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Associations between psychological stress and smoking, drinking, obesity and high blood pressure in an upper middle-income country in the African region

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Short title: Stress and cardiovascular risk factors

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Abstract

Background: Associations between psychological stress (stress) and cardiovascular risk factors (CVRFs) continue to be debated and few data are available from the African region.

Objectives: To examine associations between CVRFs and stress in the Seychelles, a rapidly developing small island state in the African region.

Methods: A population-based survey was performed in 1240 adults aged 25-64 years representative of the general population of Seychelles. Participants were asked to rank stress experienced during the past 12 months in four domains: work, social life, financial situation, and environment around home. CVRFs (high blood pressure, tobacco use, alcohol drinking and obesity) were assessed using standard procedures.

Results: Stress was associated with and age, sex, and SES. However, only few associations were found between stress and CVRFs, adjusting for age, sex and SES. Social stress was associated with smoking, drinking and obesity and there were trends for associations between stress at work and drinking and between financial stress and both smoking and drinking. Stress was not associated with high blood pressure.

Conclusions: Psychological stress in different domains was associated with different socio-demographic variables. However, only few associations were found between stress and CVRFs and, in particular, no association between stress and high blood pressure.

Keywords: psychological stress, cardiovascular risk factors, high blood pressure, smoking, drinking, obesity

Introduction

The notion that psychological stress is associated with cardiovascular disease (CVD) or cardiovascular disease risk factors (CVRFs) dates back to more than 100 years and its link with coronary heart disease has been extensively studied (Rosengren et al., 2004; Steptoe & Kivimaki, 2013). For example, the large INTERHEART and INTERSTROKE case-control studies found that self-reported stress was associated with myocardial infarction (Inoue, 2014; Yusuf et al., 2004) and stroke (O'Donnell et al., 2016). Other observational studies also suggested a link between mental stress, stroke and coronary heart disease (Inoue, 2014) (Steptoe & Kivimaki, 2012), (Haynes, Feinleib, & Kannel, 1980) and. with high blood pressure (Rainforth et al., 2007). However, many other studies did not find associations between stress and cardiovascular disease or high blood pressure (Alfredsson et al., 2002; Kang et al., 2005; Netterstrom, Kristensen, Damsgaard, Olsen, & Sjol, 1991).

A number of physiological and behavioral mechanisms have been suggested to explain links between psychological stress and CVD. Psychological stress may activate the sympathetic nervous system and the hypothalamic pituitary adrenal axis and generate hemodynamic and hormonal responses (Inoue, 2014). Psychological stress can also induce unhealthy conditions, e.g. tobacco use (Castaneda et al., 2016; Rosengren et al., 2004; Rosengren et al., 2015), alcohol use (Rosengren et al., 2015; Stringhini, Viswanathan, Gedeon, Paccaud, & Bovet, 2013), obesity (Brunner, Chandola, & Marmot, 2007; Rosengren et al., 2015), type 2 diabetes mellitus (Castaneda et al., 2016; Rosengren et al., 2015), or high blood pressure (Gasperin, Netuveli, Dias-da-Costa, & Pattussi, 2009; Gilbert-Ouimet, Trudel, Brisson, Milot, & Vezina, 2014; Steptoe, Brydon, & Kunz-Ebrecht, 2005; Steptoe & Kivimaki, 2013). However, because many studies on psychological stress and CVD are cross-sectional, the direction of the associations cannot be defined (e.g. stress can cause a person to drink but drinking can also be a cause of stress). However, a few cohort studies provide some evidence that psychological stress could be linked etiologically with CVD conditions (Iso et al., 2002; Steptoe & Kivimaki, 2012, 2013).

Psychological stress is typically associated with sex, age and socio-economic status (SES), which underlies the importance to adjust analyses between psychological stress and CVRFs for these socio-demographic variables. For example, low SES often predicts smoking, drinking, obesity and type 2 diabetes (Brunner et al., 1997; Castaneda et al., 2016; Rosengren et al., 2015; Steptoe & Kivimaki, 2013; Stringhini et al., 2013), with some differences according to sex.

Psychological stress has been defined by Selye (Selye, 1975) as a non-specific organic response to stressful situations associated with psychological and physical symptoms (e.g. feelings of tension,

irritability or anxiety, or having sleeping difficulties) (Bezerra, Assis, & Constantino, 2016; Hu et al., 2015; Rosengren et al., 2004; Yusuf et al., 2004). Most notably, psychological stress is often related to low control in responses to circumstances in social life, work, financial situation or environment (Rosengren et al., 2004; Yusuf et al., 2004). With regard to measurement, psychological stress has often been assessed using single-item questions about self-perceived stress in specific domains, along graded response scales (Rosengren et al., 2004; Rosengren et al., 2015; Yusuf et al., 2004). The term "global stress" (or simply “stress”) is often used in the literature to refer to combined psychological stress at work or at home because these components are highly interconnected (Bovet et al., 2009; Rosengren et al., 2015). However, health outcomes have also been studied in relation to stress related to a person’s financial situation (Rosengren et al., 2004; Steptoe et al., 2005) and environment, such as noise, pollution or other external disturbances (Ndrepepa & Twardella, 2011; Oiamo, Luginaah, & Baxter, 2015).

Most of the studies on the associations between stress and NCDs and their CVRFs were conducted in North America or Europe, and we are not aware of such studies in the African region. Yet, the question of stress and NCDs is also relevant for low and middle-income countries (LMICs) as both stress and NCDs may be enhanced as a consequence of urbanization and globalization, health transition and CVD (R. S. Cooper et al., 2015; Sampson, Amuyunzu-Nyamongo, & Mensah, 2013; Stringhini et al., 2013).

Based on a cross-sectional survey in the Republic of Seychelles, a rapidly developing small island state in the African region, we examined the associations between psychological stress (referred in this paper as « stress ») and four CVRFs (smoking, drinking, obesity, and high blood pressure). Stress was defined along four domains, i.e. social, work, financial and environment.

Subjects and methods

The study took place in the Republic of Seychelles, an archipelago of 115 islands located in the Indian Ocean, east of Kenya and north of Mauritius with a population of predominantly African descent. The country experienced fast socio-economic development with a gross national product increasing from less than US$ 1000 per capita in the late 1970s to 14’100 in 2014. A high prevalence of several CVRFs has been documented, including a hypertension, obesity and diabetes (Bovet et al., 2009), although age adjusted rates of heart disease and stroke have been decreasing during the past two decades (Stringhini et al., 2012) consistent with trends in some upper middle income and high income countries.

Data for this study comes from the Seychelles Heart Study IV, a national survey of NCDs conducted between October and December 2013 and in February 2014). Methods have been described (Bovet et al., 2009). Briefly, a sex- and age-stratified random sample of all adults aged 25-64 years was selected from electronically available census data. Participation rate was 83%. The protocol was approved by the Health Research and Ethics Committee of the Ministry of Health of the Seychelles. Eligible participants were free to participate and gave formal informed consent.

Weight and height were measured and body mass index calculated. Blood pressure was measured with an automated device (Omron M3) at intervals of at least 5 minutes in a quiet environment, using a cuff size adapted to arm circumference. The mean value of the second and third of three readings was considered. High blood pressure was defined as BP ≥140/90 mmHg and severe high blood pressure was defined as BP ≥160/100 mmHg.

A structured questionnaire was administered by trained survey officers to assess demographic and SES variables, psychological stress and a number of other variables. High income was considered for personal income > 8000 Seychelles rupees (~US $ 700) per month. High education was defined for education beyond obligatory school (i.e. beyond the age of 15-16 years). Smoking was defined as currently smoking at least one cigarette per day. The questionnaire also assessed the frequency and volume for all main alcohol beverages available in the country and heavy drinking was defined as an average daily intake from ≥ 60 ml ethanol.

We assessed psychological stress level by means of four questions in each of four domains: work, social, financial and environment where a person lives. The questions read as follows: “On a scale of 10 – with 0 corresponding to no stressed at all and 10 to being extremely stressed-, how would you define your stress level in relation to your work during the past 12 months?; “On a scale of 10, how would you define your stress related to your family, friends or neighbors”; “On a scale of 10, how would you define your stress related to your financial situation”; and “On a scale of 10, how would you define your stress related to the environment where you live, including noise, pollution, or other external circumstances”.

We dichotomized the four stress variables using three different cutoffs for the stress scores, i.e. ≥5, ≥6, and ≥7, respectively. We examined the distribution of stress in the four domains according to age, sex, and SES (education and income) and according to categories of the considered CVRFs (alcohol consumption, smoking habits, BMI and blood pressure). We then examined the multivariate

associations between stress in each domain and each of the considered CVRF, adjusting for the socio-demographic variables.

Statistical analysis was conducted using Stata v.14 statistical software (Stata Corp, College Station, TX, USA). P values <0.05 were considered significant. In order to make the reading of the tables more straightforward, we did not show confidence intervals and exact P values, but tables with this information can be obtained from the authors.

Results

Table 1 shows the characteristics of the participants. Around a third of the participants had a high education (post obligatory) or a high income (>SR 8000). The proportions of participants who had the considered CVRFs were generally high.

The proportions of persons reporting different levels of stress in the four domains are displayed in **Table 2**. The table also shows the distribution of stress according to categories of socio-demographic variables and CVRFs (i.e. stratified analysis). Values shown in bold are statistically significant. Overall, the proportions of participants reporting stress ranged between 7% and 14% for a stress score ≥7 but between 17% and 37% for a stress score ≥5. The proportions were fairly similar for stress at work, social stress and financial stress, but were lower for stress related to environment. The proportions of persons stressed varied according to the considered socio-demographic variables. More women than men reported social stress and financial stress and, marginally, environment-related stress. Larger proportions of younger than older persons reported stress at work and financial stress. Compared to less educated persons, persons with higher education reported more stress at work but less financial stress. There was no significant difference in stress according to smoking or drinking categories. Obese persons reported more social stress than non-obese persons. Persons with high blood pressure (BP ≥140/90) or severe high blood pressure (BP ≥160/100) tended to report less stress but most of these differences were not statistically significant.

Table 3 shows the multivariate associations between stress and the socio-demographic variables. Results showed in the top four lines are mutually adjusted (i.e. adjusted to age, sex, income and education) while the two bottom lines are adjusted to age, sex and either income (and not education) or income (and not education). A few consistent findings can be observed. Older age was associated with less stress at work and less financial stress. Male sex was associated with less social

stress and less financial stress. High income was associated with more stress at work and less financial stress. High education was associated with more stress at work but less financial stress.

Table 4 shows the multivariate associations between stress and CVRFs separately in men and women, adjusting for socio-demographic variables, using different cutoffs for stress. There was no consistent association between stress and high blood pressure. Smoking was consistently associated with greater social stress (odds ratio of up to 2 when using a stringent definition of stress). Heavy drinking was associated significantly or marginally with social stress, particularly among women. Obesity tended to be associated with higher social stress among women (odds ratio ~1.5) but with lower social stress in men (odds ratio of ~0.8).

Discussion

We can distinguish two main categories of findings in our study. First, we found many associations between the four components of stress considered in our study and age, sex and SES. Second, we found only few consistent associations between stress and the four CVFRs considered in this study, upon adjustment for sex, age and SES. There were, however, consistent or fairly consistent associations between social stress and smoking, drinking and obesity; between stress at work and drinking; and between financial stress and smoking and drinking. High blood pressure was not consistently associated with stress.

In terms of prevalence, we found that 10-30% of adults in Seychelles reported stress in any of the four considered domains, depending on the cutoffs used to define stress. The prevalence of stress differed according to stress domain, with stress at work and social stress being more frequently reported than financial stress and environmental stress. These findings are consistent with psychological stress being a frequent condition in populations. A recent American survey showed that 75% of the adult population perceived themselves as significantly stressed (Coulon, Monroe, & West, 2016). Unfortunately, our findings in Seychelles cannot be compared with other population in Africa due to lack of published data in the region.

We found many associations between stress in different domains and socio-demographic variables. Overall, stress in different domains was reported more often by women than men, by young than older persons, and by persons of high than low SES. However, financial stress was more frequently reported by persons of low vs. high SES. These associations of stress with several socio-demographic variables are generally consistent with findings in the literature. For example women and young

adults tend to report greater stress levels, in particular work, which raises issues of job strain with high demand and low control at work (de Smet et al., 2005; Kidwai, 2014). However, some of our findings contrast with findings in the literature. For example, it was reported that stress level varied in an graded manner with SES among men but not among women (Heslop et al., 2001). While a few studies report an association between stress and high SES (Heslop et al., 2001; McLeod & Kessler, 1990), more studies suggest that that stress is associated with low SES (Hatch & Dohrenwend, 2007; Heslop et al., 2001; Stronks, van de Mheen, Looman, & Mackenbach, 1998). The association between stress and low SES may relate to lower resources to manage stressful events and worse health outcomes, including CVD among persons of low vs. high SES (Lazzarino, Hamer, Stamatakis, & Steptoe, 2013; Marmot & Bell, 2016; Matthews & Gallo, 2011). Since sex, age and SES are generally associated with CVRFs, these findings also suggest that it is important to adjust analyses for the associations between stress and CVRFs for these socio-demographic variables.

The main objective of this study was to examine whether stress was associated with CVRFs, independent of social-demographic variables of the participants. We found only a small number of associations between stress in the four different domains and the four CVFRs.

The association between social stress and smoking in our study is consistent with some other studies (Bray, Fairbank, & Marsden, 1999; Jones, Harel, & Levinson, 1992). Different mechanisms have been proposed to account for the role of stress on smoking behaviors. Smokers may be smoking to relieve stress. However, several studies showed that while smoking could temporarily relieve perceived stress, it may also aggravate negative emotional states, which may lead to overall higher stress levels (Hajek, Taylor, & McRobbie, 2010; Parrott, 1995; Stein et al., 2008). Chronic smoking may also fuel negative coping strategies, e.g. management of stressful events, and act as a moderator of the impact of stress on health (Baum & Posluszny, 1999).

We found an association between social stress and alcohol drinking in both men and women in our study. This finding is consistent with the literature (Pohorecky, 1991) although some studies failed to detect a relationship (Welte & Mirand, 1995). Nevertheless, several surveys have shown evidence of drinking in the presence of stressors and inadequate coping resources (M. L. Cooper, Russell, & George, 1988; Welte, 1985; Wills, 1986). We can speculate that because smoking and drinking habits are more common in men, women with these CVRFs may be under a certain stress in their social life because of some transgression in social norms.

The association between social stress and obesity in our study is consistent with findings in other studies. Research on the social causes of eating patterns has suggested that chronic stress may be a contributor to the increased risk for obesity. (Bose, Olivan, & Laferrere, 2009; Faghri, Mignano, Huedo-Medina, & Cherniack, 2015; Sims et al., 2017). For example, obesity was more frequent in men of higher SES but among women of lower SES in Scotland (Heslop et al., 2001; Stringhini et al., 2013), a gender pattern also found in Seychelles (Stringhini et al., 2013). The social pattern in BMI may partly relate to a gender-specific perception of body size: in developing countries a larger body size may be associated with health and affluence and thinness with lack of resources and sickness (Stringhini et al., 2013; Yepes et al., 2016).

The few relationships between stress and CVRFs found in our study were mainly linked with social stress, with fewer associations related to stress at work and financial stress, and none with environmental stress. This emphasizes the importance of addressing social factors when designing CVD prevention and control programs and policy.

A number of studies have shown relationships between stress at work and socio-demographic factors, which may occur more often among women (Backe, Seidler, Latza, Rossnagel, & Schumann, 2012; Ojike et al., 2016) and among young people at working age (Rosengren et al., 2004). Yet, the association between stress at work and CVRFs remains debated (Steptoe & Kivimaki, 2013). It has been found that obese women with stress at work had an increased risk for type 2 diabetes but not a higher risk of high blood pressure or CVD (Rosengren et al., 2015). On the other hand, studies showed that men with stress at work tended to drink more alcohol (Virtanen et al., 2015) and have increased risk of having high blood pressure (Backe et al., 2012; Peter et al., 1998) and CVD events such as myocardial infarction (Rosengren et al., 2004; Yusuf et al., 2004). This gender difference might occur because the elevation of blood pressure with age tends to occur later in women than in men, and women at a working age are too young to develop CVD events (Backe et al., 2012).

The role of financial stress on health has been emphasized in the literature. It has also been suggested that financial stress may be more important in women than men, and may predict anxiety (Richardson, Elliott, Roberts, & Jansen, 2016) and eating disorders (Richardson, Elliott, & Roberts, 2015). Money is arguably a most important resource derived from work, as well as a most important source of stress for contemporary employees. Yet, surprisingly, little research, particularly in the occupational field, has examined financial stress and health (Sinclair & Cheung, 2016).

Very few data are available in the literature about the relationship between environmental stress and CVRFs. Studies in this field have generally examined external disturbances such as noise or pollution. In our study, we found a small non-significant association between high SES and environmental stress. It could be that people with high education are more sensitive to their environment and less willing to tolerate noise, pollution and external circumstances than people coming from more rural regions or marginal neighborhoods.

While there is evidence that stress is linked to unfavorable health behaviors (e.g. smoking, drinking, weight control), the association of stress with biological CVRFs remains controversial. The absence of a consistent relation between stress and high blood pressure in our study is concordant with several studies in this field (Alfredsson et al., 2002; Kang et al., 2005; Netterstrom et al., 1991). However several other studies suggested an association between stress and high blood pressure (Kulkarni, O'Farrell, Erasi, & Kochar, 1998; Muldoon et al., 1995; Sparrenberger et al., 2009; Spencer, Phillips, & Ogedegbe, 2005; Spruill, 2010; Steptoe, 2000). Factors like job strain (e.g. high job demands and low control), poor social support (mostly among men) with a lower SES have been suggested to mediate a link between stress and high blood pressure(Rosengren, A. et al. 2015(Cuffee, Ogedegbe, Williams, Ogedegbe, & Schoenthaler, 2014). These inconsistent findings in the literature may arise from limitations in study designs, small sample sizes, single CVRF outcomes, and heterogeneous measures of stress (Nyberg et al., 2013). Another problematic issue relates to the direction of the association: stress can be causally associated with high blood pressure or, inversely, be a consequence of it. In particular, similar to patients with other chronic medical conditions, hypertensive patients may experience anxiety due to their disease, which may increase their risk of developing psychological disturbances (DeJean, Giacomini, Vanstone, & Brundisini, 2013; Vetere et al., 2007).

Our study has a few limitations. First, the cross-sectional nature of the survey prevents to distinguish causes and consequences. Trials should be conducted to disentangle the direction of the associations but are hardly feasible in this field. Second, stress is difficult to assess objectively and obviously consists of several inter-related hard-to-measure qualitative elements (Rosengren et al., 2004). Third, stress was assessed using only one self-reported question in each of the four considered domains. Furthermore, responses are subjective and not necessarily directly comparable between participants. Yet, there is no universal standardized questionnaire to quantify stress and different scales have been used to measure psychological distress. Fourth, boundaries are not fully distinct between stress and other psychological states such as depression or anxiety. Many studies mix stress or psychological distress with these mental components. In our study, stress referred to feeling annoyed or losing control on some life circumstances but did not necessarily imply depression or

anxiety but also did not exclude such components. Fifth, while measurement of blood pressure and body mass index is standardized and objective, drinking and smoking were self-reported and this information is prone to different biases, including recall bias or social desirability bias. Sixth, imprecision in measuring exposure variables can result in underestimation of true associations and this imprecision in measuring exposure may have decreased or masked the actual strength of some relationships in our study.

Our study also has several strengths. First, to our knowledge this is the first study in the African region assessing the relation between psychological stress and socio-demographic variables and CVRFs. Second, our study was population-based and findings are representative of the whole adult population. However the situation in the Seychelles, a small rapidly developing islands state, does not necessarily reflect the predominant social and health conditions in other countries in the region Third we assessed stress fairly thoroughly, using a scale (0 to 10) and along four components (social, work, financial, and environment). Fourth, we examined stress defined with different cutoffs and the fact we found similar findings with different stress cutoffs strengthen the confidence we can have in our results.

Conclusions

The substantial prevalence of stress among adults (10-30% depending on how stress was defined) and the marked associations of stress with age, sex and SES emphasize the need to identify and address stress in different settings, including at work, in the community (e.g. social support, community empowerment) or at health care level (e.g. by screening and providing adequate emotional support or developing coping skills to selected patients). It is known that multifaceted approaches can be more effective in protecting against the deleterious effects of stress and for improving quality of life (2001). With regards to CVRFs, the role of stress continues to be debated (2001). By showing only a small number of independent associations between stress and CVRFs (and in particular no link with high blood pressure), our study is consistent with a limited role of stress on CVRFs but, inversely, our findings cannot exclude some impact. Since the prevalence of stress in the population is high, even small associations of stress on CVRFs could have a substantial impact at the population level. This emphasizes that stress should be considered in strategies to prevent and control CVD and NCDs at large. Further studies, including trials, are still needed to better quantify the nature and the magnitude of the links between stress and CVD and CVRFs to better guide effective interventions in this area.

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Table 1. Characteristics of the participants

	N	%
Male	709	57.2
Age >45 years	689	55.6
Income > US $ 700 per month	356	28.7
Education > obligatory school	376	30.3
Body mass index ≥30 kg/m2	400	32.5
Alcohol intake ≥60ml/day on average	111	9.0
BP >=140/90 mmHg	413	33.3
BP >= 160/90 mmHg	147	11.9
Smoking at least one cigarette daily	184	14.8
Stress ≥7	125	10.1
Stress ≥6	229	18.5
Stress ≥5	152	12.3

Table 2. Proportions of participants reporting domain-specific stress according to selected variables

		Stress at work			Stress in social life			Stress financially			Stress related to environment		
Cutoff to define stress		7 %	6 %7	5 %	7 %	6 %	5 %	7 %	6 %	5 %	7 %	6 %	5 %
All		14.2	22.0	36.7	13.3	18.1	26.7	10.2	14.4	22.1	6.9	10.2	16.5
Sex	Male	12.3	20.2	34.6	**7.9**	**11.5**	**19.8**	**6.2**	**10.0**	**17.7**	5.5	**7.7**	**13.7**
	Female	15.8	23.5	38.4	**17.3**	**23.0**	**31.9**	**13.1**	**17.8**	**25.4**	7.9	**12.1**	**18.5**
Age	≥45	**10.4**	**17.7**	**29.5**	12.8	17.7	24.8	**7.8**	**11.2**	**17.1**	7.3	9.9	15.1
	<45	**18.5**	**26.8**	**44.8**	14.0	18.5	29.0	**13.1**	**18.5**	**28.3**	6.4	10.7	18.1
Education	High	**20.9**	**32.3**	**51.8**	12.8	18.9	30.3	7.2	12.8	21.0	7.4	**12.5**	**19.7**
	Low	**11.1**	**17.2**	**29.6**	13.5	17.7	25.1	11.5	15.2	22.6	6.6	**9.3**	**15.0**
Income	High	**21.0**	**31.4**	**48.7**	**11.5**	15.4	25.3	**6.2**	**9.3**	**16.0**	6.2	8.4	14.9
	Low	**11.2**	**17.8**	**31.3**	**14.0**	19.1	27.3	**11.8**	**16.5**	**24.5**	7.1	11.0	17.1
Alcohol	High	19.0	25.7	34.3	13.5	17.1	27.0	10.8	13.5	20.7	8.1	8.1	**9.9**
	Low	13.7	21.7	37.0	13.3	18.2	26.7	10.1	14.5	22.2	6.7	10.5	**17.1**
Smoking	Yes	13.8	19.2	32.3	14.7	17.9	28.3	10.9	14.1	21.7	7.1	8.7	13.6
	No	14.3	22.6	37.5	13.1	18.1	26.4	10.0	14.5	22.2	6.8	10.5	17.0
BMI	≥30	14.8	23.5	37.8	**18.0**	**23.5**	**32.5**	13.3	16.3	23.0	8.5	**12.5**	18.8
	<30	14.0	21.3	36.2	**11.1**	**15.5**	**23.9**	8.7	13.6	21.7	6.1	**9.2**	15.4
BP	≥140 or 90	13.8	19.3	**30.7**	10.9	15.0	21.8	7.5	12.6	19.6	7.3	9.4	16.0
	<140 & 90	14.5	23.3	**39.7**	14.5	19.6	29.1	11.5	15.4	23.3	6.7	10.6	16.7
BP	≥160 or 100	15.5	21.7	32.6	9.5	15.0	21.8	6.1	12.2	21.8	6.8	8.2	17.0
	<160 &100	14.1	22.1	37.3	13.8	18.5	27.4	10.7	14.7	22.1	6.9	10.5	16.4

Domain-specific stress was rated from 0 (no stress) to 10 (maximal stress).
Estimates in blue and bold: p <0.05.

Table 3. Multivariate associations between stress in different domains and socio-demographic variables

	Stress at work			Stress in social life			Stress financially			Stress related to environment		
Cutoff to define stress	7 OR	6 OR	5 OR	7 OR	6 OR	5 OR	7 OR	6 OR	5 OR	7 OR	6 OR	5 OR
Age >45	**0.55**	**0.65**	**0.57**	0.91	1.00	0.87	**0.51**	**0.53**	**0.51**	1.23	1.03	0.88
Male	0.74	0.82	0.86	**0.41**	**0.45**	**0.55**	**0.45**	**0.55**	**0.68**	0.69	**0.65**	0.75
High income	**1.90**	**1.75**	**1.65**	0.94	0.81	0.86	0.68	**0.58**	**0.61**	0.81	0.62	0.73
High education	1.39	**1.64**	**1.85**	0.88	1.12	**1.28**	**0.55**	0.82	0.91	1.27	**1.66**	**1.50**
High income (a)	**2.21**	**2.19**	**2.16**	0.88	0.85	0.97	0.52	**0.53**	**0.59**	0.91	0.79	0.88
High education (b)	**1.87**	**2.11**	**2.30**	0.86	1.02	1.20	0.47	**0.66**	**0.74**	1.16	1.35	0.76

All estimates are adjusted to all variables in the table, except (a): not adjusted for education; and (b): not adjusted for income.
Domain-specific stress was rated from 0 (no stress) to 10 (maximal stress).
Estimates in blue and bold: $p < 0.05$.

Table 4. Associations between stress in different domains and cardiovascular risk factors

		Stress at work			Stress in social life			Stress financially			Stress related to environment		
Cutoff to define stress		7	6	5	7	6	5	7	6	5	7	6	5
BP ≥140/90	Total	1.33	1.01	0.87	0.82	0.81	1.60	**0.63**	1.04	1.04	1.10	0.99	1.10
	M	1.57	1.15	1.04	0.67	0.83	0.93	0.86	0.72	1.01	1.66	1.62	1.51
	F	1.19	0.89	0.74	0.82	0.72	0.64	0.69	1.14	1.00	0.86	0.68	0.82
BP ≥160/100	Total	1.60	1.30	1.09	0.76	0.89	0.87	0.71	1.09	1.31	1.02	0.85	1.21
	M	1.07	1.47	1.20	0.74	0.82	0.95	0.19	0.37	1.10	1.18	1.03	1.49
	F	**2.16**	1.14	1.04	0.73	0.89	0.78	1.04	1.67	1.48	0.86	0.68	0.96
Smoking daily	Total	1.26	1.02	0.96	**2.03**	**1.67**	**1.67**	1.61	1.32	1.17	1.27	0.99	0.90
	M	1.22	0.98	0.84	**2.04**	1.44	1.57	1.29	1.28	1.17	0.94	0.89	0.77
	F	1.34	1.16	1.37	**2.23**	**2.28**	**2.06**	**2.28**	1.53	1.27	2.09	1.23	1.31
Alcohol >60 ml/day	Total	1.97	1.56	1.02	1.85	1.60	1.55	1.81	1.37	1.17	1.58	0.98	0.62
	M	**2.01**	1.44	1.02	1.50	1.31	1.38	1.48	1.22	0.98	1.42	0.91	0.59
	F	1.80	2.42	1.08	**3.57**	**3.44**	2.93	3.36	2.15	2.67	2.52	1.43	0.83
Body mass index >30	Total	1.08	1.17	1.12	**1.50**	**1.45**	1.39	1.38	1.09	1.00	1.35	1.34	1.23
	M	1.15	1.33	**1.72**	0.89	**0.79**	0.83	0.97	1.03	0.99	1.49	1.24	1.45
	F	1.08	1.08	0.89	**1.60**	1.59	1.60	1.39	0.99	0.93	1.30	1.37	1.10

Domain-specific stress was rated from 0 (no stress) to 10 (maximal stress).
All estimates are adjusted for age, income and education but not to other risk factors.
Estimates in blue and bold: $p < 0.05$.