have higher energy without alcohol intake, lower fruit and vegetable intake and lower convenience food intake (mean ± SE adjusted with model 4 are 21.3 ± 0.9 vs. 26.5 ± 1.3 g/day, 1,994 ± 15 vs. 2,051 ± 22 kcal/day, 300 ± 8 vs. 277 ± 13 g/day and 226 ± 4 vs. 208 ± 7 g/day, respectively). They are also less educated than workers and are distributed differently across the metropolitan territory. The comparison between workers and retired volunteers shows that the latter have a higher proportion of men, an older age and an increased bread and starchy food intake (mean ± SE adjusted with model 4 are 48.1 ± 0.2 vs. 55.4 ± 0.3 years and 226 ± 4 vs. 238 ± 6 g/day, respectively), they have also a lower education level and a different distribution across the metropolitan territory, and they live more often in rural areas than workers. Note that the higher rates of obesity, hypertension, dyslipidemia, diabetes and/or smoking, which are observed with unadjusted analyses in both unemployed and retired volunteers when they are compared to workers, become statistically non-significant in adjusted models.

Discussion

The present analyses show that unemployment is prospectively associated with poor cardiovascular health in a national cohort of middle-aged volunteers devoid of cardiovascular disease or other overt disease at baseline. Over a 12-year follow-up period, the risk of fatal and non-fatal cardiovascular events is increased by 80 % in unemployed individuals compared to workers in agreement with several recent prospective studies (Dupre et al. 2012; Gallo et al. 2004, 2006, 2012; Mejean et al. 2013). Although it was not possible to assess cardiovascular mortality because it was too low, all-cause mortality rate is almost threefold higher in unemployed than in employed individuals, which is also in accordance with published studies (Roelfs et al. 2011). The higher magnitude of the increase in all-cause mortality comparatively to the increase in cardiovascular risk suggests that cancer mortality and/or mortality from other causes are also increased in unemployed individuals

Table 3 12-year cardiovascular event risk and all-cause mortality according to occupational groups of volunteers at baseline

Occupation	No. of cases	Unadjusted		Model 1		Model 2		Model 3		Model 4	
		HR (95 % CI)	p	HR (95 % CI)	p	HR (95 % CI)	p	HR (95 % CI)	p	HR (95 % CI)	p
Cardiovascular events											
Worker	154	1.00		1.00		1.00		1.00		1.00	
Unemployed	23	2.25 (1.41–3.42)	0.001	1.84 (1.15–2.83)	0.01	1.76 (1.09–2.69)	0.02	1.74 (1.07–2.69)	0.02	1.74 (1.07–2.72)	0.03
Retired	57	3.41 (2.49–4.60)	<0.0001	1.44 (1.00–2.07)	0.05	1.41 (0.98–2.02)	0.06	1.38 (0.96–1.99)	0.08	1.34 (0.92–1.93)	0.13
All-cause mortality											
Worker	97	1.00		1.00		1.00		1.00		1.00	
Unemployed	20	3.27 (1.96–5.19)	<0.0001	2.79 (1.66–4.47)	0.0002	2.75 (1.63–4.41)	0.0003	2.91 (1.72–4.68)	0.0002	2.89 (1.70–4.69)	0.0002
Retired	31	2.99 (1.96–4.43)	<0.0001	1.63 (1.00–2.59)	0.05	1.63 (0.99–2.59)	0.06	1.61 (0.99–2.57)	0.06	1.57 (0.96–2.52)	0.07

Cox regression models were used to compute hazard ratios and 95 % confidence intervals. Four models were applied for multivariate analyses: model 1 adjusts for gender and age, model 2 adjusts for gender, age and other biological variables (obesity, hypertension, dyslipidemia and diabetes), model 3 adjusts for gender, age, other biological variables and behavioural variables (smoking, alcohol consumption and dietary intakes), model 4 adjusts for gender, age, other biological variables, behavioural variables and socio-demographic variables (education, region and location of residence)

compared to workers as described by other reports (Lynge 1997; Milner et al. 2013).

The increased cardiovascular risk is noteworthy because it is observed in middle-aged socially privileged individuals who were not likely to have had very unhealthy lifestyles before or following unemployment (Kendzor et al. 2008; Morrell et al. 1998; Peretti-Watel and Constance 2009). These individuals had a high education level and an elevated socio-economic status, they were very motivated to participate in the study as indicated by their very low dropout rate during follow-up (Hercberg et al. 2004), and they paid great attention to their health as demonstrated by their strong adherence to lipid-lowering or antihypertensive drug treatments and their high receptiveness to nutritional messages (Kesse-Guyot et al. 2011), behaviours that were probably reinforced by the repeated inquiries throughout follow-up. The healthy lifestyle of participants is confirmed by the comparison with randomly selected individuals, which shows that they have a much lower smoking rate as well as clinical characteristics that, with the exception of blood lipids, are closer to optimal values. Accordingly, their cardiovascular risk is lower and all-cause mortality rate is halved. In addition, participants lived in a relatively protective social environment represented by the French social security system, which attenuated some of the deleterious effects of unemployment such as decreased income or reduced access to health care (Rodwin 2003; Weisz et al. 2008). It has been shown that the social and institutional environment exerts a significant moderating effect on the relationship between unemployment and mortality (Bambra and Eikemo 2009; Gerdtham and Ruhm 2006; Stuckler et al. 2009). For example, this relationship is much less pronounced in a country like Germany where the social security system is substantially developed than in a country like the USA where it is kept at a minimum (McLeod et al. 2012).

The reasons why cardiovascular risk and all-cause mortality are increased in unemployed compared to employed individuals cannot be unequivocally assessed in the present study. In particular, it is not possible to investigate whether these poor health outcomes are a consequence (Hammarstrom 1994; Janlert 1997; Laitinen et al. 2002a; Martikainen 1990; Moser et al. 1987; Hammer 1997a) or a cause of unemployment (Bartley and Owen 1996; Bockerman and Ilmakunnas 2009; Claussen 1993; Jusot et al. 2008; Salm 2009). However, the fact that the analyses were performed in individuals devoid of overt illnesses at baseline, which could have impaired access to the job market, is in favour of unemployment being a cause of poor health outcomes during follow-up.

Concerning potential factors that could mediate the link between unemployment and poor cardiovascular health, the present study cannot provide unequivocal evidence either.

Table 4 12-year cardiovascular event risk and all-cause mortality according to clinical and behavioural characteristics of volunteers at baseline

	Cardiovascular events					All-cause mortality				
	No. of cases	Models 1		Models 4		No. of cases	Models 1		Models 4	
		HR (95 % CI)	*p*	HR (95 % CI)	*p*		HR (95 % CI)	*p*	HR (95 % CI)	*p*
Gender										
Women	44	1.00		1.00		60	1.00		1.00	
Men	198	4.89 (3.54–6.90)	<0.0001	4.12 (2.83–6.13)	<0.0001	92	1.79 (1.28–2.52)	0.0006	1.46 (1.01–2.20)	0.04
Age										
<50	61	1.00		1.00		55	1.00		1.00	
≥50	181	3.01 (2.25–4.08)	<0.0001	2.53 (1.85–3.51)	<0.0001	97	2.03 (1.45–2.87)	<0.0001	1.59 (1.09–2.34)	0.02
Obesity										
No	201	1.00		1.00		135	1.00		1.00	
Yes	41	2.35 (1.66–3.25)	<0.0001	1.88 (1.30–2.66)	0.001	17	1.23 (0.69–2.02)	0.47	1.06 (0.59–1.77)	0.84
Hypertension										
No	104	1.00		1.00		75	1.00		1.00	
Yes	138	1.96 (1.51–2.55)	<0.0001	1.63 (1.24–2.15)	0.0004	77	1.75 (1.25–2.46)	0.001	1.67 (1.18–2.37)	0.004
Dyslipidemia										
No	102	1.00		1.00		80	1.00		1.00	
Yes	140	1.82 (1.41–2.37)	<0.0001	1.54 (1.18–2.01)	0.001	72	1.42 (1.02–1.98)	0.04	1.25 (0.89–1.75)	0.19
Diabetes										
No	210	1.00		1.00		140	1.00		1.00	
Yes	32	2.44 (1.65–3.49)	<0.0001	1.81 (1.20–2.63)	0.005	12	1.64 (0.85–2.84)	0.13	1.39 (0.72–2.48)	0.31
Smoking										
No	191	1.00		1.00		122	1.00		1.00	
Yes	51	2.13 (1.55–2.89)	<0.0001	1.97 (1.42–2.71)	<0.0001	30	1.87 (1.23–2.76)	0.004	1.77 (1.15–2.66)	0.01
Alcohol consumption										
No	29	1.00		1.00		18	1.00		1.00	
Yes	213	0.96 (0.66–1.46)	0.86	0.91 (0.62–1.39)	0.66	134	1.25 (0.78–2.12)	0.37	1.15 (0.71–1.98)	0.59

Cox regression models were used to compute hazard ratios and 95 % confidence intervals. Two types of models were applied for multivariate analyses: columns named models 1 compile hazard ratios adjusted for gender and age, columns named models 4 compile hazard ratios adjusted for gender, age, other biological variables (obesity, hypertension, dyslipidemia and diabetes), behavioural variables (smoking, alcohol consumption and dietary intakes) and socio-demographic variables (education, occupation, region and location of residence). Note that the models were applied separately for each of the variables

The fact that the statistical association between unemployment and poor health outcomes persists to the same degree after adjustment for health behaviours and clinical characteristics that are major cardiovascular risk factors (smoking, alcohol consumption, dietary intakes, obesity, hypertension, dyslipidemia and diabetes) does not support the involvement of these factors. Reduced access to health care in unemployed individuals leading to a worsening of cardiovascular diseases is another factor that could mediate the link between unemployment and poor health outcomes (Driscoll and Bernstein 2012). However, this possibility seems unlikely because we have previously shown that physician access and delivery of cardiovascular drugs are not associated with unemployment status in individuals randomly selected from the French population (Meneton et al. 2012). Whatever the factors underlying the link between unemployment and poor cardiovascular health, it can be noted that they seem not related to the inactivity per se as retired individuals do not display poorer health outcomes compared to workers after adjustment for confounding variables.

Although the comparison of the characteristics of individuals at baseline can only give limited insights, it nevertheless suggests that unemployed individuals have some unhealthy habits, including higher alcohol consumption, higher energy without alcohol intake and lower fruit and vegetable intake, compared to workers. Such association between unemployment and unhealthy eating and drinking behaviours has been reported by other studies (Laitinen et al. 2002a; Mejean et al. 2013) and is not surprising given that individuals with limited economic means have been shown to have lower quality diets (Darmon and Drewnowski 2008). In contrast, obesity, hypertension, dyslipidemia, diabetes and smoking rates are not different between

Table 5 Comparison of clinical, behavioural and socio-demographic characteristics between workers and other occupational groups of volunteers at baseline

	Worker ($n = 4{,}505$)	Unemployed ($n = 309$)	p_u	p_1	p_4	Retired ($n = 525$)	p_u	p_1	p_4
Men [n (%)]	1,970 (43.7)	129 (41.7)	0.50	0.0003	<0.0001	339 (64.6)	<0.0001	<0.0001	<0.0001
Age (years)	47.5 ± 5.8	49.7 ± 7.0	<0.0001	<0.0001	<0.0001	56.4 ± 4.2	<0.0001	<0.0001	<0.0001
Obesity [n (%)]	305 (6.8)	31 (10.0)	0.04	0.08	0.10	58 (11.0)	0.0007	0.06	0.12
Hypertension [n (%)]	1,279 (28.4)	96 (31.1)	0.32	0.18	0.09	229 (43.6)	<0.0001	0.09	0.08
Dyslipidemia [n (%)]	1,494 (33.2)	126 (40.8)	0.007	0.18	0.43	269 (51.2)	<0.0001	0.86	0.85
Diabetes [n (%)]	170 (3.8)	22 (7.1)	0.008	0.05	0.09	36 (6.9)	0.002	0.56	0.43
Smoking [n (%)]	611 (13.6)	53 (17.1)	0.09	0.01	0.14	51 (9.7)	0.01	0.38	0.29
Alcohol consumption (g/day)	17.0 ± 21.3	22.6 ± 28.5	<0.0001	<0.0001	<0.0001	22.6 ± 22.5	<0.0001	0.04	0.08
Dietary intakes									
Energy w/o alcohol (kcal/day)	2,013 ± 634	2,022 ± 636	0.81	0.30	0.002	2,132 ± 658	<0.0001	0.006	0.56
Fruits and vegetables (g/day)	327 ± 200	305 ± 198	0.06	0.02	0.03	358 ± 203	0.0008	0.79	0.60
Dairy products (g/day)	262 ± 185	246 ± 179	0.12	0.10	0.13	255 ± 186	0.38	0.18	0.17
Meats (g/day)	115 ± 72	120 ± 85	0.18	0.11	0.22	125 ± 78	0.001	0.37	0.39
Fishes (g/day)	40 ± 47	38 ± 52	0.46	0.28	0.22	45 ± 47	0.03	0.57	0.40
Breads and starchy foods (g/day)	230 ± 136	238 ± 143	0.34	0.54	0.92	270 ± 157	<0.0001	<0.0001	0.01
Convenience foods (g/day)	233 ± 127	218 ± 127	0.04	0.02	0.0008	232 ± 121	0.86	0.72	0.79
Education [n (%)]									
Primary school	829 (18.4)	89 (28.8)				147 (28.0)			
Secondary school	1,684 (37.4)	133 (43.0)	<0.0001	<0.0001	<0.0001	231 (44.0)	<0.0001	0.01	0.03
University	1,992 (44.2)	87 (28.2)				147 (28.0)			
Region of residence [n (%)]									
Paris area	1,083 (24.0)	93 (30.1)				113 (21.5)			
North-west	468 (10.4)	21 (6.8)				52 (9.9)			
North-east	359 (8.0)	23 (7.4)				55 (10.5)			
West	1,239 (27.5)	62 (20.1)	<0.0001	0.0002	<0.0001	126 (24.0)	0.16	0.09	0.06
Centre-east	372 (8.3)	20 (6.5)				49 (9.3)			
South-west	257 (5.7)	12 (3.9)				29 (5.5)			
Rhône-Alpes-Auvergne	351 (7.8)	30 (9.7)				46 (8.8)			
Mediterranean coast	376 (8.3)	48 (15.5)				55 (10.5)			
Location of residence [n (%)]									
Urban	2,928 (65.0)	219 (70.9)				316 (60.2)			
Peri-urban	835 (18.5)	50 (16.2)	0.09	0.18	0.39	94 (17.9)	0.009	0.0002	0.007
Rural	742 (16.5)	40 (12.9)				115 (21.9)			

Continuous variables are expressed as mean ± SD. The percentages in parenthesis for the categorical variables refer to the total number of individuals in each occupation group. The comparison between occupational groups was made separately for each of the variables using analysis of covariance (ANCOVA) tests (continuous variables) or logistic regression models (categorical variables). Columns p_u compile statistical significance from unadjusted tests or models, columns p_1 compile statistical significance from tests or models adjusting for age and gender, columns p_4 compile statistical significance from tests or models adjusting for gender, age, other biological variables (obesity, hypertension, dyslipidemia and diabetes), behavioural variables (smoking, alcohol consumption and dietary intakes) and socio-demographic variables (education, region and location of residence)

unemployed individuals and workers. This differs with the results of several studies showing that the percentage of smokers (Bolton and Rodriguez 2009; Claussen 1993; Falba et al. 2005; Hammarstrom and Janlert 2003; Montgomery et al. 1998; Reine et al. 2004) or obesity and diabetes rates (Akil and Ahmad 2011; Freyer-Adam et al. 2011; Laitinen et al. 2002b; Robinson et al. 1989) are higher in unemployed than in employed individuals. The origin of this discrepancy is not clear, but could be related to the fact that unemployed individuals with a high social status appear to be less exposed to unhealthy behaviours and to the accompanying poor clinical characteristics, than those with a low social status (Kendzor et al. 2008; Peretti-Watel and Constance 2009).

The present study has several limitations in addition to those already mentioned. The fact that strokes and coronary heart disease events were not distinguished among cardiovascular health outcomes is an important one. The lack of information concerning the employment status of volunteers during follow-up is another one because it precludes assessment of the effect of duration of unemployment and weakens the association with health outcomes as some volunteers probably returned to work, while others lost their job during follow-up. Equally missing are data concerning the former occupation of unemployed volunteers that certainly influences the probability of reemployment. It is also necessary to make clear that the present study was not designed to test whether the association between unemployment and cardiovascular risk varies according to social status. The term "socially privileged" is only an average description of the cohort of healthy volunteers in which the association between unemployment and cardiovascular risk was assessed.

In conclusion, these analyses show that unemployment is associated with poor cardiovascular health and high all-cause mortality in middle-aged socially privileged individuals. Besides supporting the existence of a link between unemployment and the development of cardiovascular diseases, they recall the necessity to promote strategies to avoid health deterioration in unemployed individuals, including those with a high social status. They suggest that these preventive strategies should not exclusively target conventional behavioural and clinical risk factors, but also other health determinants such as psychosocial factors that probably play an important role. Governments and companies should consider when taking economic decisions that "killing the jobs means killing the people", both in the metaphoric and literal sense".

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