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Symptoms of low blood pressure: a population study

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Abstract

***Objective*—To establish whether an association exists between blood pressures in the "low normal" range and common symptoms such as tiredness, dizziness, headache, and palpitation, as suggested by French and German medical practice but not English or American medical practice.**

***Design*—Cross sectional population based survey (the health and lifestyle survey) of blood pressure measurements and self reported common symptoms. Results were analysed by combined stratification and logistic regression.**

***Subjects*—7383 (82%) Adults aged 18 and over chosen from the electoral register in England, Wales, and Scotland for the health and lifestyle survey, in whom satisfactory physiological measurements were taken, from 9003 in the interviewed sample.**

***Main outcome measures*—Body mass index, smoking, social class, exercise, self declared physical illnesses, hours slept, use of drugs, and psychological illness as determined with the general health questionnaire assessed as potential confounders.**

***Results*—True confounders were sex, age, taking of drugs, physical illness, exercise, and body mass index. A negative association was found between systolic blood pressure and self reported tiredness and feeling faint, which persisted after adjustment for the confounders. The association was strongest in women aged under 50. A negative association between systolic blood pressure and headache and a positive association between systolic blood pressure and palpitation were explained by confounding by age.**

***Conclusions*—Systemic hypotension is associated with persistent tiredness but treatment is not suggested as either possible or necessary. Instead, low blood pressures may be associated with opposite effects on mortality contrasted with morbidity.**

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Introduction

In the United Kingdom systolic blood pressures in the "low normal" range are regarded as desirable whereas in West Germany they are seen as pathological and are treated with antihypotensive drugs such as digoxin and ergotamine, as well as with numerous physical treatments.[1,2] Cardiac glycosides are the second most common prescription drugs in West Germany.[3] Similar cross cultural differences have been confirmed in several other European countries.[2,4] In the United States and Canada the academic consensus follows the British model in believing that "constitutional" hypotension is a spurious disease entity, and the concept is either dismissed or ignored in all the current leading medical and cardiology textbooks in the United States and United Kingdom. Nevertheless, even in the English speaking world, large numbers of people receive treatment for low blood pressure; one Canadian survey found that nearly a tenth of a community sample was receiving treatment for "low blood pressure."[5]

What is the evidence? At the beginning of this century most authorities assumed that low blood pressure was associated with several so called "neurasthenic" symptoms, such as tiredness, weakness, fainting, and dizziness,[6,7] although the same symptoms were also attributed to high blood pressure.[8] However, scepticism increased, culminating in Robinson's definitive article on the topic in 1940.[9] He vehemently attacked those who regarded low blood pressure as pathological and presented data showing that low blood pressure was associated with decreased mortality. He continued, "the symptoms usually ascribed to hypotension are in reality commoner among hypertensive persons. There are no symptoms peculiar to low blood pressure." This rapidly became the new conventional wisdom. A leading text now states: "Most persons with systolic pressures in the range of 90 to 110 mm Hg are normal and may actually have a greater life expectancy than those with 'normal' pressures."[10] Although the evidence is, however, unequivocal that low blood pressure is associated with decreased mortality[11] (the exception being the association between very low pressures and increased mortality in subjects with ischaemic heart disease, the so called J curve relation[12]), few data on the morbidity of low blood pressure exist. For example, although discussing mortality and morbidity, Robinson presented data only on mortality.[9]

Pemberton's analyses on data from an Australian survey, which disclosed a relation between tiredness and low blood pressure in women,[1] reopened the debate. The relation did not extend to either dizziness or fainting, symptoms also traditionally associated with low blood pressure, whereas palpitations showed an opposite trend, being more common with higher blood pressures. Pemberton could quote only crude rates. Blood pressure and tiredness are influenced by many variables so it is necessary to determine whether his findings may not only be replicated but also be explained by confounding. We present an analysis of data from the health and lifestyle survey,[13] which provides an opportunity to answer these questions.

Methods

HEALTH AND LIFESTYLE SURVEY

The health and lifestyle survey is the most comprehensive population based health survey carried out in Britain to date. The sampling frame for the survey was the entire adult population of England, Wales, and Scotland aged 18 and over. Preliminary selection was

made randomly from the electoral register. Further selection was made using probability proportional to the size of the constituency, and then to that of the ward. The result was a sample of 12 254 addresses, for which 9003 interviews were conducted, giving a non-response rate of 26·5%, mostly due to refusals. A high proportion of those interviewed (82·4%) consented to a follow up visit from a research nurse, at which time various physiological measurements were carried out, including blood pressure measurement. In 7383 people satisfactory measurements were taken, representing 82% of the interviewed sample or 60·2% of the entire sampling frame. Finally, respondents were asked to complete the 30 item general health questionnaire[14] and return it in a self addressed envelope. A total of 7304 participants accepted the questionnaire, and 6317 completed questionnaires were returned, representing 86·4% of those given the questionnaire or 70·2% of the entire sample.

The sample was compared with that of the 1981 census; owing to differences in availability for interview there was a slight excess of women, especially elderly women.[15] Compared with other census data there was a slight underrepresentation of both single and divorced or separated women. It has been concluded, however, that "these sources of bias are small and the study appears to offer a good and representative sample of the population."[15]

MEASUREMENTS

Blood pressure was measured by taking four measurements on a single occasion with the subject seated in an upright chair. A Datascope "Accutorr," set up to deflate and inflate the cuff automatically at one minute intervals, was used. Values were obtained by oscillometry and displayed digitally. The dependent variable was taken as the lowest observed value for systolic pressure. No differences were, however, obtained when the dependent variable was either mean systolic pressure or mean diastolic pressure.

Symptoms—A set list of 16 somatic symptoms were recorded by the interviewer during the semistructured interview. Fatigue was measured by the response to a single question: "Within the last month have you suffered from any problems with always feeling tired?" Other symptoms were recorded similarly.

TABLE I—*Relation between systolic blood pressure and principal confounders (means)*

Systolic blood pressure (mm Hg)	General health questionnaire	Body mass index (weight (kg)/(height (m))^2	Age (years)
<100	9·63	22·03	35·51
100-109	9·90	22·68	36·13
110-119	9·39	23·76	39·12
120-129	9·08	24·62	43·06
130-139	9·54	25·55	49·76
140-149	9·61	26·09	55·90
150-159	9·26	26·06	59·92
≥160	9·17	26·76	66·09
All	9·40	24·54	45·86

TABLE III—*Relation between tiredness and systolic blood pressure when data stratified by sex. Figures are percentages (numbers)*

Systolic blood pressure (mm Hg)	Always tired		Fainting and dizziness	
	Men	Women	Men	Women
<100	26·1 (12)	41·8 (107)	8·7 (4)	12·8 (33)
100-109	25·9 (63)	37·1 (286)	6·2 (15)	8·9 (69)
110-119	22·3 (146)	28·3 (294)	6·4 (42)	7·5 (78)
120-129	18·0 (174)	29·1 (242)	3·6 (35)	6·9 (57)
130-139	17·5 (112)	31·2 (159)	3·7 (24)	10·0 (51)
140-149	21·1 (84)	25·0 (73)	6·3 (25)	7·9 (23)
150-159	14·9 (27)	24·8 (41)	5·5 (10)	14·0 (23)
≥160	17·1 (30)	21·4 (47)	4·0 (7)	11·8 (33)
Total	19·6 (648)	30·6 (1249)	4·9 (162)	8·8 (367)
Test for trend	8·23 p=0·004	33·18 p<0·001	1·15 p=0·283	1·02 p=0·311

Psychological illness was assessed by the general health questionnaire 30, which was chosen as it is fairly free of somatic symptoms that may be present in both physical and psychological disorders. Particularly relevant to this analysis was that there is no question on fatigue. The questionnaire may be used in several ways to obtain data on the psychological health of a population. Recently a revised system of scoring has been devised as more appropriate for prevalence studies in which many respondents have chronic illness.[16] In the health and lifestyle survey data set the revised method of scoring gives a more normal distribution of psychological morbidity than previous scoring methods.[17] This may also be used as a dichotomous variable. A cut off point between 12 and 13 has been suggested for identifying probable psychiatric "caseness."[16 17] Both methods of scoring were used in the study.

Body mass index was calculated according to the formula: weight (kg)/(height (m))^2.

Exercise—A composite variable representing the amount of time each respondent had spent in any form of physical exercise during the previous 14 days was created and divided into four categories of activity: 0, nil or very low; 1, low or moderate; 2, moderate or active; and 3, high.

Social class was taken from the registrar general's socioeconomic groupings. Three categories were used: classes I and II, III, and IV and V.

Other variables—Other important variables, such as taking of drugs (including antihypertensive agents) and current smoking, were assessed as part of the interview and were coded as present or absent. The subjects were also asked about the presence of any known physical illness, which was coded according to a checklist comprising 31 categories. Finally, the number of hours slept was divided into three categories. Subjects who admitted to sleeping for less than seven hours were categorised as low sleepers, between seven and nine hours as normal sleepers, and more than nine as high sleepers.

Data analysis and control of confounders—Potential confounders were identified in the complete data set

TABLE II—*Relation between systolic blood pressure and principal confounders (proportions)*

Systolic blood pressure (mm Hg)	No	% Taking drugs	% Women	% Physical illness	% Smokers	% Nil or very low exercise	% In social class I or II	% With low sleep	% Psychiatric caseness (from general health questionnaire)
<100	302	33·8	84·7	26·2	33·7	26·2	28·8	27·2	30·2
100-109	1014	28·8	87·0	21·8	34·6	25·3	29·4	30·5	33·2
110-119	1691	27·5	61·4	23·8	34·7	23·6	30·0	30·3	29·9
120-129	1795	29·3	48·0	28·2	34·1	27·8	29·6	34·9	27·4
130-139	1149	37·1	44·3	31·9	31·2	36·6	28·1	37·4	29·5
140-149	691	44·6	42·3	36·7	30·0	38·6	29·2	41·3	32·2
150-159	346	52·0	47·7	41·0	31·5	45·3	23·7	43·2	27·6
≥160	395	58·7	55·7	42·0	23·8	47·8	25·4	40·6	29·7
All	7383	34·3	55·3	29·0	32·8	30·7	28·8	34·6	29·7

(tables I, II). After stratification by sex (table III) adjustment was made for age and sex by the Mantel-Haenszel technique after tests for heterogeneity (tables IV, V). Finally, the fully adjusted effect of increasing blood pressure on the risk of being fatigued was calculated with logistic regression to control for the true confounders previously identified (table VI). Logistic regression uses the equation:

$$\log(p/1-p)=m+aX+bY\ldots$$

where p is the proportion of fatigued subjects; m, a, and b are the parameters to be estimated and X, Y, etc, are the factors. These were entered as dummy variables (0,1) for dichotomous variables (sex, taking of drugs, physical illness), factored variables with three categories (sleep, social class, and exercise), factored variables with five categories (age), and as a continuous variable (body mass index). A main effects model was used with no interaction terms. The logarithms of the odds were converted to odds ratios for ease of understanding and were quoted relative to the baseline of systolic blood pressure of <100 mm Hg. Calculations were performed with the EGRET package for epidemiological analysis.

TABLE IV—*Relation between symptoms and systolic blood pressure adjusted for sex. Figures are odds ratios (95% confidence intervals)*

Systolic blood pressure (mm Hg)	Always tired	Palpitations	Fainting and dizziness	Headache
<100	1·00	1·00	1·00	1·00
100-109	0·84 (0·64 to 1·11)	0·83 (0·54 to 1·27)	0·67 (0·43 to 1·03)	1·03 (0·78 to 1·36)
110-119	0·58 (0·45 to 0·76)	1·00 (0·67 to 1·50)	0·57 (0·38 to 0·87)	0·92 (0·70 to 1·20)
120-129	0·58 (0·44 to 0·76)	1·18 (0·79 to 1·78)	0·48 (0·31 to 0·75)	0·86 (0·63 to 1·09)
130-139	0·63 (0·47 to 0·84)	1·93 (1·30 to 2·97)	0·70 (0·44 to 1·10)	0·83 (0·61 to 1·11)
140-149	0·51 (0·37 to 0·72)	1·89 (1·23 to 3·02)	0·60 (0·36 to 1·02)	0·71 (0·51 to 0·98)
150-159	0·47 (0·32 to 0·69)	2·18 (1·36 to 3·61)	0·99 (0·56 to 1·74)	0·50 (0·34 to 0·74)
≥160	0·41 (0·29 to 0·60)	2·40 (1·52 to 3·83)	0·82 (0·47 to 1·41)	0·60 (0·41 to 0·86)
Test for trend	40·64, p<0·001	102·47, p<0·001	0·10, p=0·756	30·56, p<0·001

TABLE V—*Relation between symptoms and systolic blood pressure adjusted for sex and age. Figures are odds ratios (95% confidence intervals)*

Systolic blood pressure (mm Hg)	Always tired	Palpitations	Fainting and dizziness	Headache
<100	1·00	1·00	1·00	1·00
100-109	0·84 (0·62 to 1·14)	0·83 (0·55 to 1·25)	0·85 (0·64 to 1·12)	1·05 (0·80 to 1·38)
110-119	0·59 (0·44 to 0·80)	0·87 (0·59 to 1·29)	0·59 (0·45 to 0·77)	0·98 (0·76 to 1·28)
120-129	0·59 (0·44 to 0·80)	0·84 (0·57 to 1·24)	0·61 (0·45 to 0·81)	0·96 (0·73 to 1·25)
130-139	0·62 (0·45 to 0·85)	1·00 (0·67 to 1·48)	0·65 (0·46 to 0·91)	0·98 (0·74 to 1·30)
140-149	0·55 (0·38 to 0·78)	0·86 (0·56 to 1·30)	0·67 (0·44 to 1·03)	0·91 (0·67 to 1·25)
150-159	0·45 (0·29 to 0·69)	0·97 (0·62 to 1·53)	0·43 (0·24 to 0·76)	0·77 (0·53 to 1·10)
≥160	0·44 (0·29 to 0·67)	0·89 (0·57 to 1·39)	0·47 (0·23 to 0·86)	0·93 (0·65 to 1·33)
Test for trend	22·64, p<0·001	0·39, p=0·532	22·62, p<0·001	2·38, p=0·123

TABLE VI—*Relation between tiredness and fainting or dizziness and systolic blood pressure adjusted for all identified confounders.* Figures are odds ratios (95% confidence intervals)*

Systolic blood pressure (mm Hg)	Tiredness	Fainting or dizziness
<100	1·00	1·00
100-109	0·85 (0·64 to 1·12)	0·73 (0·46 to 1·16)
110-119	0·65 (0·49 to 0·85)	0·68 (0·44 to 1·06)
120-129	0·61 (0·46 to 0·81)	0·48 (0·30 to 0·75)
130-139	0·62 (0·46 to 0·83)	0·52 (0·32 to 0·83)
140-149	0·61 (0·44 to 0·83)	0·51 (0·30 to 0·86)
150-159	0·49 (0·33 to 0·72)	0·60 (0·34 to 1·07)
≥160	0·46 (0·31 to 0·67)	0·45 (0·26 to 0·79)

*Age, sex, social class, taking drugs, body mass index, sleep, physical illness, and physical activity.

TABLE VII—*Effect of age on relation between systolic blood pressure and fainting and dizziness. Figures are percentages (numbers)*

Systolic blood pressure (mm Hg)	Age (years)				
	18-24	25-34	35-49	50-64	≥65
<109	11·2 (30)	7·0 (28)	9·0 (38)	10·1 (14)	18·0 (11)
110-129	5·9 (32)	5·0 (39)	4·5 (54)	5·7 (37)	15·9 (50)
130-149	1·9 (2)	1·8 (4)	5·3 (24)	8·6 (52)	9·1 (420)
≥150	0	4·7 (1)	1·5 (1)	6·5 (19)	12·6 (45)
Test for trend	12·77, p<0·001	5·61, p=0·018	7·46, p=0·006	0, p=0·974	2·99, p=0·084
Total	6·9 (64)	5·0 (72)	5·5 (117)	7·2 (122)	12·3 (147)

Results

Tables I and II give the relation between potential confounders and systolic pressure in the health and lifestyle survey. Thus, although psychological illness, as measured by the general health questionnaire, had a strong association with tiredness, it was not associated with blood pressure and thus was not a confounder. True confounders were sex, age, taking of drugs, physical illness, exercise, and body mass index. All were associated with tiredness, in both previous reports[18] and in this data set,[19] and all were associated with systolic blood pressure. Social class may have a weak association with blood pressure[20] but did not here. Nevertheless, because of social class differentials in response rates systolic blood pressure was also treated as a potential confounder.

After stratifying the data by sex there was a clear relation between systolic blood pressure and tiredness in both men and women (table III). In men the trend was present only for lower systolic blood pressures, but in women it was present throughout the range. Controlling for any of the confounders by restriction (for example, analysing only those subjects not taking any form of medication) gave the same trends (data not shown). The relation persisted after adjustment for sex (table IV) and age (table V) and, finally, after using logistic regression to take into account all the identified confounders (table VI). The association was also not explained by variations in heart rate; in the 18-39 age group there was no effect of pulse rate on the risk of tiredness, stratified by taking drugs and smoking category (data not shown).

A different relation with blood pressure was evident when the other symptoms studied by Pemberton were considered (table IV). As well as tiredness, headache was also negatively related to systolic pressure whereas palpitations showed the reverse association. However, the association between systolic pressure and both headache and palpitation was confounded by age as palpitation was positively associated with age and headaches were negatively associated. Both associations disappeared after appropriate adjustment for age (table V). Fainting and dizziness, which anecdotally might be considered to be linked to either extreme of blood pressure, were not associated with any particular trend in the unadjusted data (table III). However, this is misleading as stratification by age disclosed a complex relation between blood pressure and age and the prevalence of fainting and dizziness (table VII). The relation between fainting and dizziness and age seemed to be U shaped, with the greatest risk in the youngest and the oldest subjects, whereas the relation between low blood pressure and both tiredness and feeling faint was most pronounced in the younger age group (data not shown). The Mantel-Haenszel adjusted odds ratios for the effect of sex and age on the prevalence of fainting and dizziness showed the same association as for feeling tired (table V).

Discussion

Contrary to our expectations, we showed a relation between tiredness and low blood pressure and thus confirmed the findings of Pemberton.[1] The association was also found for feeling faint or for dizziness; the lack of any such relation in Pemberton's crude data was because of the confounding effect of age. On the other hand, the unadjusted relation between systolic blood pressure and both palpitation and headache was

explained by age and did not persist after appropriate adjustment. We conclude that both tiredness and feeling faint are associated with systolic pressures customarily regarded as beneficial in this country.

Might this be explained by limitations in method? To be able to explain the observed findings by non-response non-responders would have to differ from responders in both the exposure (systolic blood pressure) and the outcome (tiredness). No such differences were found whereas other differences, such as social class (data not shown), were controlled for in the subsequent analysis. A differential non-response on an unmeasured variable may never be excluded, but it is difficult to envisage any potential candidate variable that would differentially affect both blood pressure and tiredness. Observer bias is unlikely as the hypothesis under investigation was unknown to both the researchers and the respondents. Systematic bias in measuring blood pressure is also unlikely given the design of the study, and, even if present, it is implausible that it might have influenced the recording of fatigue. The effect was unlikely to be caused by subjects with low blood pressure being aware of the fact and thus developing symptoms ("labelling"). This is the explanation for the relation between hypertension and similar symptoms,[20 21] but there is no tradition in Britain of regarding low blood pressure as pathological, and any such effect would be accompanied by other symptoms of psychological illness. Finally, variables such as social class and treatment cover a hybrid of different factors, and grouping them together may hide important effects. Nevertheless, the strength of the observed association seems too large to be completely attributed to inadequate adjustment for confounders.

Thus we have shown an association between systolic blood pressure and fatigue. This linear trend is present at all pressures, suggesting a continuous distribution of risk without any threshold or cut off. There is no clear shortcoming in method to account for the observation. Nevertheless, there are several reasons for extreme caution before accepting that low blood pressure causes tiredness. Firstly, there is no clear pathophysiological explanation for this result. Most explanations of an alleged relation between symptoms and blood pressure in the population entail some link with autonomic arousal and hence between blood pressure, and psychosocial stress and "tension." Although such models are the basis of many lay explanations of hypertension,[22] there is little empirical evidence for any link between psychological illness and blood pressure,[20 21] which was confirmed by this population study. Furthermore, an association would be in an opposite direction to that found here and might be expected to influence other symptoms, such as headache and anxiety. This was not found. Alternatively, the autoregulatory system, which serves to protect the cerebral circulation from the effects of both low and high blood pressures,[23] may be at fault, but this remains speculative. Secondly, both tiredness and low blood pressure may be related to a third, unidentified common factor. For example, undiagnosed anaemia might still explain the association (adjustment could be made only for subjects who declared anaemia), but this is unlikely to be more than a partial explanation of the strength of the observed association. Although no obvious modern candidates, either inherited or acquired, exist for a common "low vitality" factor, such a concept would have been familiar to a previous generation of doctors.[6] It would therefore be inappropriate to use the current findings to justify treatment of low blood pressure in individual subjects with symptoms. Observations concerning risk in populations cannot be extrapolated to "disease" in individual subjects. The danger of creating spurious illness categories and "non-diseases" is real.[24] Instead, reviewing the evidence for the efficacy of treatment in those countries in which such treatment is already practised may be more worth while.

A more appropriate conclusion is to note the differences in the relation between blood pressure and mortality in contrast to that between blood pressure and morbidity. Epidemiologists and physicians have tended to concentrate on mortality. Perhaps that is why possible associations between fatigue and low blood pressure have been rather neglected.

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