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CLINICAL RESEARCH
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Socioeconomic status, blood pressure progression, and incident hypertension in a prospective cohort of female health professionals

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Aims The aim of this study was to examine the association between socioeconomic status, blood pressure (BP) progression, and incident hypertension.

Methods and results We included 27 207 female health professionals free of hypertension and cardiovascular disease at baseline. Participants were classified into five education and six income categories. The main outcome variables were BP progression at 48 months of follow-up and incident hypertension during the entire study period. At 48 months, 48.1% of women had BP progression. The multivariable adjusted relative risks [95% confidence intervals (CIs)] for BP progression were 1.0 (referent), 0.96 (0.92–1.00), 0.92 (0.88–0.96), 0.90 (0.85–0.94), and 0.84 (0.78–0.91) (*P* for trend <0.0001) across increasing education categories and 1.0 (referent), 1.01 (0.94–1.08), 0.99 (0.93–1.06), 0.97 (0.91–1.04), 0.96 (0.90–1.03), and 0.89 (0.83–0.96) across increasing income categories (*P* for trend = 0.0001). During a median follow-up of 9.8 years, 8248 cases of incident hypertension occurred. Multivariable adjusted hazard ratios (95% CI) were 1.0 (referent), 0.92 (0.86–0.99), 0.85 (0.79–0.92), 0.87 (0.80–0.94), and 0.74 (0.65–0.84) (*P* for trend <0.0001) across increasing education categories and 1.0 (referent), 1.07 (0.95–1.21), 1.07 (0.95–1.20), 1.06 (0.94–1.18), 1.04 (0.93–1.16), and 0.93 (0.82–1.06) (*P* for trend 0.08) across increasing income categories. In joint analyses, education but not income remained associated with BP progression and incident hypertension.

Conclusion Socioeconomic status, as determined by education but not by income, is a strong independent predictor of BP progression and incident hypertension in women.

Keywords Blood pressure • Hypertension • Socioeconomic status • Education • Income

Introduction

Socioeconomic status (SES) is inversely associated with cardiovascular disease.[1,2] This relationship may be partly mediated by an increased prevalence of traditional cardiovascular risk factors, such as hypertension, among individuals with low SES.[3] In this context, several cross-sectional studies have assessed the relationship between SES, blood pressure (BP), and hypertension.[4–7] Although many of these studies report a significant association between various markers of SES and BP or hypertension, data from prospective investigations remain scarce.

One of the few prospective studies relating SES to incident hypertension was performed in young adults and revealed no significant relationship between baseline categories of income or education and incident hypertension.[8] However, this study was limited by a young population with a relatively narrow age range (18–30 years), as well as by a small number of events. Thus, a meaningful association between SES and incident hypertension could not be conclusively determined. Additional work has also implicated obesity as one of the most important confounders of the relationship between SES and hypertension,[4] but it is relatively unknown

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whether the effect of SES is similar for individuals within different categories of body weight.

In an effort to address these issues, we prospectively evaluated the relationship between two measures of SES—education and income—and incident hypertension among apparently healthy women participating in the Women's Health Study.

Methods

Participants

Study subjects were participants of the Women's Health Study, a completed randomized trial evaluating the use of low-dose aspirin, vitamin E, and beta-carotene in the primary prevention of cardiovascular disease and cancer among 39 876 female health professionals. Details of the study design have been described previously.[9,10] Briefly, randomization began in 1993, and the trial concluded on 31 March 2004. After exclusion of 10 530 women with hypertension at baseline and 2139 women with missing SES variables, the remaining 27 207 women were included in this analysis. Women with missing SES variables had similar baseline characteristics compared with those included in our analyses (data not shown). Median follow-up for this sample population was 9.8 years (interquartile range 6.2–10.5). All women provided written informed consent, and the trial was approved by the Institutional Review Board of Brigham and Women's Hospital.

Information on baseline variables was collected using mailed questionnaires. Follow-up questionnaires asking participants about clinical and demographic information were sent every 6 months during the first year and every 12 months thereafter. Covariates of interest ascertained at baseline included age, education, income, BP, body mass index (BMI) (kg/m^2), race/ethnicity, smoking, diabetes, hypercholesterolaemia, hormone replacement therapy, menopausal status, exercise, and alcohol consumption.

Socioeconomic variables

Self-reported education and income were utilized as measures of SES. We grouped women into five categories of the education level beyond high school: ≤2 years of health professional education, 2 to <4 years of health professional education, bachelor's degree, master's degree, and doctoral degree. Annual household income is reported in six categories of US dollars (<$20 000, $20 000–29 999, $30 000–39 999, $40 000–49 999, $50 000–99 999, and ≥$100 000).

Outcome assessment

Blood pressure at randomization was self-reported by the female health professionals, a group where self-report of BP is highly accurate.[11–13] At baseline, three BP categories were defined as follows: (i) below 120 mmHg for systolic and 75 mmHg for diastolic BP; (ii) 120–129 mmHg for systolic or 75–84 mmHg for diastolic BP; and (iii) 130–139 mmHg for systolic or 85–89 mmHg for diastolic BP.[14] Women with discordant systolic and diastolic BP categories were classified into the higher category.

Incident cases of hypertension were defined by at least one of the following criteria: a new physician diagnosis of hypertension assessed at years 1, 3 and yearly thereafter; self-report of anti-hypertensive treatment assessed at years 1, 3, and 4; or self-reported systolic BP of at least 140 mmHg or diastolic BP of at least 90 mmHg at years 1 and 4.

Women reporting a new physician diagnosis of hypertension also provided month and year of diagnosis. For a diagnosis defined by another criterion or a missing date for the diagnosis of a physician, a date between the current and the previous questionnaires was randomly assigned. Women who developed cardiovascular disease were censored at the date of diagnosis and not considered at risk for incident hypertension thereafter, because management of their disease could affect BP levels. All 27 207 women were included in the incident hypertension analyses.

To assess BP progression, we created categories of self-reported BP at 48 months of follow-up identical to those at baseline. Blood pressure progression was defined by progressing at least one BP category compared with baseline or by a new diagnosis of hypertension during the first 48 months. We excluded 331 women who had a cardiovascular event or died during the first 48 months and 3124 women with missing BP information at 48 months, leaving 23 752 women in the analysis for BP progression at 48 months. Women with missing BP information at 48 months had similar baseline characteristics as those included in the analysis (data not shown).

Statistical analysis

Differences in baseline characteristics across categories of education and income were compared using χ^2 tests or analysis of variance. Because odds ratios may overestimate risk estimates in cases of non-rare events, we constructed relative risk models using PROC GENMOD in SAS to examine the relationship between each measure of SES and BP progression at 48 months. Cox proportional-hazards models were fitted to assess these relationships for incident hypertension. Three separate models were constructed for all analyses: (i) age-adjusted, (ii) baseline BP and BMI adjusted, and (iii) multivariable models adjusting for age, BMI, smoking, race/ethnicity, baseline BP category, history of diabetes, history of hypercholesterolaemia, hormone replacement therapy, menopausal status, exercise, alcohol consumption, and randomized treatment assignments (aspirin, vitamin E, and beta-carotene). Education and income were assessed separately and in combined models.

We performed two *a priori* subgroup analyses. First, since the effect of income on the evaluated outcomes might differ in women <65 years compared with those ≥65 years because the latter group likely consists principally of retirees, we repeated all analyses within these two age strata. Secondly, because previous data indicate that BMI is an important confounder of the association between SES and incident hypertension,[4] we also performed stratified analyses according to clinically recognized BMI categories [normal (<25 kg/m^2), overweight (≥25 and <30 kg/m^2), and obese (≥30 kg/m^2)]. To assess whether the effect of education or income differs across age or BMI categories, we included interaction terms in the non-stratified regression models. The significance of these interactions was based on a score test in BP progression models and on a likelihood ratio test in incident hypertension models. In a sensitivity analysis, we used all available information on height and weight during follow-up to construct a Cox model with BMI as a time-dependent covariate.

A two-tailed *P*-value <0.05 was considered to indicate statistical significance. Tests for trend were performed using integer scores across categories. The proportional hazards assumption was examined for all models by including education or income categories by logarithm of time interaction terms into the model.[15] All analyses were carried out using SAS version 9 (SAS Institute Inc., Cary, NC, USA).

Results

Baseline characteristics stratified by education category are shown in *Table 1*. Mean age was 54 ± 7 years. All differences across categories of education and income (data not shown) were

Table 1 Baseline characteristics according to education category

Characteristic	<2 years of health professional education (*n* = 3471)	2 to <4 years of health professional education (*n* = 11 405)	Bachelor's degree (*n* = 6571)	Master's degree (*n* = 4319)	Doctorate (*n* = 1441)
Age (years)	54 ± 7	54 ± 7	53 ± 6	53 ± 6	54 ± 7
BMI (kg/m^2)	26.3 ± 5	25.3 ± 5	25.0 ± 4	24.8 ± 4	24.1 ± 4
Race/ethnicity (%)					
White	93.7	97.1	95.5	95.7	86.4
Hispanic	2	1	1.1	0.7	1.5
African-American	3.4	1	1.4	1.9	2.5
Other	0.9	0.9	2	1.7	9.6
History of diabetes (%)	2.3	1.3	1.2	0.9	0.9
History of hypercholesterolaemia (%)	27.2	25.9	23.3	21.4	22.2
Smoking (%)					
Current	24.6	15.4	10.4	7.1	5.1
Former	29.6	36.6	36.3	38.7	32.9
Never	45.8	48.1	53.4	54.2	62
Exercise, times/week (%)					
Rarely/never	46.4	39.1	31.9	28.8	27.6
<1	19.3	20.1	21.4	19.9	18.5
1–3	27.7	30.8	34.6	37	36.4
>3	6.7	10	12.2	14.3	17.5
Alcohol consumption (%)					
Rarely/never	60.6	45.1	38.3	33.6	32.4
1–3 drinks per month	12.7	12.9	14	14.2	12.4
1–6 drinks per week	21.2	32.6	36.5	39.5	38.8
≥1 drink per day	5.5	9.5	11.1	12.6	16.5
Hormone replacement therapy (%)					
Current	36.6	41.7	40.4	40.2	42.9
Past	13.4	8.8	6.4	5.4	5
Never	50.1	49.5	53.2	54.4	52.1
Menopausal status (%)					
Pre-menopausal	26.4	28	35.2	37.2	33.3
Post-menopausal	50.8	53.8	46.8	46.9	53.7
Uncertain	22.8	18.2	17.9	15.9	13
Baseline BP category (%)					
<120/75 mmHg	39.9	42.6	45.8	44.1	46.8
120–129/75–84 mmHg	39.6	39	38.6	40.3	40.8
130–139/85–89 mmHg	20.5	18.4	15.7	15.6	12.5

Data are mean ± standard deviation or percentages.

statistically significant (each $P < 0.0001$). At 48 months of follow-up, 11 421 of 23 752 women (48.1%) had BP progression. Across categories of increasing education, the proportions of women with BP progression at 48 months were 52.6, 49.8, 46.4, 44.5, and 42.0%. The corresponding proportions for categories of increasing income were 55.8, 54.6, 51.4, 49.0, 46.9, and 41.4%.

After multivariable adjustment, women in the highest category of education or income had a 16 and 11% lower risk of BP progression when compared with those in the lowest education or income category, respectively (*Table 2*). As illustrated in *Table 2*, adjustment for variables other than baseline BP and BMI had minimal impact on the relative risk estimates.

Table 2 Relative risk of blood pressure progression at 48 months according to socioeconomic status categories

Predictor	No. of women	No. of events	Age-adjusted	Age, baseline BP, and BMI adjusted	Multivariable adjusted*
Education					
<2 years of health professional education†	2958	1555	1.0	1.0	1.0
2 to <4 years of health professional education	10 025	4996	0.94 (0.90–0.98)	0.96 (0.92–1.00)	0.96 (0.92–1.00)
Bachelor's degree	5764	2673	0.89 (0.86–0.93)	0.92 (0.88–0.96)	0.92 (0.88–0.96)
Master's degree	3781	1683	0.86 (0.82–0.90)	0.89 (0.85–0.94)	0.90 (0.85–0.94)
Doctorate	1224	514	0.79 (0.73–0.85)	0.85 (0.79–0.91)	0.84 (0.78–0.91)
P for linear trend	—	—	<0.0001	<0.0001	<0.0001
Annual household income, US$					
<20 000†	945	527	1.0	1.0	1.0
20 000–29 999	2090	1140	1.02 (0.95–1.09)	1.02 (0.95–1.09)	1.01 (0.94–1.08)
30 000–39 999	3173	1632	0.99 (0.93–1.06)	1.00 (0.93–1.07)	0.99 (0.93–1.06)
40 000–49 999	3958	1938	0.97 (0.91–1.03)	0.98 (0.92–1.05)	0.97 (0.91–1.04)
50 000–99 999	10 199	4782	0.95 (0.89–1.01)	0.97 (0.91–1.04)	0.96 (0.90–1.03)
>100 000	3387	1402	0.84 (0.78–0.90)	0.90 (0.83–0.96)	0.89 (0.83–0.96)
P for linear trend	—	—	<0.0001	<0.0001	0.0001

Data are relative risks (95% confidence interval).
*Due to missing covariates, the multivariable (crude) analysis was based on 10 953 (11 421) events among 22 785 (23 752) women.
†Reference category.

Table 3 Hazard of incident hypertension according to socioeconomic status categories during 9.8 years of follow-up

Predictor	No. of women	No. of events	Incidence rate/ 1000 person-years	Age-adjusted	Age, baseline BP, and BMI adjusted	Multivariable adjusted*
Education						
<2 years of health professional education†	3471	1231	47.8	1.0	1.0	1.0
2 to <4 years of health professional education	11 405	3643	39.7	0.84 (0.79–0.90)	0.91 (0.86–0.98)	0.92 (0.86–0.99)
Bachelor's degree	6571	1834	35.0	0.75 (0.70–0.81)	0.84 (0.78–0.91)	0.85 (0.79–0.92)
Master's degree	4319	1201	34.9	0.75 (0.69–0.81)	0.85 (0.79–0.92)	0.87 (0.80–0.94)
Doctorate	1441	331	27.7	0.58 (0.51–0.65)	0.74 (0.65–0.83)	0.74 (0.65–0.84)
P for linear trend	—	—		<0.0001	<0.0001	<0.0001
Annual household income, US$						
<20 000†	1159	415	44.7	1.0	1.0	1.0
20 000–29 999	2454	884	45.3	1.06 (0.94–1.19)	1.08 (0.96–1.22)	1.07 (0.95–1.21)
30 000–39 999	3679	1211	40.7	0.99 (0.89–1.11)	1.07 (0.96–1.20)	1.07 (0.95–1.20)
40 000–49 999	4492	1438	40.2	1.00 (0.89–1.12)	1.07 (0.95–1.20)	1.06 (0.94–1.18)
50 000–99 999	11 570	3378	37.1	0.93 (0.83–1.03)	1.04 (0.94–1.16)	1.04 (0.93–1.16)
>100 000	3853	922	29.6	0.74 (0.66–0.84)	0.94 (0.83–1.06)	0.93 (0.82–1.06)
P for linear trend	—	—		<0.0001	0.05	0.08

Data are incidences or hazard ratios (95% confidence interval).
*Due to missing covariates, the multivariable (crude) analysis was based on 7968 (8248) events among 26 322 (27 207) women.
†Reference category.

During a median follow-up of 9.8 years, we observed 8248 cases of incident hypertension. Age adjusted-incidence rates across increasing levels of education or income are shown in *Table 3*. After adjustment for potential confounders, improvements in education remained inversely associated with the risk of incident hypertension. Compared with those in the lowest category of education, women in the highest category had a 26% lower risk of developing hypertension during follow-up (P for trend across categories <0.0001). In contrast, the inverse trend across income categories in univariate analysis was attenuated after full multivariable adjustment ($P = 0.08$) (*Table 3*).

We found that the proportional hazards assumption was violated for both education ($P = 0.002$) and income ($P = 0.0001$), suggesting a greater relative hazard for incident hypertension during early follow-up and attenuation over time. Therefore, we performed several analyses to clarify these relationships. First, the results in *Table 3* are similar to those found for BP progression in *Table 2*. Second, a cross-sectional analysis at baseline including women with hypertension at baseline and using relative risks provided similar results, suggesting the absence of an SES-specific cohort effect during the course of the study. Third, given that education status should not change during the study period, we also assessed the risk of having hypertension at the end of the study period, again finding very similar results. Finally, age-stratified analyses did not reveal any age-specific effects in this cohort. Taken together, *Table 3* gives valid overall effect estimates of SES on incident hypertension over the entire follow-up period.

In combined models of 4-year progression that included both education and income, the relative risks [95% confidence intervals (CIs)] were 1.0 (referent), 0.97 (0.93–1.01), 0.93 (0.89–0.98), 0.91 (0.86–0.96), and 0.87 (0.80–0.94) for increasing categories of education (P for trend <0.0001) and 1.0 (referent), 1.01 (0.95–1.09), 1.01 (0.95–1.09), 0.99 (0.93–1.06), 1.00 (0.93–1.07), and 0.94 (0.87–1.01) across increasing categories of income (P for trend $= 0.05$). Multivariable models for incident hypertension that included both education and income revealed hazard ratios (95% confidence intervals) across increasing categories of education of 1.0 (referent), 0.91 (0.85–0.98), 0.85 (0.78–0.92), 0.86 (0.79–0.94), and 0.75 (0.66–0.86) (P for trend <0.0001). Income categories were not significantly associated with incident hypertension in the combined model (data not shown).

Analyses stratified by age revealed similar effects of education and income on both BP progression and incident hypertension in women $\geq$65 years when compared with those $<$65 years (data not shown). Accordingly, age by education or income interaction tests were not statistically significant (each $P > 0.13$).

Updated information on body weight was available at 24, 36, 60, 72 and 108 months of follow-up. Including BMI as a time-dependent covariate in the multivariable education model only minimally changed the hazard ratios across increasing education categories (1.0 (referent), 0.93 (0.87–0.99), 0.86 (0.80–0.92), 0.87 (0.80–0.95), and 0.74 (0.66–0.84)) (P for trend <0.0001).

P-values for the interaction between BMI and income categories were 0.004 for BP progression and 0.23 for incident hypertension. There was evidence of an interaction between BMI and education categories for both BP progression and incident hypertension (P for interaction $= 0.001$ and 0.002, respectively). As shown in *Table 4*, the lower risk of BP progression and incident hypertension with improvements in education was only evident in normal weight and overweight women. Although obese women had the highest risk of BP progression and incident hypertension, better education did not confer a reduced risk of BP progression and incident hypertension in this subgroup.

Discussion

This prospective study demonstrates that SES is independently associated with BP progression and incident hypertension in women. After multivariable adjustment, both education and income were associated with BP progression, but only education was significantly related to incident hypertension. This finding is plausible given that income can fluctuate over time and thus is susceptible to misclassification. Furthermore, income does not necessarily reflect an individual's wealth, which may influence the health behaviour of an individual. In contrast, education is typically determined relatively early in life, is less subject to fluctuation thereafter, and therefore much less susceptible to misclassification bias.

The present study provides insight into the relationship between SES and cardiovascular disease by demonstrating a strong relationship even in women with a relatively narrow range of income and education. While direct causation cannot be implied, the present study supports the absence of a threshold effect, as previously described for the relationship between SES and cardiovascular disease or mortality.[1,16] Thus, even the small difference between a master's degree and a doctorate may have a substantial impact on the future cardiovascular risk of an individual.

Our prospective study extends the findings of previously published, cross-sectional studies.[3–7] For example, among US adults aged 25–74 years, those with less than a high school education had a 6.7% higher prevalence of hypertension compared with those who had a high school education.[3] Similarly, a population-based study from the Netherlands found a 1.8-fold increased odds of hypertension in women with a primary education or less compared with those with a university degree.[17] A prospective evaluation to better understand these cross-sectional data is important, given that a prior prospective study in a young, biracial population did not find a significant association between baseline categories of income or education and the risk of incident hypertension.[8] The absence of a statistically significant result in the latter study was probably due to a low event rate among participants. Of note, risk estimates for low education [1.34 (0.94–1.90)] and low income [(1.36 (0.84–2.19)] were similar to those observed in our study.

The present study confirms the important confounding effect of BMI on the relationship between SES and BP progression or incident hypertension,[4] such that the addition of covariates other than baseline BP did not have a significant impact on the coefficients for education and income. It is also essential to point out that although education was a strong predictor of BP progression and incident hypertension in non-obese women only, obese women had the highest overall risk of BP progression and incident hypertension, although this risk was similar across all categories of education. If confirmed by other large-scale

Table 4 Blood pressure progression, incident hypertension, and socioeconomic status according to baseline body mass index categories

Predictor	BP progression			Incident hypertension		
	Normal weight† (n = 13 007)	Overweight† (n = 6771)	Obese† (n = 3007)	Normal weight† (n = 15 040)	Overweight† (n = 7785)	Obese† (n = 3497)
Education						
<2 years of health professional education*	1.0	1.0	1.0	1.0	1.0	1.0
2 to <4 years of health professional education	0.93 (0.88–0.99)	0.94 (0.88–1.01)	1.03 (0.95–1.13)	0.88 (0.79–0.98)	0.93 (0.83–1.04)	0.97 (0.85–1.11)
Bachelor's degree	0.88 (0.82–0.94)	0.93 (0.86–1.00)	1.03 (0.93–1.13)	0.80 (0.71–0.90)	0.87 (0.76–0.98)	0.94 (0.80–1.10)
Master's degree	0.86 (0.80–0.93)	0.87 (0.80–0.95)	1.05 (0.94–1.17)	0.80 (0.70–0.91)	0.89 (0.78–1.02)	1.00 (0.84–1.19)
Doctorate	0.80 (0.72–0.89)	0.86 (0.75–0.98)	0.99 (0.82–1.20)	0.65 (0.54–0.78)	0.78 (0.62–0.96)	0.97 (0.72–1.31)
P for interaction	0.001			0.002		
Annual household income, US$						
<20 000*	1.0	1.0	1.0	1.0	1.0	1.0
20 000–29 999	0.93 (0.84–1.03)	1.15 (1.02–1.30)	0.99 (0.84–1.16)	0.99 (0.82–1.19)	1.18 (0.97–1.44)	1.16 (0.90–1.50)
30 000–39 999	0.92 (0.84–1.02)	1.09 (0.97–1.23)	0.99 (0.84–1.15)	0.96 (0.80–1.15)	1.22 (1.00–1.48)	1.11 (0.86–1.42)
40 000–49 999	0.88 (0.80–0.97)	1.09 (0.97–1.23)	0.99 (0.85–1.15)	0.96 (0.80–1.14)	1.22 (1.01–1.48)	1.12 (0.88–1.44)
50 000–99 999	0.87 (0.79–0.95)	1.09 (0.97–1.22)	0.97 (0.84–1.13)	0.92 (0.77–1.09)	1.25 (1.04–1.50)	1.09 (0.86–1.38)
>100 000	0.82 (0.74–0.90)	1.01 (0.88–1.15)	0.93 (0.78–1.11)	0.86 (0.71–1.03)	1.11 (0.89–1.37)	0.96 (0.72–1.28)
P for interaction	0.004			0.23		

Data are relative risks (95% confidence interval) for BP progression and hazard ratios (95% confidence interval) for incident hypertension.
*Reference category.
†Normal weight was defined as BMI < 25 kg/m^2; overweight was defined as BMI ≥ 25 and < 30 kg/m^2; obesity was defined as BMI ≥ 30 kg/m^2.

prospective studies, our findings suggest that obesity is an important risk factor for BP progression and incident hypertension independent of SES and that high SES does not decrease risk in obese women.

Possible factors that relate low SES to an increased risk of hypertension include access and quality of care,[18] diet,[19,20] social support, emotional stress, or a disadvantaged neighbourhood environment.[21] For example, a diet poor in fruits and vegetables or containing higher salt content[22] due to diminished financial and socio-environmental resources may predispose persons with lower SES to an increased risk of hypertension.[19] Furthermore, persons of lower SES status might have higher exposure to chronic stressors such as job and financial stress that could result in heightened sympathetic nervous system and neurohormonal activity.[23,24] Both factors might influence the development of hypertension and other cardiovascular risk factors.[25] For example, data from the Whitehall Study and others show that increased job strain and poor job control are associated with increased BP or hypertension.[25–27] Finally, foetal growth and low birth weight have been associated with social inequalities, educational attainment, and incident hypertension, such that early life development and foetal programming may be underlying causal factors of the relationships described in this study.[28–31]

Strengths of the present study include its prospective design, sample size, and long-term follow-up with a large number of events. Potential study limitations also require discussion. First, generalizability to other populations may be limited because our population consists of predominantly white, middle-aged female health professionals who have a relatively narrow spectrum of education. It is unclear whether our results also apply to populations who are not involved in health care. Secondly, BP and hypertension status were self-reported. However, the prognostic value of self-reported BP in cohort studies involving US health professionals is similar compared with directly measured BP values in participants of other cohort studies.[13] The validity of this approach has also been examined in the Nurses' Health Study, in which 99% of the women who reported high BP levels had their diagnosis confirmed by medical record review.[12] Moreover, in this cohort, self-reported BP, total cholesterol, and BMI are strong predictors of cardiovascular risk, with relative risks consistent in magnitude with those observed in other major studies.[11,32,33] However, we may have slightly misjudged the true incidence of BP progression and hypertension in our cohort, as our estimates were in part based on a single, self-reported measurement. Moreover, it is possible that within each baseline BP category, lower SES women had higher BP levels compared with higher SES women, an issue that we were unable to take into account.

Conclusion

This prospective study demonstrates that SES is a powerful and independent predictor of BP progression and incident hypertension in initially healthy women. In this population, education was a more robust indicator of incident hypertension than income. Furthermore, although obesity is a key contributor to the development of hypertension, we found that obese women with <2 years of professional education did not have a higher risk of BP progression or incident hypertension than their counterparts with doctorates. Finally, our findings indicate that even in this well-educated cohort of health professionals, SES as measured by education and income remains an important determinant of hypertension.

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