RESEARCH REPORT

Association of adult socioeconomic position with hypertension in older people

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Objective: To determine the role of obesity, adult behavioural risk factors, and markers of specific childhood exposures in the association between adult socioeconomic position and hypertension in a cohort of people aged 60 years and older.
Design: Cross sectional study.
Setting: Spain.
Participants: 4009 subjects representative of the Spanish non-institutionalised population aged 60 years and older.
Main outcome measure: Prevalence of hypertension according to education and social class, and proportion of excess difference in hypertension prevalence in lower socioeconomic groups explained by different risk factors for hypertension.
Results: The highest prevalence of hypertension was seen in subjects with less education and in those belonging to a low social class. In men, the hypertension risk factors analysed did not explain the difference in prevalence by education, but they explained almost half of the difference by social class. In women, these risk factors explained the differences in hypertension prevalence by education and a substantial part of the differences by social class. Central and general obesity, and physical inactivity were the risk factors that were the most important in this association in women.
Conclusions: In women, socioeconomic position has no direct effect on hypertension in the case of education and only a small effect in the case of social class. In contrast, most of the effect of education and half of the effect of social class on hypertension in men is direct or, at least, is not explained by the risk factors analysed. The mechanisms that can explain the association between socioeconomic position and hypertension in older men remain to be established.

Hypertension is an important risk factor for cardiovascular diseases, especially stroke. Most studies carried out in the developed countries have found a higher mean blood pressure and greater frequency of hypertension among people of lower socioeconomic status.[1 2] This socioeconomic difference in hypertension is one of the reasons that has been mentioned to explain the association between educational level and stroke mortality in the developed countries.[3] These studies have been carried out in young and/or middle aged subjects, however few investigations have evaluated the association between adult socioeconomic position and hypertension in older people. Furthermore, the few investigations made in older people have yielded inconsistent results.[4–6]

The development of effective policy interventions to break the link between adverse adult socioeconomic position and stroke in older people requires evaluation of the possible existence of a relation between adult socioeconomic position and hypertension in this population group. The relation between adult socioeconomic position and arterial hypertension is complex. Hypertension depends on other factors such as obesity, physical inactivity, excessive alcohol consumption, sodium and potassium intake, and psychological stress. These factors show a relation with socioeconomic position in middle age, but in the elderly population this relation is less well known and, in some cases, there is evidence that its magnitude is smaller.[7 8] In addition, some factors operating during childhood, such as socioeconomic circumstances or growth rate, are associated both with blood pressure and with socioeconomic position in adulthood.[9–11]

The objective of this study is to evaluate the association between adult socioeconomic position and hypertension in a cohort of people aged 60 years and older, and to determine the role that obesity, adult behavioural risk factors, and markers of specific childhood exposures have in this association.

METHODS

Sample

We selected a sample of men and women representative of the Spanish non-institutionalised population aged 60 years or older. Study subjects were selected through probabilistic multistage cluster sampling. Census sections were selected at random, followed by individual households where information was then obtained from residents. A total of 4009 subjects (71% of those invited) participated, and baseline data were collected between October 2000 and February 2001. There were no important differences between responders and a random sample of non-responders in age (mean age 71.9 and 72.5, respectively), sex (56.6% and 59% women, respectively), and educational level (percentage with primary studies or less 92% and 93%, respectively). The information was collected by personal interview using a structured questionnaire, followed by a physical examination to measure blood pressure and anthropometric characteristics. Ethical committee approval for this study was obtained and all subjects gave informed consent.

Classification of hypertensive subjects

Blood pressure was measured in the right arm of seated participants after a minimum five minute rest. Full details of the measurements of blood pressure have been previously reported.[12] Basically, the study design called for two sets of six blood pressure measurements to be obtained from each subject. The first and second set were separated by a time interval (several hours, within the space of a single day), so that the average of both sets reflects more closely the usual blood pressure in each subject. In each set, three mercury based measurements were alternated with three automated based measurements (each mercury reading preceding each automated reading) with a two minute interval between each cuff inflation. The mean of all the blood pressure measurements was used for the analysis. Subjects were deemed to be hypertensive when their systolic blood pressure was $\geqslant$ 140 mm Hg or their diastolic blood pressure was $\geqslant$ 90 mm Hg or they were on current antihypertensive drug treatment.

Measurement of socioeconomic position

The three measures of socioeconomic position most frequently used are education, social class based on occupation, and income. We analysed only the first two because no information on income was collected in this study. Education is an indicator that reflects material and psychosocial conditions during adulthood.[13] Educational qualifications are strong predictors of occupation and, consequently, of income. In addition to economic resources, persons with higher educational level have a series of psychosocial resources such as a high sense of personal control over problematic events of daily life and a better knowledge and understanding of the lifestyles that constitute a risk for health. Educational level was grouped into three categories based on the highest educational level attained by the subject: low—illiterate persons and those who did not complete primary education; medium—subjects who completed primary education; and high—subjects who completed secondary or higher level education.

Social class reflects a series of economic and social resources and refers to the location of subjects within the economy—as employers, employees, or self employed. The possession of educational credentials and skill assets also contributes to social class position.[14] To assign social class to subjects we used an occupational classification made up of 16 categories based on two criteria: capital assets with reference to employment status—employer, self employed, or employed—and skill and credential assets. For women who had never worked, this was measured by their husband's occupation. Occupational social class was grouped into four categories: non-manual workers (professionals, managers, proprietors, and clerical workers), self employed farm workers, skilled manual workers, and unskilled manual workers.

Measurement of hypertension risk factors

Studies have been made of a number of lifestyle related exposures and early life experiences that play an important part in the origins of hypertension.[9 15] Among the former factors are high body weight and central obesity, excessive consumption of alcohol, physical inactivity, and excessive consumption of cured meat products—as an indicator of high sodium intake. The latter factors have included height as an indicator of growth rate in childhood and father's occupation as an indicator of childhood socioeconomic circumstances.

Body mass index (BMI) was calculated as weight (in kg) divided by height (in metres) squared. A study participant was considered to be obese if they had a BMI $\geqslant$ 30 kg/m^2 and to have central obesity when waist circumference was greater than 102 cm in men and 88 cm in women.[16] Subjects were asked about the type of physical exercise done in their free time; in the case of unemployed or retired persons, exercise at any time was considered. A person whose only reported leisure time activity was completely sedentary—reading, watching television, etc—was considered to be physically

Table 1 Age adjusted prevalence (95% confidence interval)—in percentage—of risk factors for hypertension in Spanish people aged 60 years and older according to educational level

Risk factors for hypertension	Number of people	Educational level: High	Middle	Low	p Value for trend
Men					
General obesity	1503	31.0 (26.0,36.9)	25.6 (20.4,32,0)	38.0 (31.1,46.4)	0.002*
Central obesity	1616	46.1 (40.0,52.1)	42.7 (36.6,49.7)	49.3 (31.1,46.4)	0.137
Physical inactivity	1611	24.4 (20.0,29.8)	30.2 (23.9,38.1)	46.2 (37.4,57.1)	<0.001
Heavy alcohol intake	1616	11.0 (8.0,15.2)	11.6 (11.2,12.1)	17.6 (12.3,25.2)	<0.001
Heavy intake of cured meats	1616	19.0 (15.1, 24.0)	17.7 (13.2, 23.7)	18.9 (14.3, 24.9)	0.213
Short stature	1616	21.4 (17.2,26.7)	29.6 (32.1,37.9)	35.7 (28.2,45.2)	<0.001
Low childhood social class	1588	31.9 (27.0,27.7)	43.8 (36.2,52.9)	49.1 (40.9,58.9)	<0.001
Women					
General obesity	1926	30.2 (24.0,38.0)	41.9 (32.8,53.5)	42.5 (33.5,54.0)	0.023
Central obesity	2118	62.9 (56.2,70.4)	72.7 (64.5,82.0)	76.1 (67.8,85.4)	0.007
Physical inactivity	2106	41.5 (34.8,49.5)	42.1 (34.7,51.0)	56.4 (47.1,67.6)	<0.001*
Heavy alcohol intake	2118	2.1 (0.8,5.7)	1.7 (0.5,5.3)	2.3 (0.8,6.8)	0.507
Heavy intake of cured meats	2118	15.5 (11.0,21.8)	10.0 (6.6, 14.9)	10.7 (7.3, 15.7)	0.265
Short stature	2117	22.6 (17.2,29.7)	30.1 (22.5,40.1)	32.5 (24.7,42.9)	0.010
Low childhood social class	2061	21.5 (16.2,28.5)	43.3 (32.2,58.1)	47.5 (35.5,63.4)	<0.001

*p Value for departure from a linear trend <0.05.

Table 2 Age adjusted prevalence (95% confidence interval)—in percentage—of risk factors for hypertension in Spanish people aged 60 years and older according to social class

Risk factors for hypertension	Number of people	Social class: Non-manual workers	Skilled manual workers	Unskilled manual workers	Land owners and self employed farm workers	p Value for trend*
Men						
General obesity	1541	32.8 (26.0,36.9)	30.3 (29.1, 37.0)	32.8 (25.6, 35.9)	26.4 (19.9, 34.7)	0.507
Central obesity	1654	45.7 (42.0,49.9)	48.3 (41,4, 56,3)	49.3 (42.3, 57.4)	48.0 (40.2, 57.4)	0.365
Physical inactivity	1650	31.8 (28.2,35.8)	35.0 (29.9, 40.9)	41.0 (34.2, 49.2)	43.1 (35.5, 52.2)	0.008
Heavy alcohol intake	1654	11.4 (9.1,14.3)	15.1 (11.2, 20.2)	18.1 (12.1, 24.5)	23.7 (16.0, 35.2)	0.013
Heavy intake of cured meats	1654	16.2 (13.5, 19.5)	19.7 (15.5, 25.2)	14.0 (9.8, 20.0)	24.9 (18.3, 34.0)	0.875
Short stature	1654	25.5 (22.2,29.3)	28.5 (23.9, 33.8)	42.6 (35.6, 51.0)	30.8 (24.4,38.9)	<0.001*
Low childhood social class	1620	32.0 (28.4,36.1)	55.7 (48.4, 64.0)	66.6 (57.3, 77.3)	16.1 (11.3, 22.8)	<0.001
Women						
General obesity	1811	36.6 (33.1,40.5)	40.3 (35.2, 46.3)	51.3 (44.3, 59.5)	43.1 (36.1, 51.5)	<0.001
Central obesity	2004	69.3 (65.9,72.8)	68.8 (64.3, 73.6)	78.9 (73.6, 84.6)	72.9 (66.8, 79.6)	<0.001*
Physical inactivity	1992	48.3 (44.8,52.2)	50.1 (45.2, 55.5)	55.2 (49.2, 62.1)	49.1 (42.9, 56.2)	0.036
Heavy alcohol intake	2004	2.2 (1.3,3.6)	2.5 (2.1, 2.9)	2.7 (1.2, 6.2)	0.9 (0.2, 3.6)	0.586
Heavy intake of cured meats	2004	11.9 (10.7, 14.5)	9.9 (7.3, 13.3)	11.3 (7.8, 16.2)	7.8 (4.9, 12.4)	0.568
Short stature	2003	30.3 (27.1,33.9)	33.1 (30.1, 40.0)	34.2 (29.0, 40.8)	29.8 (24.6, 36.2)	0.061
Low childhood social class	1952	35.1 (31.7,38.9)	48.7 (43.0, 55.1)	58.8 (51.7, 67.0)	16.9 (12.7, 22.5)	<0.001

*p Value for departure from a linear trend <0.05.

inactive. Alcohol intake was measured using a quantity-frequency index. Heavy drinkers were considered to be those with a daily consumption of more than 50 ml (men) or 30 ml (women) of absolute alcohol. Participants were asked about their weekly intake of different types of food. Consumption of cured meats at least four days per week was considered to be excessive. Participants were also divided into four categories based on quartiles of the height distribution. Cut off points for height quartiles were estimated for men and women separately. Father's occupation was measured in the same way as the subject's occupation, and was grouped into two categories: non-manual workers and self employed farm workers, and manual workers.

Statistical analysis

The age adjusted prevalence of hypertension risk factors by the variables characterising adult socioeconomic position was estimated using binomial regression analysis. These estimates included subjects with complete information on all socioeconomic variables and for each of the risk factors. Self employed farm workers were excluded from the evaluation of the trend in the prevalence of hypertension risk factors by social class, because it is difficult to assign a rank to this category in a classification of social class.[17] Multiple binomial regression analysis was also used to assess the association between adult socioeconomic position and hypertension prevalence and the effect on this of adjustment for potential explanatory factors on the causal pathways—general obesity, central obesity, behavioural risk factors, and markers of childhood exposures. All subjects with information on blood pressure and the socioeconomic variables were included in the analysis. Subjects with non-responses regarding the potential explanatory factors were also included in the analysis by creating a new category in each variable that measured those factors. Self employed farm workers were also excluded in the evaluation of the association between social class and hypertension.

We used binomial regression instead of logistic regression because the prevalence of hypertension is high, and estimates based on logistic regression (odds ratios) overestimate the magnitude of the association.[18] After estimating the regression coefficients, we calculated the prevalence in each exposure category; the associations are presented as prevalence differences. As these are absolute and not relative differences, the value of the null hypothesis is 0, therefore the lower limit of non-significant confidence intervals is negative. The proportion of excess difference in hypertension prevalence in the low socioeconomic group explained by different factors was calculated as [(age adjusted prevalence difference)−(risk factor and age adjusted prevalence difference)/(age adjusted prevalence difference)]. In the results tables this estimate is shown as the percentage of reduction of the prevalence difference. For example, if the difference in the age adjusted prevalence in the low socioeconomic group with respect to the high socioeconomic group is 6%, and after adjusting for age and one additional risk factor this difference is 4%, the percentage of reduction attributable to these factors is 33% ($4-6/6=0.33$). The calculations were made with SAS statistical package version 8.2.

RESULTS

Table 1 shows that men and women with low educational level had the highest prevalence of general obesity, central obesity, physical inactivity, short stature, and manual social class in childhood. Men with low educational level also presented a higher prevalence of excessive alcohol consumption. These hypertension risk factors do not show such a clear relation with social class in men, except for excessive alcohol

Table 3 Age adjusted prevalence (in percentage) of hypertension and prevalence difference adjusted for hypertension risk factors according to educational level

	Men				Women			
	High	Middle	Low	% Reduction*	High	Middle	Low	% Reduction*
Number of participants	301	580	735		178	721	1219	
Age adjusted prevalence	59.8	64.1	66.4		64.8	65.9	69.8	
Prevalence difference (95% confidence interval) adjusted for:								
Age	0.0	4.3 (−2.4, 11.8)	6.6 (0.0, 14.0)	–	0.0	1.1 (−6.4, 9.6)	5.0 (−2.6, 13.5)	–
Age and general obesity	0.0	5.1 (−1.5, 12.4)	5.9 (−0.5, 13.0)	10.6	0.0	0.8 (−6.6, 9.0)	4.0 (−3.3, 12.2)	20.0
Age and central obesity	0.0	4.7 (−1.9, 12.0)	6.8 (0.4, 14.0)	−3.0	0.0	−0.7 (−7.7, 7.3)	2.1 (−4.9, 10.0)	58.0
Age and physical activity	0.0	4.1 (−2.5, 11.6)	6.1 (−0.5, 13.6)	7.6	0.0	1.5 (−4.9, 8.5)	3.7 (−2.6, 10.7)	26.0
Age and heavy alcohol intake	0.0	4.4 (−2.3, 11.8)	6.9 (0.3, 14.4)	−4.5	0.0	1.1 (−6.4, 9.6)	5.0 (−2.6, 13.5)	–
Age and heavy intake of cured meats	0.0	4.1 (−2.6, 13.8)	6.5 (−0.1, 13.8)	1.5	0.0	1.1 (−6.5, 9.6)	4.8 (−2.8, 13.3)	4.0
Age and height	0.0	4.2 (−2.6, 11.7)	6.5 (−0.3, 14.1)	1.5	0.0	1.4 (−6.8, 9.3)	5.3 (−3.6, 12.9)	−6.0
Age and father's social class	0.0	5.6 (−1.4, 13.5)	7.7 (0.7, 15.5)	−16.6	0.0	0.7 (−6.8, 9.3)	4.2 (−3.6, 12.9)	16.0
Age and all factors	0.0	4.5 (−1.9, 11.7)	5.4 (−1.2, 12.9)	18.2	0.0	0.1 (−4.4, 5.0)	0.7 (−3.8, 5.5)	86.0

* Percentage of the age adjusted prevalence difference in low educational level explained by the adjustment factors.

consumption, height, and social class in childhood (table 2). Table 2 also shows that, in women, the results by social class were similar to the results by education: in general, the risk factors of those in the low adult social class tended to be adverse, except for alcohol intake and consumption of cured meats.

Tables 3 and 4 show the number of subjects included in each category of the measures of socioeconomic position, as well as the prevalence of hypertension by educational level and social class. Persons with low educational level had a higher prevalence of hypertension (66.4% in men and 69.8% in women) than those with high educational level (59.8% in men and 64.8% in women) (table 3), although in women the difference was not statistically significant. In men, the prevalence difference between subjects with high and low educational level changed 18% after adjusting for all the potential explanatory factors. In women, the gradient in the prevalence of hypertension almost disappeared after adjusting for the potential explanatory factors. The factors that explained the largest percentage of the prevalence difference between women with high and low educational level were central obesity (58%) and physical inactivity (26%) (table 3).

Table 4 Age adjusted prevalence (in percentage) of hypertension and prevalence difference adjusted for hypertension risk factors according to social class

	Men				Women			
	Non-manual workers	Skilled manual workers	Unskilled manual workers	% Reduction*	Non-manual workers	Skilled manual workers	Unskilled manual workers	% Reduction*
Number of participants	588	620	255		705	678	346	
Age adjusted prevalence	63.3	65.6	67.9		63.9	69.9	70.0	
Prevalence difference (95% confidence interval) adjusted for:								
Age	0.0	2.3 (−2.9, 8.0)	4.6 (−2.0, 11.8)	–	0.0	5.7 (0.8, 11.0)	5.5 (0.0, 11.5)	–
Age and general obesity	0.0	3.7 (−1.6, 9.5)	4.4 (−1.9, 11.3)	4.3	0.0	5.3 (−0.6, 10.3)	4.4 (−1.1, 10.4)	20.0
Age and central obesity	0.0	2.7 (−2.5, 7.5)	4.3 (−2.1, 11.3)	6.5	0.0	4.2 (0.1, −1.5, 8.6	3.4 (0.8, 9.8)	38.2
Age and physical activity	0.0	2.4 (−2.8, 8.1)	4.2 (−2.4, 11.5)	8.7	0.0	5.2 (0.6, 10.3)	4.7 (−0.7, 10.6)	14.5
Age and heavy alcohol intake	0.0	2.3 (−2.9, 8.0)	4.6 (−1.9, 11.9)	0.0	0.0	5.6 (0.8, 10.7)	5.3 (−0.4, 11.6)	3.6
Age and heavy intake of cured meats	0.0	2.2 (−3.0, 7.9)	4.4 (−2.1, 11.6)	4.3	0.0	5.4 (0.7, 10.7)	4.5 (−1.1, 10.4)	18.2
Age and height	0.0	1.9 (−3.3, 7.6)	4.6 (−2.0, 11.9)	0.0	0.0	4.9 (0.6, 9.5)	4.7 (−0.4, 10.3)	14.5
Age and father's social class	0.0	1.8 (−3.5, 7.6)	3.1 (−3.6, 10.7)	32.6	0.0	5.1 (0.3, 10.4)	4.6 (−1.2, 11.0)	16.4
Age and all factors	0.0	2.2 (−3.5, 7.9)	2.5 (−4.1, 9.8)	45.6	0.0	2.4 (−0.5, 5.5)	1.8 (−1.7, 5.6)	67.3

* Percentage of the age adjusted prevalence difference in unskilled manual workers explained by the adjustment factors.

Key points

- Little evidence is available about the role of hypertension risk factors in the association between socioeconomic position during adulthood and the prevalence of hypertension in the elderly population.
- Our study found small socioeconomic differences in the prevalence of hypertension.
- In men, the hypertension risk factors analysed in this study did not explain the difference in prevalence by education, but they explained almost half of the difference in prevalence by social class.
- In women, these risk factors explained most of the differences in hypertension prevalence by education and a substantial part of the differences by social class. Central obesity, general obesity, and physical inactivity were the risk factors that played the most important part in this association.

Subjects in the low social class had a higher prevalence of hypertension (67.9% in men and 70.0% in women) than those in the high social class (63.3% in men 63.9% in women) (table 4), although in men the difference was not statistically significant. Social class in childhood was the factor that explained the largest percentage of the difference in the prevalence of hypertension in men. In women, the difference in the prevalence of hypertension between high and low social class was reduced by two thirds after adjusting for all the potential explanatory factors. The factors that explained the largest part of the difference in the prevalence of hypertension between women of high and low social class were central obesity (38%) and general obesity (20%).

DISCUSSION

Principal findings

The men and women in our study with low educational level and belonging to the low social class had a higher prevalence of hypertension than those with a high level of education and belonging to the high social class. The magnitude of the socioeconomic differences in the age adjusted prevalence of hypertension is small, and in some cases the differences were not significant. However, the consistency of the results in men, on the one hand, and in women, on the other, suggests that the risk factors that explain the small socioeconomic variation in the prevalence of hypertension differ by sex. In men, the hypertension risk factors analysed did not explain the difference in prevalence by education, but they explained almost half of the difference in prevalence by social class. Social class in childhood was the risk factor that explained most of the excess prevalence of hypertension in those with low social class. In contrast, in women, these risk factors explained most of the differences in hypertension prevalence by education and a substantial part of the differences by social class. Central obesity, general obesity, and physical inactivity were the risk factors that played the most important part in this association.

Study limitations

This study is cross sectional, thus it is necessary to consider the possibility of reverse causality or survival bias. Reverse causality as an explanation for the association between education and hypertension is implausible because education remains essentially stable after age 20–25 years. Likewise, it is unlikely that the association between social class and hypertension is attributable to social mobility, as hypertension is usually an asymptomatic disease. Furthermore, in women the hypothesis of reverse causality can be ruled out in the results by social class, because most women were assigned to the husband's social class.

The association may have been underestimated because of survival bias. Hypertension is associated with the occurrence of cardiovascular diseases; because mortality from these diseases affects men in middle age, the probability of finding socioeconomic differences in hypertension in men who live past 60 is small. Mortality from cardiovascular diseases before age 60 is less frequent in women, therefore the effect of survival bias on the results in women was probably smaller. This underestimate may explain the lack of statistical significance in some results.

On the other hand, some 29% of those selected did not participate in the study. It is possible that persons with a low socioeconomic position could have had a lower response rate because more of them were sick or had hypertensive associated conditions. If this was the case, the associations would have been underestimated. However, there were no important differences between responders and a random sample of non-responders with respect to educational level.

Strengths of the study

The results are derived from a representative sample of the population with a participation rate similar to or higher than that of other large epidemiological studies.[6 19] The distribution of our population by age, sex, and educational level was similar to that of the sampling framework. The possibility that those who participated are healthier than persons in the general population would not affect our results, as it is highly unlikely that the association between socioeconomic position and hypertension is weaker or operates in the opposite direction among non-participants.

To our knowledge, this is the first study that has evaluated the part played by hypertension risk factors in the association between socioeconomic position during adulthood and the prevalence of hypertension in the elderly population. Furthermore, we incorporated central obesity, whereas most studies of this subject have used only body mass index as a measure of body fat.[2]

We measured blood pressure up to 12 times throughout the day, using mercury and automated devices. We believe that this has minimised the possible misclassification bias associated with within-person blood pressure variability. This bias, if it existed, would have moved the association toward the null.

Comparison with other studies and probable explanations

Very few studies have evaluated the relation between socioeconomic position and the prevalence of hypertension in elderly persons, thus the possibilities of comparison with the results of other studies are limited. Nevertheless, the inverse relation seen between hypertension and socioeconomic position agrees with the findings of most studies carried out in the adult population in developed countries.[1 2] As was found in our study, the magnitude of the observed association in these investigations is small.

Policy implications

These results offer ample possibilities for policy interventions and for clinical practice in older women. However, the mechanisms that can explain the association among older men remain to be established.

Various studies have assessed the role of hypertension risk factors in this association and have found that these factors explain the socioeconomic gradient in hypertension. It has also been found that obesity is the risk factor that explains most of the association between socioeconomic position and hypertension.[2] Most of these studies have focused exclusively on general obesity, despite the fact that central obesity shows a better correlation than general obesity with blood pressure and with other cardiovascular risk factors, in both adults[20] and the elderly.[21] In our study, this high correlation between central obesity and blood pressure is clearly evident in women, as seen in the fact that it explains a larger part of the observed association than general obesity.

Some studies have found the magnitude of the association between socioeconomic position and hypertension to be lower in men than in women, and some have even found no association in men. These findings could be attributed to the fact that the socioeconomic gradient in obesity in men is smaller than in women, or to the absence of this gradient in men, as seen in some studies.[22] In some places the relation between socioeconomic position and hypertension in men has emerged recently,[23–25] and some authors point out that this has coincided with the emergence of the socioeconomic gradient in obesity.[2] This hypothesis could explain the lack of significant differences in hypertension prevalence by social class in men, as neither general obesity nor central obesity showed an association with social class in men.

The lack of variation in the obesity measures by socioeconomic position in men is not the only factor that explains the different results found in men and women. Some risk factors probably have a different effect on hypertension in men and women. For example, physical inactivity shows an important socioeconomic variation in men and women, but does not explain the socioeconomic differences in hypertension prevalence in men. This is also the case of social class in childhood, which is the risk factor that explains the largest part of the difference in hypertension prevalence between low and high social class in men. A previous study in this population found that low social class in childhood is associated with a higher prevalence of hypertension in men, but not in women.[26] The strong association observed between social class in childhood and social class in adulthood is undoubtedly responsible for this finding.

Other factors not measured in this study are probably responsible for the results found in men. This requires further investigation of hypertension risk factors not included in our study. Some of these factors could be the psychosocial stressors.[15] An increase in blood pressure has been shown in different situations of prolonged exposure to psychological demands when the possibilities for controlling the situation are perceived as limited.[27] Various epidemiological studies support the idea that psychosocial stress among persons in low socioeconomic strata contribute to differences in blood pressure.[28 29] There are some life events that can increase stress in elderly persons. One such event is retirement.[30] In our study this event would have affected only the men, as the employment rate in the cohort of women studied was low. In theory, better educated and higher occupational class subjects would experience the greatest loss after retirement because they have more job involvement together with greater autonomy and decision making capacity. This could explain the small differences in hypertension prevalence by socioeconomic position in men. However, the sense of control in better educated and higher class older men is probably greater than in less well educated and working class subjects, because they have more resources that allow them to adapt to the change. On the other hand, women may experience increased stress when their husbands retire because of having to cope with their spouses at home and having to manage on a reduced income, which could partly explain the differences in hypertension prevalence by socioeconomic position in women.

In summary, a recent review of socioeconomic status and hypertension concludes that there is little evidence that socioeconomic level increases hypertension through mechanisms other than the known risk factors.[2] Our study shows that the socioeconomic differences in hypertension prevalence in an elderly population are small, and suggests that in women the direct effect of socioeconomic status on hypertension is practically absent in the case of education and is small in the case of social class. The same situation does not occur in men, for whom most of the effect of education and half of the effect of social class on hypertension is direct or, at least, is not explained by the risk factors analysed. These results offer possibilities for policy interventions and for clinical practice in older women. They also suggest the need to study whether interventions aimed at increasing physical activity and promoting weight loss can successfully reduce socioeconomic differences in these risk factors. However, the mechanisms that can explain the association among older men remain to be established.

CONTRIBUTORS

E Regidor and JL Gutiérrez-Fisac formulated the hypothesis. All authors contributed to the analysis, data interpretation, and writing of this study. E Regidor is the guarantor of the article.

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REFERENCES

1 **Kaplan GA**, Keil JE. Socioeconomic factors and cardiovascular disease: a review of the literature. *Circulation* 1993;**88**:1973–98.
2 **Colhoun HM**, Hemingway H, Poulter NR. Socio-economic status and blood pressure: an overview analysis. *J Human Hypertens* 1998;**12**:91–110.
3 **Avendaño M**, Kunst AE, Huisman M, *et al*. Educational level and stroke mortality: a comparison of 10 European populations during the 1990s. *Stroke* 2004;**35**:432–7.
4 **Winkleby MA**, Fortmann SP, Barret DC. Social class disparities in risk factors for disease: eight-year prevalence patterns by level of education. *Prev Med* 1990;**19**:1–12.
5 **Svetkey LP**, George LK, Burchett BM, *et al*. Black/white differences in hypertension in the elderly: an epidemiologic analysis in central North Carolina. *Am J Epidemiol* 1993;**137**:64–73.
6 **Van Rossum CTM**, van de Mheen H, Witteman JCM, *et al*. Prevalence, treatment, and control of hypertension by sociodemographic factors among the Dutch elderly. *Hypertension* 2000;**35**:814–21.
7 **Makela P**. Valkonen T, Martelin T. Contribution of deaths related to alcohol use to socioeconomic variation in mortality: register based follow up study, *BMJ* 1997;**315**:211–16.
8 **Gutiérrez-Fisac JL**, Regidor E, Banegas JR, *et al*. The size of obesity differences associated with educational level in Spain, 1987 and 1995/97. *J Epidemiol Community Health* 2002;**56**:457–60.
9 **Whincup P**, Cook D. Blood pressure and hypertension. In: Kuh D, Ben-Shlomo Y, eds. *A life course approach to chronic disease epidemiology*. Oxford: Oxford University Press, 1997:121–44.
10 **Montgomery SM**, Berney LR, Blane D. Prepubertal stature and blood pressure in early old age. *Arch Dis Child* 2000;**82**:358–63.
11 **Ben-Shlomo Y**, Kuh D. A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives. *Int J Epidemiol* 2002;**31**:285–93.
12 **Banegas JR**, Rodríguez-Artalejo F, Ruilope LM, *et al*. Hypertension magnitude and management in the elderly population of Spain. *J Hypertens* 2002;**20**:2157–64.
13 **Ross CE**, Wu C. The link between education and health. *Am Soc Rev* 1995;**60**:719–45.

14 **Krieger N**, Williams DR, Moss NE. Measuring social class in US public health research. Concepts, methodologies, and guidelines. *Annu Rev Public Health* 1997;**18**:341–78.
15 **Whelton PK**. Epidemiology of hypertension. *Lancet* 1994;**344**:101–6.
16 **National Institutes of Health**. *Clinical guidelines on the identification, evaluation and treatment of overweight and obesity in adults. The evidence report*. Bethesda, MD: National Institutes of Health, http://www.nhlbi.nih.gov/guidelines/obesity/ob_home.htm (accessed 19 Jan 2005).
17 **Blane D**. Urbanization and the life course. *Int J Epidemiol* 2004;**33**:730–1.
18 **Skov T**, Deddens J, Petersen MR, *et al*. Prevalence proportion ratios: estimation and hypothesis testing. *Int J Epidemiol* 1998;**27**:91–5.
19 **Lawlor DE**, Ebrahim S, Davey Smith G. Socioeconomic position in childhood and adulthood and insulin resistance: cross sectional survey using data from British womens heart and health study. *BMJ* 2002;**325**:825–9.
20 **Wu CH**, Yao WJ, Lu FH, *et al*. Relationship between glycosylated hemoglobin, blood pressure, serum lipid profiles and body fat distribution in healthy Chinese. *Atherosclerosis* 1998;**137**:157–65.
21 **Wu CH**, Yao WJ, Lu FH, *et al*. Sex differences of body fat distribution and cardiovascular dysmetabolic factors in old age. *Age Ageing* 2000;**30**:331–6.
22 **Sobal J**, Stunkard AJ. Socioeconomic status and obesity: a review of the literature. *Psychol Bull* 1989;**105**:260–75.
23 **Pekkanen J**, Uutela A, Valkonen T, *et al*. Coronary risk factor levels: differences between educational groups in 1972–87 in eastern Finland. *J Epidemiol Community Health* 1995;**49**:144–9.
24 **Hoeymans N**, Smit HA, Verkleij H, *et al*. Cardiovascular risk factors in relation to educational level in 36 000 men and women in The Netherlands. *Eur Heart J* 1996;**17**:518–25.
25 **Duijkers TJ**, Kromhout D, Spruit IP, *et al*. Inter-mediating risk factors in the relation between socioeconomic status and 25-year mortality (the Zutphen study). *Int J Epidemiol* 1989;**18**:658–62.
26 **Regidor E**, Banegas JR, Gutiérrez-Fisac JL, *et al*. Socioeconomic position in childhood and cardiovascular risk factors in older Spanish people. *Int J Epidemiol* 2004;**33**:723–30.
27 **Brunner E**, Marmot M. Social organizations, stress, and health. In: Marmot M, Wilkinson RG, eds. *Social determinants of health*. Oxford: Oxford University Press, 1999:17–43.
28 **James SA**, Strogatz DS, Wing SB, *et al*. Socioeconomic status, John Henryism, and hypertension in blacks and whites. *Am J Epidemiol* 1987;**126**:664–73.
29 **Marmot MG**, Davey Smith G, Stansfeld S, *et al*. Health inequalities among British civil servants: the Whitehall study. *Lancet* 1991;**337**:1387–93.
30 **Rodin J**. Aging and health: effects of the sense of control. *Science* 1986;**233**:1271–6.