Are spouses of patients with hypertension at increased risk of having hypertension? A population-based case-control study

JULIA HIPPISLEY-COX

MIKE PRINGLE

SUMMARY

Background. *Studies of couples, who tend to share an environment but are genetically dissimilar, can shed light on the contribution of environmental factors to hypertension. There has been renewed interest in these environmental factors following the re-analysis of the INTERSALT study.*

Aim. *To determine whether patients whose spouses have hypertension are at increased risk of hypertension, using a population-based case-control study.*

Method. *The total study population consisted of all 3923 patients over 30 years old registered with one general practice. Male cases with hypertension were matched to male controls without hypertension. Female cases with hypertension were matched to female controls without hypertension. The variables were: diagnosed hypertension; having a spouse with diagnosed hypertension; age; sex; weight; height; body-mass index; couple status; diabetes; and systolic and diastolic blood pressure readings.*

Results. *On multivariate analysis, when age, body-mass index, diabetes, couple status, and having a blood pressure reading were included, men whose spouses had hypertension had a two-fold increased risk of hypertension (adjusted odds ratio (OR) 2.24; 95% CI 1.77–2.72; P = 0.001). Similarly, on multivariate analysis, women whose spouses had hypertension had a two-fold increased risk of hypertension (adjusted OR = 2.23; 95% CI 1.75–2.72; P = 0.001). The risk for both male and female subjects persisted after adjustment for other variables. There was a significant correlation between systolic (r = 0.41; P<0.0001) and diastolic (r = 0.25; P<0.0001) blood pressures between spouse pairs.*

Conclusion. *The independent association between having a spouse with hypertension and increased risk of hypertension supports the view that there are significant environmental factors in the aetiology of hypertension. The finding has implications for the screening and treatment of hypertension in primary care.*

Keywords: case-controlled studies; hypertension; spouse.

Introduction

THERE has been renewed interest in the role of environmental factors in the aetiology of hypertension, following the re-analysis of the INTERSALT study.[1] Traditionally, twin studies have been used to determine the relative contributions of genetic and environmental factors to the aetiology of hypertension.[2,3] Studies of couples, who tend to share environments but are genetically dissimilar, can also throw light on the contribution of environmental factors to hypertension. Some,[4-8] but not all, studies[9-13] have shown spouse concordance for blood pressure readings; this has largely been attributed to assortative mating for height or body-mass index,[2,8,14] rather than shared environmental aetiological factors. Previous studies have been limited by sample size,[2,4] selection of hospital cases and controls,[4] failure to include potentially confounding variables,[5-8] and the use of unsophisticated statistical analysis.[4,10,11] Furthermore, isolated blood pressure values have been studied rather than a diagnosis of hypertension. It is still unclear whether there is an epidemiological association between having a spouse with hypertension and risk of hypertension. If there were such an association, then there is a case for determining the costs and benefits of targeted screening and intervention for spouses of hypertensive patients. Therefore we set out to determine whether patients whose spouses have hypertension are themselves at increased risk of hypertension.

Method

All registered patients over the age of 30 years from one rural general practice were identified from the computerized age–sex register. The practice population consists of over 95% of all the residents in the practice area. The computer database has been previously validated and found to have a high standard for data completeness and accuracy.[15] Both the practice nurses and general practitioners are able to enter the actual blood pressure values taken during a consultation. However, only the general practitioners make the diagnosis of hypertension and enter the diagnosis onto the computer. Male cases with diagnosis of hypertension and male controls without a diagnosis of hypertension were identified from the computer database. Similarly, female cases with hypertension and female controls without hypertension were identified. All diagnoses of hypertension were made according to the British Hypertension Society guidelines. The age–sex register was used to identify couples, defined as two patients of similar age, of opposite sex, at the same address, who are not siblings. Data for age, sex, height and most recent weight from the previous 24 months were used. The presence or absence of diabetes was recorded. The most recent systolic and diastolic blood pressure readings from the preceding 24 months were recorded as well as the date of first diagnosis of hypertension, if present. The univariate and multivariate associations were determined by unconditional logistic regression using SPSS for Windows (6.0). The main outcome variable was a diagnosis of hypertension. Pearson's correlation coefficient was determined for spouse–spouse systolic and diastolic blood pressure readings. A two-tailed significance level of 0.05 was used for the main variable of interest, which was having a spouse with hypertension.

Results

Of the 5632 registered patients, 3923 (70%) were aged over 30. There were 1393 couples and 1137 individuals identified. Of the 446 subjects (11% of 3923) with a diagnosis of hypertension, 382 patients were on antihypertensive medication. Table 1 shows

J Hippisley-Cox, MRCP, lecturer in general practice; and M Pringle, MD, professor of general practice, Department of General Practice, The Medical School, Queen's Medical Centre, Nottingham.
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the baseline characteristics for the 264 female cases and 1816 female controls, as well as the 182 male cases and 1661 male controls. Of the 2786 subjects who were part of a couple, blood pressure readings were unavailable in 216 (7.8%). Of the 1137 subjects who were single, blood pressure readings were unavailable in 135 (11.9%).

Univariate associations for hypertension

Univariate analysis showed that the following were risk factors for hypertension in women: increased age; increased weight; decreased height; and increased body-mass index (Table 2). Females with a spouse had a significantly lower chance (OR 0.62, 95% CI 0.35–0.88) of having hypertension compared with single females. Females whose spouses had hypertension had a two-fold increased risk of hypertension (OR 2.50, 95% CI 2.10–2.90).

When men were studied, the following factors were risk factors for hypertension on univariate analysis: diabetes; increased age; increased weight; and increased body-mass index (Table 2). Men whose spouses had hypertension had a three-fold increased risk of hypertension (OR 3.31, 95% CI 2.90–3.73).

Multivariate associations for hypertension

When women were studied, the strongest predictor for hypertension was having a spouse with hypertension (adjusted OR = 2.23, 95% CI 1.75–2.72). The following factors were also significant on multivariate analysis: increased age; increased body-mass index; and diabetes (Table 2). When the analysis was restricted

Table 1a. Baseline characteristics for female cases (n =264) with hypertension compared to female controls (n =1816) without hypertension.

	Number of female cases with data (percentage of 264)	Female cases mean (SD)	Number of female controls with data (percentage of 1816)	Female controls mean (SD)
Age (years)	264 (100)	68 (12.0)	1816 (100)	55.0 (16.0)
Weight (kg)	250 (95)	71.8 (16.4)	1653 (91)	66.7 (12.2)
Height (cm)	253 (96)	160.7 (6.7)	1661 (91)	162.0 (6.8)
Body-mass index (kg/m^2)	245 (93)	27.7 (6.0)	1592 (88)	25.4 (4.5)
Systolic blood pressure (mmHg)	260 (98)	162.3 (22.5)	1703 (94)	133.8 (21.6)
Diastolic blood pressure (mmHg)	260 (98)	87.0 (10.0)	1703 (94)	133.8 (21.6)
		Number (percentage of 264)		Number (percentage of 1816)
Having a partner with hypertension	264 (100)		1816 (100)	
No		228 (86)		1708 (94)
Yes		36 (14)		108 (6)
Part of a couple	264 (100)		1816 (100)	
No		113 (43)		574 (32)
Yes		151 (57)		1242 (68)
Diabetes	264 (100)		1816 (100)	
No		240 (91)		1779 (98)
Yes		24 (9)		37 (2)
Blood pressure reading taken	264 (100)		1816 (100)	
No		0 (0)		101 (6)
Yes		264 (100)		1715 (94)

Table 1b. Baseline characteristics for male cases (n =182) with hypertension compared to male controls (n =1661) without hypertension.

	Number of male cases with data (percentage of 182)	Male cases mean (SD)	Number of male controls with data (percentage of 1661)	Male controls mean (SD)
Age (years)	182 (100)	64.0 (12.0)	1661 (100)	54.0 (15.0)
Weight (kg)	175 (96)	86.4 (14.0)	1330 (80)	81.5 (12.9)
Height (cm)	171 (94)	175.8 (6.5)	1290 (78)	175.9 (7.2)
Body-mass index (kg/m^2)	168 (92)	27.9 (4.0)	1280 (77)	26.3 (3.5)
Systolic blood pressure (mmHg)	182 (100)	157.7 (22.0)	1408 (85)	136.3 (19.2)
Diastolic blood pressure (mmHg)	182 (100)	89.4 (10.5)	1406 (85)	81.1 (10.3)
		Number (percentage of 182)		Number (percentage of 1661)
Having a partner with hypertension	182 (100)		1661 (100)	
No		146 (80)		1546 (93)
Yes		36 (20)		115 (7)
Part of a couple	182 (100)		1661 (100)	
No		38 (21)		412 (25)
Yes		144 (79)		1249 (75)
Diabetes	182 (100)		1661 (100)	
No		165 (91)		1602 (96)
Yes		17 (9)		59 (4)
Blood pressure reading taken	182 (100)		1661 (100)	
No		0 (0)		250 (15)
Yes		182 (100)		1411 (85)

Table 2. Univariate and multivariate associations for cases with hypertension compared to controls without hypertension. (Only couples have been included in the multivariate analysis.)

	Unadjusted odds ratios	95% CI	P value	Adjusted odds ratios[a]	95% CI	P value
Males						
Age (years)	1.04	1.03 to 1.06	<0.0001	1.04	1.03 to 1.06	<0.0001
Weight (kg)	1.03	1.02 to 1.04	<0.0001	–	–	–
Height (cm)	1.00	0.97 to 1.02	0.81	–	–	–
Body-mass index (kg/m^2)	1.12	1.08 to 1.16	<0.0001	1.13	1.08 to 1.18	<0.0001
Diabetes[b]	2.80	2.23 to 3.36	0.0003	1.27	0.56 to 1.97	0.51
Having a partner with hypertension[c]	3.31	2.90 to 3.73	<0.0001	2.24	1.77 to 2.72	0.001
Couple status[d]	1.25	0.89 to 1.64	0.24	–	–	–
Females						
Age (years)	1.05	1.04 to 1.06	<0.0001	1.07	1.05 to 1.09	<0.0001
Weight (kg)	1.03	1.02 to 1.04	<0.0001	–	–	–
Height (cm)	0.97	0.95 to 0.99	0.005	–	–	–
Body-mass index (kg/m^2)	1.09	1.07 to 1.12	<0.0001	1.10	1.07 to 1.13	<0.0001
Diabetes[b]	4.81	4.28 to 5.34	<0.0001	2.89	2.07 to 3.72	0.01
Having a partner with hypertension[c]	2.50	2.10 to 2.90	<0.0001	2.23	1.75 to 2.72	0.001
Couple status[d]	0.62	0.35 to 0.88	0.0003	–	–	–

[a]Odds ratio adjusted for age, BMI, diabetes, having a partner with hypertension, BP reading taken. [b]Subjects with diabetes compared to subjects without diabetes. [c]Subjects with a partner with hypertension compared with subjects without a partner with hypertension. [d]Subjects with a spouse compared with baseline of subjects without a spouse.

to subjects under 75 years, women with a spouse with hypertension still had an increased risk of hypertension (adjusted OR 2.38; 95% CI 1.87–2.89). A second multivariate model was fitted to the data, including height and weight as separate variables instead of body-mass index. This model did not substantially change the odds ratios or significance levels of the other variables.

On the multivariate analysis for men, the strongest predictor of hypertension was having a spouse with hypertension (adjusted OR 2.24; 95% CI 1.77–2.72). The following factors also remained significant on multivariate analysis: increased age; and increased body-mass index (Table 2). However, the association between diabetes and hypertension found on univariate analysis was no longer significant. When the analysis was restricted to subjects who were under 75 years, men with a spouse with hypertension still had an increased risk of hypertension (adjusted OR 1.96; 95% CI 1.44–2.49). A second multivariate model, which included height and weight as separate variables, gave similar odds ratios or significance levels to those derived from the first model shown in Table 2.

Although subjects who are part of a couple have an increased chance of having a recorded blood pressure reading (OR 1.60; 95% CI 1.28–2.01; $P<0.0001$), this does not explain our findings. We adjusted for the presence or absence of a blood pressure reading in our multivariate analysis both for men and for women (Table 2).

Correlation for blood pressure values between spouse pairs

There was a significant correlation between systolic ($r = 0.41$; $P<0.0001$) and diastolic ($r = 0.25$; $P<0.0001$) blood pressures between spouses. This was despite the use of antihypertensive drugs in 382 patients with hypertension.

Discussion

This study has shown that patients whose spouses have hypertension have twice the risk of hypertension compared with patients whose spouses did not have hypertension. This association is independent of age, diabetes or body-mass index, and applies to both men and women. Having a spouse with hypertension was the strongest risk factor for men and the second strongest risk factor for women. The results suggest that shared environmental factors are important in the aetiology of hypertension.

The effect of spouses on risk of hypertension

On univariate analysis of women, being a member of a couple was associated with a reduced risk of having hypertension. This could suggest that having a spouse protects against hypertension, which would be consistent with other studies that have demonstrated a protective effect of marriage on risk of hypertension[16] and cardiovascular disease mortality.[17] Male and female patients whose spouses had hypertension were at increased risk of hypertension both on univariate and multivariate analysis. This is consistent with shared environmental factors. Spouse concordance for other factors associated with cardiovascular disease has been demonstrated. For example, in one study, concordance was found between fasting plasma glucose measurements in spouses,[18] a finding not explained by other factors including obesity, smoking, antihypertensive medication, or family history of ischaemic heart disease.

Is the increased risk due to assortative mating?

Previous studies have suggested that concordance for blood pressure readings between spouses is likely to be due to assortative mating.[2,8,14] For example, if obese patients are more likely to have obese spouses, then they could share an increased risk of hypertension due to their obesity. If this were the case, then the association between exposure to a spouse with hypertension and risk of hypertension would have been much reduced by the inclusion of body-mass index in the multivariate analysis. This is not, however, the case. These data do not allow us to comment on the possibility of assortative mating for psychological factors,[19] which deserves further study. There is some evidence that spouses of hypertensive patients are more likely to have a recorded blood pressure reading, perhaps due to an increased awareness of hypertension. We do not think that this explains our results, as we adjusted for the presence or absence of a blood pressure reading in our multivariate analysis.

Strengths and weakness of the study

This study has used routinely collected data from a general practice database which has been validated and found to have a high standard of data completeness and accuracy.[15] Similar general practice databases have been used for research[20] and found not to have undue bias, particularly for epidemiological studies of patient morbidity. [21] Although such databases contain routinely collected data, the values (e.g. for blood pressure values, weight, and height) are entered during the consultation and are likely to be as accurate as any other data entry process. Another weakness of the study is our definition of couples ('two patients of similar age, of opposite sex at the same address who are not siblings'). This definition has three limitations that need to be mentioned. First, we will have classified some subjects who were widowed as single. Such subjects may have had a partner with hypertension who had died, thus biasing our results. However, as only couples were included in the multivariate analysis, we think that our results still stand. Secondly, we may have included some pairs of subjects as 'couples' who do not see themselves as such. However, we would still expect such 'couples' to have some shared environment factors as a result of having the same address. Thirdly, we have no information on the length of time that subjects had been couples or the time sequence of events. This would only have been possible to determine by patient questionnaire, which was not part of our methodology on this occasion. As this is a case-control study, we would expect similar limitations to apply both to cases and controls and are therefore not to have caused significant bias. Although this study has been conducted on a single practice population, we have no reason to believe that the patients studied are different from any other practice population.[15]

The strengths of this study lie in its large sample size, selection of community cases and controls, inclusion of single subjects (rather than couples alone), and use of multivariate analysis to adjust for potential confounders. Furthermore, we have used an established diagnosis of hypertension, which arguably has a greater validity compared with the use of isolated blood pressure measurements.

What are the implications for screening and treatment?

Currently, patients are mainly screened for hypertension opportunistically. Given the magnitude of the increased risk of hypertension among spouses of hypertensive patients, such subjects may require more intense surveillance. The costs and benefits would need to be determined. The main implication for treatment, however, relates to the possibility of dietary interventions aimed at couples. There is recent evidence for the efficacy of dietary modifications in the treatment of hypertension.[22] In addition, there is evidence from the MRFIT study and the British Family Heart Study, for the effectiveness of interventions aimed at reducing cardiovascular risk on the wives of men in the study.[23, 24] The effect was particularly marked for subjects whose wives had hypertension. This was thought to reflect changes in dietary behaviour and is consistent with other evidence for the effectiveness of family intervention on dietary change.[25]

Conclusion

In this study, having a spouse with hypertension was a strong risk factor for hypertension and this is not explained by assortative mating for body size. As couples tend not to share genes, this result suggests that there are important environmental aetiological factors for hypertension. This has implications both for screening and environmental modification for hypertensive patients in primary care.

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Address for correspondence

Julia Hippisley-Cox, Department of General Practice, The Medical School, Queen's Medical Centre, Nottingham NG7 2UH.