How Does Lower Education Get Inside the Body to Raise Blood Pressure?
What Can We Do to Prevent This?

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It has long been known that lower socioeconomic status (SES) is a potent risk factor for cardiovascular disease.1 Much effort has been devoted to identifying the mechanisms responsible for this risk, because knowledge of these mechanisms is essential to guide the development of interventions to prevent or ameliorate the health-damaging effects. By showing that increased systolic blood pressure (SBP) levels in persons of lower educational attainment in a large sample drawn from the Paris metropolitan area are mediated to a significant extent by increased body mass index (BMI), waist circumference, and resting heart rate (HR), the report by Chaix et al2 in this issue of Hypertension makes an important contribution toward achieving this goal.

Much work remains to be done, however, because the proportion of the association between lower individual education and elevated SBP explained by BMI/waist circumference and resting HR is 28.0% and 14.7%, respectively, meaning that a substantial proportion of the effect of lower education on SBP is mediated by other factors. Moreover, although it is helpful to know that one way lower education gets inside the body to raise blood pressure is via increased BMI, central fat accumulation, and resting HR, it is by no means clear how lower education gets inside the body to influence these mediators of increased blood pressure.

Psychosocial risk factors like hostility, depression, and social isolation are increased in lower SES groups3,4 and, therefore, deserve attention as potential mediators of both the ≥70% of the association between lower education and increased SBP that is not accounted for by BMI, waist circumference, and resting HR, as well as the influence of lower education on BMI, waist circumference, and resting HR. Although the Residential Environment and Coronary Heart Disease Cohort Study focused primarily on physical risk factors as mediators of the effects of lower SES on blood pressure, data were collected on perceived stress and depressive symptoms, making possible the evaluation of these potential psychosocial mediators. Although neither was found to mediate effects of lower individual education on SBP via resting HR, both perceived stress and depressive symptoms were statistically significant mediators of the association of lower individual education with increased SBP via BMI/waist circumference. The amount of the effect of lower education on SBP via BMI/waist circumference that was accounted for by the elevated perceived stress or depressive symptoms in persons with lower education was small, however, at only 5.0% and 2.4%, respectively.

There is considerable evidence that hostility could be a psychosocial risk factor that accounts for a more substantial portion of the effect of lower education to increase blood pressure. Higher hostility levels were observed in persons with fewer years of education in a national survey of 2536 US adults.4 Higher hostility levels in 4710 college freshmen predicted increased BMI in midlife, and higher hostility levels assessed at midlife in this sample were associated with increased prevalence of hypertension.5 Higher hostility levels were also associated with higher waist:hip ratios in a US national sample of young adults, and those with hostility levels in the top quartile in this sample consumed an average of 600 more calories per day than those in the lowest quartile.6 Further linking hostility with eating habits that could account for its associations with increased daily caloric intake, BMI, and waist:hip ratio, higher hostility levels were associated with greater likelihood to continue eating when satiated in a population-based sample of 629 residents of St. Louis, Mo.7

It is possible that increased weight and BMI could themselves be causing increases in hostility. The fact that hostility scores in college freshmen predicted higher BMI 21 to 23 years later5 makes it more likely that it is hostility that is causing an increase in BMI and central obesity. It is less likely, moreover, that consuming 600 more calories per day6 and continuing to eat even when satiated7 will themselves make one more hostile than the idea that having a high hostility level will cause one to have these eating habits.

In addition to these indications that higher hostility levels contribute to increased caloric intake, weight, BMI, and waist circumference, higher hostility levels have also been found to be associated with increased sympathetically mediated increases in blood pressure, HR, and muscle blood flow in response to harassment during performance of a mental task.8

The Figure illustrates potential pathways whereby a lower education level could contribute to the development of higher SBP levels via increased sympathetic nervous system activation, resting HR, waist circumference, and BMI that result from higher hostility levels. Also shown is an additional pathway to increased sympathetic activation via increased...
neighborhood and job stress to which persons with lower education levels are exposed.

More research will be required to determine whether hostility is indeed a stronger mediator of the effects of lower education on precursors like elevated BMI, waist circumference, and resting HR and on blood pressure itself than the psychosocial factors of perceived stress and depressive symptoms that were available for testing in the Residential Environment and Coronary Heart Disease Cohort Study. If hostility is playing such a stronger role in the effects of lower education on blood pressure, interventions that reduce hostility could prove an effective means of reducing the health-damaging effects of lower education levels. Evidence from 2 small randomized clinical trials of behavioral interventions in male coronary heart disease patients indicates that training in psychosocial skills could be an effective means of reducing hostility, as well as depression, perceived stress, and blood pressure and HR both at rest and during mental stress challenge.\(^9,10\) Such training could, therefore, be one means of reducing the health-damaging effects of lower education. If such training does result in reduced SBP via reductions in waist circumference, BMI, and resting HR, it would confirm the importance of higher hostility as a mediator of the increased SBP that Chaix et al\(^2\) found in persons with lower education levels.

To the extent that the association between lower education and higher blood pressure documented by Chaix et al\(^2\) is reflecting a causal effect of lower education, the finding of this association in France, a country with a National Health Insurance System for Salaried Workers that ensures good medical care for lower SES groups, suggests that simply providing better medical care to lower SES persons may not be an effective means of ameliorating the health-damaging effects of lower education. Behavioral interventions that enable persons with lower education (and income) levels to cope more effectively with the many stresses that they encounter in daily life may be required to accomplish this goal.

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**References**
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