Anxiety But Not Depression Is Associated With Elevated Blood Pressure in a Community Group of French Elderly

Sabrina Paterniti, MD, Annick Alpérovitch, MD, Pierre Ducimetière, PhD, Marie-Josè Dealberto, MD, PhD, Jean-Pierre Lépine, MD, and Jean-Claude Bisserbe, MD

Objective: This study examined whether anxiety and depression were independently associated with elevated blood pressure in elderly persons. **Method:** The study group consisted of 1389 subjects aged 59 to 71 years recruited from the electoral rolls of the city of Nantes (France). Subjects completed the Center for Epidemiologic Studies-Depression scale (CES-D) and the Spielberger Inventory scales to assess depressive symptoms and anxiety symptoms, respectively. Data were collected on sociodemographic characteristics, smoking and drinking habits, medical history, and drug use. Two measures of systolic and diastolic blood pressure were taken after a 10-minute rest. Body mass index was computed from weight and height measurements. Subjects taking antihypertensive drugs ($N = 281$) were excluded from the present analysis. **Results:** Depression and anxiety scores were significantly correlated ($r = .61$ in men; $r = .65$ in women; $p < .001$). In univariate analyses, anxiety scores were correlated with systolic and diastolic blood pressure in men, but not in women; blood pressure was not associated with depressive symptoms in either sex. Multivariate logistic regressions, controlling for possible confounders, showed that in both men and women, the risk of high blood pressure increased with increasing anxiety scores; odds ratios for high blood pressure were less than 1 in subjects with depressive symptomatology. **Conclusions:** This study suggested that anxiety but not depression was independently associated with an increased risk for high blood pressure. **Key words:** anxiety, depression, blood pressure.

EVA Study = Etude sur le Vieillissiment Artériel; CES-D = Center for Epidemiologic Studies-Depression scale; BMI = body mass index; DBP = diastolic blood pressure; SBP = systolic blood pressure.

INTRODUCTION

The brain exerts a complex regulatory action on cardiovascular function through the autonomic nervous system. Cognitive and emotional state can influence blood pressure, heart rate, and vascular perfusion. It is well established that acute stress and anxiety can lead to a transient increase in blood pressure via changes in cardiac output and vascular resistance (1, 2); chronic stress can induce prolonged hypertension (3–5). Increased risk for hypertension and cardiovascular mortality has also been reported in anxiety disorder (6–8). Conversely, higher levels of anxiety have been found in hypertensive subjects (9–10).

The relationship between depression and blood pressure is more controversial. Some authors have reported that depression occurred more often in patients with high blood pressure than in those without hypertension (11–12); other authors have not confirmed this relationship (13–15). Depression and depressive symptomatology have also been associated with an increased risk of cardiovascular morbidity, especially myocardial infarction (16–18). Recent longitudinal studies (19, 20) have shown a relationship between anxiety or depression and the subsequent development of hypertension. At the opposite, other studies suggested an association between psychiatric disorders and low blood pressure. Increased prevalence of dizziness-giddiness, unexplained tiredness, and high levels of psychiatric morbidity, particularly of depressive symptoms, were found in patients with low blood pressure (21–25).

Thus, there is evidence that specific psychological dysfunctions might have different effects on blood pressure. In view of this hypothesis, the question of co-occurrence of various psychiatric disorders must be carefully addressed.

Most of the studies exploring the relationship between blood pressure and psychopathological symptoms have focused either on depression or on anxiety, without considering both conditions together, although depressive and anxiety symptoms are commonly associated (26–27). Anxiety and depression can be associated at a subsyndromal level, especially in primary care (28). Anxiety symptoms are also common in depressed patients (29), and, finally, depressive and anxiety disorders often are comorbid (30).

The present study, which examined a large study group of elderly subjects, had two major objectives. The first was to examine the relationship between anxiety and depression on blood pressure measures. The second was to assess more specifically the independent relationship of anxiety and depression with increased blood pressure.

From the Institut National de la Santé et de la Recherche Medicale, Unit 360 (S.P., A.A., M.-J.D.), Unit 302 (J.-C.B.), and Unit 258 (P.D.), Hôpital Fernand Widal (J.-P.L.), Paris, France.

Address reprint requests to: Sabrina Paterniti, MD, INSERM U360, Hôpital La Salpêatrière, 75651 Paris Cedex 13, France.

Received for publication October 10, 1997; revision received July 15, 1998.

0033-3174/99/6101-0077

METHOD

Study Group

The EVA Study is an ongoing longitudinal study on cognitive and vascular aging conducted in the city of Nantes (western France). The study group consisted of 1389 volunteers, born between 1922 and 1932, recruited from the electoral rolls of the city of Nantes. The study protocol was approved by the Ethics Committee of Bicêtre University Hospital and written consent was given by all participants.

Interview and Measures

During the baseline visit, which occurred between June 1991 and July 1993, a structured questionnaire, including items on sociodemographic characteristics, smoking, alcohol consumption, medical history, and current use of medications, was administered to participants by a member of the study staff. Medical examination included blood sampling, ultrasound examination of carotid arteries, and 1 hour of cognitive testing.

Subjects were classified as current smokers, former smokers, or never smokers. Mean weekly alcohol intake (in ml) was estimated from a detailed description of alcoholic beverage consumption during a typical week.

Each subject was asked whether he or she had suffered from any of six specified common diseases (myocardial infarction, angina, stroke, hypercholesterolemia, hypertension, diabetes) or from any other chronic medical conditions. All drugs used during the month preceding the examination were registered. Subjects taking antihypertensive drugs were excluded from the present analyses, but those reporting a history of untreated high blood pressure were included.

Weight and height were measured and body mass index was computed as weight (kg) divided by height squared (m^2). Two separate measures of systolic and diastolic blood pressure were taken after 10 minutes rest, using an automatic blood pressure monitor; means of the two measures of systolic and diastolic blood pressure were used for the analysis. Intraclass correlation coefficients between the two blood pressure measurements were equal to 0.74 and 0.63 for systolic and diastolic blood pressures, respectively. High blood pressure was defined as systolic blood pressure $\geq$ 160 mm Hg and/or diastolic blood pressure $\geq$ 90 mm Hg.

The French version of the CES-D (31) was used to assess depressive symptoms. The CES-D is a 20-item self-report of depressive symptoms experienced in the past week. Each item is rated from 0 to 3 (rarely, some of time, occasionally, most of time); the total score ranges from 0 (no depressive symptom) to 60. The CES-D scale has been used widely in epidemiological studies and has been shown to be appropriate for use in studies with elderly subjects (32, 33). As recommended for the French population (34), CES-D scores more than 16 in men and more than 22 in women were considered as indicative of increased depressive symptomatology.

Anxious symptoms were evaluated by means of the French translation of the 20-item Spielberger Inventory-trait (form X-2) (35). The Spielberger Inventory Trait (form X-2) has been used extensively in research and clinical practice; its factorial validity has been shown in elderly subjects (36). The Spielberger Inventory trait provides a measure of the relatively stable dispositional aspects of anxiety. The items are rated from 1 to 4 in terms of frequency categories (almost never, sometimes, often, almost always). For technical reasons, the Spielberger Inventory was not administered to subjects who were enrolled in the first 6 months of the EVA study.

The CES-D and the Spielberger Inventory were mailed to the participants approximately 3 weeks before the examination and completed questionnaires were returned at the time of the examination.

Statistical Analysis

Descriptive and analytic statistics were performed using SAS software (37). The CES-D and Spielberger Inventory scales were examined in two different ways. First, they were considered as continuous variables. Second, they were considered as four-category variables based on quartiles of the score distributions. Indeed, the relationship between blood pressure and psychopathological measures is not necessarily linear; some studies suggest a U-shape association between blood pressure and depression (25). The relationship between blood pressure and anxiety or depression might concern only the highest psychopathological levels. Use of quartiles might thus be more able to detect different types of relationship than the use of the continuous variables.

Associations between blood pressure, CES-D scores, Spielberger Inventory scores, and the covariates were assessed using variance analysis and Pearson's correlation coefficient. The adjusted odds ratios and 95% confidence intervals of high blood pressure for quartiles of the two psychological measure distributions were calculated, using logistic regression. For both the CES-D scale and the Spielberger Inventory, the first quartile (lowest scores) was taken as the reference category. All odds ratios were adjusted on BMI and the use of antidepressants that are known to be related with blood pressure level; presence of chronic disease, drug use, and alcohol consumption were also taken into account.

Because of the strong correlation between the Spielberger and the CES-D scores, we performed collinearity analysis using the SAS PROC REG procedure for multivariate linear regressions and the ratios coefficient/SEs for logistic regressions. This analysis did not detect a major collinearity problem.

All analyses were made separately in men and women. Subjects taking antihypertensive drugs were excluded, inasmuch as we were interested in the relationship between psychopathology and naturally occurring blood pressure. Statistical significance was set at $p = .05$ (2-tailed test).

RESULTS

Among the 1389 individuals of the EVA Study group, 273 had been included before the Spielberger Inventory was introduced. Among the 1116 remaining subjects, 281 were excluded because they were treated by antihypertensive drugs at the time of the study and 68 because they had not completed the CES-D or the Spielberger scales.

The 281 subjects who were treated by antihypertensive drugs differed from nonusers for blood pressure values, body mass index, and the presence of chronic diseases (both cardiovascular and others); they did not differ for age, education, CES-D and Spielberger scales, and psychotropics use. Although blood pressure was not significantly associated with anxiety and depressive symptom scores, men taking antihypertensive drugs were slightly more depressed than men not taking antihypertensive drugs (CES-D score: 9.92 vs. 8.80, $p = .06$) and slightly less anxious (Spielberger score: 35.0 vs. 36.3, $p = .08$).

There were no differences between men who did not complete the psychological scales and those who did for age, diastolic and systolic blood pressures, percentage of hypertensives, and the presence of chronic diseases (cardiovascular and others). Among women, the two groups differed only for systolic blood pressure [subjects not included: $N = 151$, mean (SD) = 127.7 (13.6); subjects included: $N = 458$, mean (SD) = 124.8 (15.7); $p = .03$].

The final study group consisted of 309 men and 458 women aged 59 to 71 years [mean age (SD) = 65 (3) years in both sexes]. Men and women differed for most variables including education level, drinking and smoking habits, drug use (and specifically psychotropics), the presence of noncardiovascular chronic diseases, mean diastolic and systolic blood pressures, and body mass index (Table 1). High blood pressure as defined in the Methods section was found in 19.4% of men ($N = 60$) and 6.5% of women ($N = 30$).

Spielberger scores and CES-D scores were strongly correlated in both sexes ($r = .61$, $p < .001$ in men; $r = .65$, $p < .001$ in women).

Both anxiety and depression scores were significantly higher in women than in men (Table 1). However, proportions of subjects with CES-D scores indicating increased depressive symptomatology were similar in men (12.3%) and in women (14.6%).

Univariate associations between blood pressure, CES-D scores, Spielberger Inventory scores, and the covariates described in the Methods section were examined to assess the magnitude of possible confounding effects. As expected, diastolic and systolic blood pressures were significantly correlated with body mass index. Cardiac rate was highly correlated with systolic and diastolic blood pressure, but was not correlated with psychopathological measures (partial correlation adjusting for sex, age, and BMI; Spielberger scores: $r = .06$, $p = .09$; CES-D scores: $r = .04$, $p = .24$). Smoking habits were not associated with blood pressure levels nor with psychopathological measures.

Only in men, we found a significant positive association between blood pressure and alcohol consumption. Drug use (psychotropics and other drugs) was associated with high anxiety scores in both sexes, and with high CES-D scores in women only. Women with higher anxiety scores had lower body mass index and reported chronic diseases more frequently than those with lower scores. The other variables were associated neither with blood pressure nor with psychopathological measures. In particular, smoking habits were not associated with psychopathological measure nor with blood pressure levels.

Significant correlations between Spielberger scores and diastolic and systolic blood pressure were found in men, but not in women (Table 2). CES-D scores were not significantly correlated with blood pressure in either sex.

To assess the independent association between blood pressure, and Spielberger and CES-D scores, we performed a series of multivariate analyses.

First, Spielberger score, CES-D score, age, and BMI were entered as continuous variables in multiple lin-

TABLE 1. Characteristics of the Study Group

	Men ($N = 309$)	Women ($N = 458$)	*P* Value
Age (yr), mean (SD)	65.0 (3.0)	64.9 (2.9)	.60
Schooling (yr), mean (SD)	11.2 (4.0)	10.3 (3.2)	.001
Alcohol consumption (ml/wk), mean (SD)	183 (182)	56 (79)	.0001
Smoking *N* (%)			
Never	86 (27.8)	379 (82.8)	
Former	184 (59.5)	54 (11.8)	.001
Current	39 (12.6)	25 (5.5)	
At least one chronic disease, *N* (%)			
Myocardial infarction, heart failure	8 (3.5)	3 (0.6)	.03
Others	142 (46.0)	240 (52.4)	.08
Number of medications, *N* (%)			
0	124 (40.1)	103 (22.5)	
1–3	135 (43.7)	212 (46.3)	.001
≥4	50 (16.2)	143 (31.2)	
Psychotropic drugs, *N* (%)			
0	269 (87.1)	337 (73.6)	
1	30 (9.7)	78 (17.0)	.001
≥2	10 (3.2)	43 (9.4)	
Anxiolytics/hypnotics, *N* (%)	23 (7.4)	80 (17.5)	.001
Antidepressants, *N*, (%)	6 (1.9)	24 (5.2)	.02
Spielberger score, mean (SD)	36.1 (8.3)	41.0 (9.4)	.0001
CES-D score, mean (SD)	8.9 (6.5)	13.5 (8.7)	.0001
Body mass index (kg/m^2), mean (SD)	26.3 (3.4)	24.2 (3.7)	.0001
Systolic blood pressure, mean (SD)	134.5 (16.8)	124.8 (15.7)	.0001
Diastolic blood pressure, mean (SD)	80.2 (10.6)	75.8 (9.4)	.0001
Cardiac rate, mean (SD)	67.5 (11.0)	70.3 (10.0)	.0003

TABLE 2. Partial Correlations Between Psychopathological Measures and Blood Pressure (Adjusting for Age and BMI)

	Men ($N = 309$)		Women ($N = 458$)	
	SBP[a], *r* (*p*)	DBP[b], *r* (*p*)	SBP[a], *r* (*p*)	DBP[b], *r* (*p*)
CES-D score	0.06 (0.33)	0.08 (0.17)	0.03 (0.50)	0.05 (0.26)
Spielberger score	0.11 (0.05)	0.19 (0.001)	0.04 (0.41)	0.08 (0.08)

[a] SBP = systolic blood pressure.
[b] DBP = diastolic blood pressure.

ear regression models computed in men and women separately. The analysis showed a significant or near significant positive correlation between anxious symptoms and blood pressure in men (SBP: $\beta = .23$, $p = .09$; DBP: $\beta = .26$, $p = .002$). Nonsignificant positive correlations between anxious symptoms and blood pressure were found in women (SBP: $\beta = .09$, $p = .36$; DBP: $\beta = .09$, $p = .11$).

Nonsignificant negative correlations between CES-D scores and blood pressure were found in men (SBP: $\beta = -.04$, $p = .81$; DBP: $\beta = -.09$, $p = .46$) and women (SBP: $\beta = -.008$, $p = .94$; DBP: $\beta = -.03$, $p = .68$). There was no significant statistical interaction between CES-D and Spielberger scores.

Odds ratios were computed from multivariate logistic regression to estimate the relative risk of high blood pressure (dependent variable) for the second, third, and fourth quartiles of the psychological scale distributions, compared with the first quartile [adjusting on BMI and antidepressant use (Table 3)]. Odds ratios for high blood pressure increased with increasing anxiety scores in both men and women. Subjects in the second or the third quartile of the Spielberger score distribution had a moderate, nonsignificant risk of high blood pressure; odds ratio values were two to three times higher in the fourth quartile, compared with the second and the third. In contrast, high depressive symptoms were significantly associated with lower risk of high blood pressure in men, but analysis did not suggest that risk decreased with increasing depressive symptoms. No consistent relationship between CES-D and blood pressure was found in women. When additional adjustment variables were included in the logistic regression model (ie, drug use, presence of chronic disease, alcohol consumption), odds ratios were similar.

Because of the small number of subjects with high blood pressure in our study group, especially among women, we reanalyzed our data, using a less stringent definition of high blood pressure. High blood pressure was defined using the cutoffs of 150 mm Hg and 85 mm Hg for systolic and diastolic measures, respectively. As expected, odds ratio values were slightly lower than those given in Table 3, but the overall pattern of relationship between anxiety, depression, and increased blood pressure remained unchanged.

Lastly, because subjects reporting untreated high blood pressure had been included in the study group, we considered the possibility that awareness of hypertensive status could give rise to anxious symptoms. Overall, as shown in Table 3, results of logistic regression analyses did not change substantially when these subjects ($N = 69$) were excluded.

DISCUSSION

The specific pathophysiological mechanisms that are involved in anxiety and depression may have different effects on the cardiovascular system and especially on blood pressure (38, 39). Therefore, the cooccurrence of both anxiety and depression can obscure specific relationship between one single disorder and blood pressure. This might explain in part the inconsistent results about the association between depression and blood pressure (11–15).

The strong evidence for an association between high blood pressure and anxiety is supported by a large number of case-control studies that compared either psychological symptoms in hypertensive patients and controls, or blood pressure in patients with a variety of psychiatric disorders and controls [see Pilgrim (40) for

TABLE 3. Odds Ratios for Subjects Not Taking Hypertensive Drugs Who Had High Blood Pressure According to Anxiety and Depression Scores

	Total No. Not Taking Antihypertensive Drugs		Excluding Subjects Reporting Untreated Hypertension	
	Men ($N = 309$)	Women ($N = 458$)	Men ($N = 283$)	Women ($N = 415$)
	Odds ratio[a] (95% CI)	Odds ratio[a] (95% CI)	Odds ratio[a] (95% CI)	Odds ratio[a] (95% CI)
Spielberger quartile				
1^ (first)	1	1	1	1
2^ (second)	1.64 (0.66–4.07)	2.72 (0.87–8.50)	2.06 (0.75–5.61)	7.22 (1.50–34.7)
3^ (third)	1.55 (0.58–4.13)	1.72 (0.42–7.04)	2.14 (0.72–6.38)	2.09 (0.27–16.2)
4^ (fourth)	3.64 (1.40–9.47)	6.77 (1.72–26.6)	4.68 (1.58–13.9)	10.0 (1.44–69.2)
CES-D quartile				
1^ (first)	1	1	1	1
2^ (second)	0.38 (0.16–0.90)	1.55 (0.56–4.25)	0.35 (0.13–0.92)	1.68 (0.51–5.57)
3^ (third)	0.61 (0.26–1.44)	0.40 (0.11–1.45)	0.50 (0.19–1.29)	0.32 (0.06–1.77)
4^ (fourth)	0.36 (0.13–0.98)	0.44 (0.12–1.60)	0.31 (0.10–0.93)	0.54 (0.11–2.70)

[a] Odds ratios adjusted on BMI and psychotropic drug use.

review]. In most studies, patients were recruited in hospitals or general practice. There have been surprisingly few epidemiological studies in the population sample, using instruments specifically designed to measure the intensity of anxious feelings and controlling for important variables as body mass index, antihypertensive treatments, or psychotropic drugs.

In a large group of 767 elderly subjects who were not treated with antihypertensive drugs, we found that the prevalence of high blood pressure increased with increasing levels of anxious symptoms measured on the Spielberger Inventory scale. Men with the highest anxiety scores (fourth quartile) were 3.6 times more likely to have high blood pressure, compared with those with the lowest scores (first quartile); similarly, relative risk of high blood pressure for women with the highest anxiety scores was equal to 6.8. Association between anxiety and blood pressure was independent of body mass index, drug use including psychotropics, alcohol consumption, chronic disease, and depressive symptoms assessed from the CES-D scale. It remained unchanged when individuals who reported a history of untreated high blood pressure were excluded from the analysis. In contrast, a higher level of depressive symptoms was associated with lower risk of high blood pressure in men; no consistent relationship was found in women.

We found different results about the relationship between depression and blood pressure when linear or logistic regressions were performed. In linear regression, no association was found, whereas in logistic regression a significant negative association was found in men. However, the results of the two types of analysis are not exactly comparable: In multiple regression, SBP and DBP are considered separately, whereas in logistic regression the risk of high SBP or high DBP is taken into account. Following this latter definition, more subjects have high blood pressure; this might increase the study power.

Our findings do not permit the establishment of a causal relationship between anxiety and blood pressure. We have ruled out that awareness of one's high blood pressure could explain this association. Behavioral patterns of anxious patients, such as life style, diets, drinking, smoking, or other health habits may play a role as risk factors of high blood pressure. Psychosocial stressors have been shown to produce increases of blood pressure (41); they also could produce anxiety. Other different factors, such as race and personality (2), renin-angiotensin system (42), and neurotransmitter dysregulation (43), could also contribute to confound the relationship between anxiety and high blood pressure. Lastly, anxiety may produce hypertension via increased sympathetic activity.

In our study, we found a stronger relationship between the highest anxiety levels (fourth quartile) and high blood pressure, the mild level of anxiety not being significantly associated with high blood pressure. This result could indicate that only pathological anxiety is associated with a higher risk of high blood pressure, and that mild anxiety levels are not. The lack of psychiatric diagnosis did not permit the confirmation of this hypothesis.

Some points about the study's methodology must be raised. The EVA Study group is composed of volunteers recruited from voting registers. Study participants have higher educational achievement and monthly income than the general population of the same age. Moreover, it is plausible that several individuals who agreed to participate had specific personality profiles. By excluding subjects taking antihypertensive drugs from the analysis, we circumvented selection bias directly related with hypertension history but not more subtle unrecognized self-selection criteria. There were no major differences between subjects who completed the CES-D and Spielberger scales and nonrespondents, and it is unlikely that the low nonrespondent rate (8%) might constitute an important bias. Subjects had completed the psychological self-rated scales within the 3 weeks preceding their examination at the study center where blood pressure was measured.

Excluding subjects taking antihypertensive drugs may raise some problems in the interpretation of results. On the basis of our findings, it could be expected that subjects taking antihypertensive drugs had higher anxious scores, whereas we found, on the contrary, that they were less anxious. This apparently paradoxical result may be due to the psychotropic effects of the antihypertensive drugs (44).Thus, reserpine induces depressive symptoms (45), and β blockers are prescribed for treating some anxiety disorders (46). In our study, 45.5% of subjects taking antihypertensive drugs were β blocker users; subjects using β blockers had significantly lower anxiety levels than those taking other categories of antihypertensive drugs (data not shown). Thus, the psychotropic effect of antihypertensive drugs could mask the association between psychopathology and blood pressure.

A limitation of our study was the inability to identify "white coat" hypertensives, that is patients with increased blood pressure in the clinic who have normal pressure at other times (47). A recent study has found that 18% of 50 elderly hypertensive patients were "white coat" hypertensives (48). Anxiety has been proposed to explain this phenomenon. However, no differences in anxiety scores between patients with "white coat" and stable hypertension has been found

(49). Therefore, although it is possible that "white coat" hypertensives were more prevalent among subjects reporting more anxious symptoms, it is not likely that the relationship between anxiety and high blood pressure simply reflects the "white coat" phenomenon.

A variety of instruments and criteria can be used to assess psychological disorders. The CES-D scale and the Spielberger Inventory have been designed for measuring the intensity of depressive and anxious symptoms, respectively, and not for making a clinical diagnosis of depressive episode or anxiety. In the present study, about 13% of subjects had CES-D scores indicative of high risk of current depression. This proportion was comparable to the prevalence of depression in other elderly in the French population (50). This prevalence rate was high compared with that found in the elderly population when depression diagnosis is based on DSM-III criteria (51); but it was much lower than the prevalence of depression in clinical studies of hypertensive patients (11, 13, 52).

Clinical studies have reported an association between typical (melancholic) depression and hypertension (11, 20). However, population studies have shown that low blood pressure was associated with higher depressive symptoms (25) or with syndromes characterized by high depressive symptomatology, such as chronic fatigue syndrome (53). In our study, depressive symptoms were not correlated with blood pressure measures and when taking into account anxiety symptoms, higher depressive symptomatology was negatively associated with the risk of high blood pressure.

In conclusion, our results indicated that increased anxious symptoms were associated with a four-times increased risk of high blood pressure in men and women. The results suggested also that, at the opposite, depressive symptoms tended toward a negative correlation with blood pressure values. These cross-sectional findings do not allow us to conclude that anxiety is a risk factor for subsequent high blood pressure, nor that depression is a protective factor against it. The analysis of longitudinal data of the EVA Study will examine these issues.

The EVA Study is organized under agreement between INSERM (Institut National de la Santé et de la Recherche Medicale) and the Merck Sharp and Dhome-Chibret Company. Dr. Sabrina Paterniti was supported by a postdoctoral grant from INSERM. We are grateful to C. Delanoë and E. Marceteau for their technical support. We thank Bruno Falissard, PhD, for his statistical advice.

REFERENCES

1. Whitehead WE, Blackwell B, De Silva H, Robinson A. Anxiety and anger in hypertension. J Psychosom Res 1994;21:383–9.
2. Shapiro D, Goldstein IB, Jamner LD. Effects of cynical hostility, anger out, and defensiveness on ambulatory blood pressure in black and white college students. Psychosom Med 1996;58: 354–64.
3. Forsyth RP, Hoffbrand BI, Melmon KL. Hemodynamic effects of angiotensin in normal and environmentally-stressed monkeys. Circulation 1971;44:119–26.
4. Jonsonn A, Hanson L. Prolonged exposure to a stressful stimulus (noise) as a cause of raised blood pressure in man. Lancet 1977; 1:86–7.
5. Cobb S, Rose RM. Hypertension, peptic ulcer and diabetes in air traffic controllers. JAMA 1973;224:489–92.
6. Noyes R, Clancy J, Hoenk TR, Slymen DJ. The prognosis of anxiety neurosis. Arch Gen Psychiatry 1980;37:173–6.
7. Coryell W, Noyes R, House JD. Mortality among outpatients with anxiety disorders. Am J Psychiatry 1986;143:508–12.
8. Fontaine R, Boisvert D Psychophysiological disorders in anxious patients: hypertension and hypotension. Psychother Psychosom 1982;38:165–72.
9. Baer PE, Collins FH, Bourianoff GG, Ketchel MF. Assessing personality factors in emotional hypertension with a brief self report instrument. Psychosom Med 1979;41:321–30.
10. Consoli S. Emotion, réaction et action: voies et impasses de l'hypertension. Arch Mal Coeur 1987;80:29–33.
11. Rabkin JG, Charles E, Kass F. Hypertension and DSM-III depression in psychiatric outpatients. Am J Psychiatry 1983;140: 1072–4.
12. Wells KB, Golding JM, Burnam A. Affective, substance use, and anxiety disorders in persons with arthritis, diabetes, heart disease, high blood pressure, or chronic lung conditions. Gen Hosp Psychiatry 1989;11:320–7.
13. Wheatley D, Balter M, Levine J, Lipman R, Bauer ML, Bonato R. Psychiatric aspects of hypertension. Br J Psychiatry 1975;127: 327–36.
14. Friedman MJ, Bennet PL. Depression and hypertension. Psychosom Med 1977;39:134–42.
15. Goldberg EL, Comstock GW, Graves CG. Psychosocial factors and blood pressure. Psychol Med 1980;10:243–55.
16. Booth-Kewley S, Friedman HS. Psychological predictors of heart diseases: a quantitative review. Psychol Bull 1987;101: 343–62.
17. Carney RM, Freedland KE, Jaffe AS. Insomnia and depression prior to myocardial infarction. Psychosom Med 1990;52:603–9.
18. Anda R, Williamson D, Jones D, Macera C, Eaker E, Glassman A, et al. Depressed affect, hopelessness, and risk of ischemic heart disease in a cohort of US adults. Epidemiology 1993;4:285–94.
19. Simonsick EM, Wallace RB, Blazer DG, Berkman LF. Depressive symptomatology and hypertension-associated morbidity and mortality in older adults. Psychosom Med 1995;57:427–35.
20. Jonas BS, Franks P, Ingram DD. Are symptoms of anxiety and depression risk factors for hypertension? Arch Fam Med 1997; 5:44–8.
21. Pemberton J. Does constitutional hypotension exist? BMJ 1989; 298:660–2.
22. Wessely S, Nickson J, Cox B. Symptoms of low blood pressure: a population study. BMJ 1990;301:18–25.
23. Pilgrim JA, Stansfeld S, Marmot MG. Low blood pressure, low mood? BMJ 1992;304:75–8.
24. Rosengren A, Tibblin G, Wilhelmsen L. Low systolic blood pressure and self-perceived well being in middle-aged men. BMJ 1993;306:243–6.

25. Barrett-Connor E, Palinkas LA. Low blood pressure and depression in older men: a population based study. BMJ 1994;308: 446–9.
26. Hiller W, Zazudig M, Bose MV. The overlap between depression and anxiety on different levels of psychopathology. J Affect Disord 1989;16:223–31.
27. Eaton WW, Ritter C. Distinguishing anxiety and depression with field survey data. Psychol Med 1988;18:155–66.
28. DSM-IV. Diagnostic and Statistical Manual of Mental Disorders. 4th ed. Washington DC: American Psychiatric Association; 1994.
29. Fawcett J, Krawitz HM. Anxiety syndromes and their relationship to depressive illness. J Clin Psychiatry 1983;44:8–11.
30. Wittchen HU, Essau CA. Comorbidity and mixed anxiety-depressive disorder: is there epidemiological evidence? J Clin Psychiatry 1993;54 (Suppl):9–15.
31. Radloff LS. The CES-D scale: a self-report depression scale for research in the general population. Appl Psychol Measurement 1977;1:385–401.
32. Beekman ATF, Deeg DJH, Tilburg TV, Smit JH, Hooijer C, Tilburg W van. Major and minor depression in later life: a study of prevalence and risk factors. J Affect Disord 1995;36:65–75.
33. Radloff LS, Teri L. Use of the CES-D with older adults. Clin Gerontol 1986;5:119–36.
34. Fuhrer R, Rouillon F. La version française de l'échelle CES-D [Center for Epidemiologic Studies-Depression scale]. Description et traduction de l'échelle d'autovalutation. Psychiatr Psychobiol 1989;4:163–6.
35. Spielberger CD, Gorsuch RL, Lushene RE. STAI manual for the State-Trait Anxiety Inventory. Palo Alto (CA): Consulting Psychologist Press; 1970.
36. Patterson RL, O'Sullivan M, Spielberger CD. Measurement of state and trait anxiety in elderly mental health clients. J Behav Assess 1980;2:89–97.
37. SAS Institute Inc. SAS/STAT User's Guide, Version 6. 4th ed. Cary (NC): SAS Institute Inc; 1989.
38. Roose SP, Dalack GW, Woodring S. Death, depression, and heart disease. J Clin Psychiatry 1991;52(Suppl 6):34–9.
39. Dager SR, Roy-Byrne P, Dunner DL. Stress, anxiety and the cardiovascular system. In: Noyes R Jr, Roth M, Burrows GD, editors. Handbook of anxiety. Vol 2: Classification, etiological factors and associated disturbances. Amsterdam: Elsevier; 1988.
40. Pilgrim GA. Psychological aspects of high and low blood pressure. Psychol Med 1994;24:9–14.
41. Schnall PL, Landsbergis PA, Berger D. Job strain and cardiovascular disease. Annu Rev Public Health 1994;15:381–411.
42. Henri JP, Lin J, Meehan WP. Psychosocial stress and experimental hypertension. In: Laragh JH, Brenner BM, editors. Hypertension. New York: Raven Press; 1995. p. 905–21.
43. Siever LJ, Davis KL. Overview: toward a dysregulation hypothesis of depression. Am J Psychiatry 1985;142:1017–31.
44. Paykel ES, Fleminger R, Watson JP. Psychiatric side effects of antihypertensive drugs other than reserpine. J Clin Psychopharmacol 1982;2:14–39.
45. Long TD, Kathol RG. Critical review of data supporting affective disorder caused by nonpsychotropic medication. Ann Clin Psychiatry 1993;5:259–70.
46. Tyrer P. Current status of β-blocking drugs in the treatment of anxiety disorders. Drugs 1988;36:773–83.
47. Pickering TG, James GD, Boddie C, Harschfield GA, Blank S, Laragh JH. How common is white coat hypertension? JAMA 1988;259:225–8.
48. Trenkwalder P, Plaschke M, Steffes-Tremer I, Lydtin H. " White Coat" hypertension and alerting reaction in elderly and very elderly hypertensive patients. Blood Press 1993;2:262–71.
49. Schneider RH, Egan BM, Johnson EH, Drobny H, Julius S. Anger and anxiety in borderline hypertension. Psychosom Med 1986; 48:242–8.
50. Dufouil C, Fuhrer R, Dartigues JF, Alpérovitch A. Longitudinal analysis of the association between depressive symptomatology and cognitive deterioration. Am J Epidemiol 1996;144:634–41.
51. Blazer D. Depression in the elderly. N Engl J Med 1989;320: 164–6.
52. Huapaya L, Ananth J. Depression associated with hypertension: a review. Psychiatr J Univ Ottawa 1980;5:58–62.
53. Fuhrer R, Wessely S. The epidemiology of fatigue and depression: a French primary-care study. Psychol Med 1995;25: 895–905.