Socioeconomic Trajectories and Incident Hypertension in a Biracial Cohort of Young Adults

Karen A. Matthews, Catarina I. Kiefe, Cora E. Lewis, Kiang Liu, Stephen Sidney, Carla Yunis

Abstract—We assessed the impact of initial socioeconomic status and change in socioeconomic status across 10 years, ie, status trajectories, on the development of essential hypertension among black and white young men and women. Three thousand eight hundred twenty-seven normotensive individuals ages 18 to 30 years at study entry were followed for 10 years, with blood pressure, body mass index, and socioeconomic status characteristics measured at years 0, 2, 5, 7, and 10. Socioeconomic status trajectory measures were a new educational degree earned by year 10; difficulties paying for basics during years 2 to 10; and change in income category from year 5 to 10, defined in relation to year 0 status. Hypertension was defined as systolic blood pressure ≥140, diastolic blood pressure ≥90, or antihypertensive medication use at year 10. Reporting difficulties paying for basics at study entry (odds ratio=1.45, 95% confidence interval, 1.05 to 2.02) and continued difficulties during year 2 to 10 follow-up (odds ratio=1.62, 95% confidence interval, 1.04 to 2.53) were independently associated with incident hypertension, adjusted for race-gender group, body mass index, site, age, and initial systolic blood pressure. Decline in income from year 5 to 10 tended to be associated with hypertension, \( P=0.07 \), but a new educational degree after study onset was not. Socioeconomic trajectories are independently associated with incidence of hypertension. A dynamic index of socioeconomic status may be a useful concept in understanding the effects of socioeconomic status on the natural history of hypertension. (Hypertension. 2002;39:772-776.)

Key Words: socioeconomic factors, race, young adults, life course

It is well established that middle-aged and elderly adults who are from lower socioeconomic status (SES) groups are at elevated risk for cardiovascular diseases. A recent literature review concluded that lower SES adults had higher mean blood pressure and higher rates of hypertension in developed countries, with the gradient stronger and more consistently obtained in women than in men. However, the magnitude of the association was small and was accounted for in large part by the SES gradient in obesity. Children from lower SES families do not have a greater risk for high blood pressure than their higher SES counterparts, suggesting that the influence of lower SES on blood pressure may become apparent in young to middle adulthood.

Most previous research has measured SES at one point in time, ie, treated SES as a stable or static characteristic. A more dynamic view of SES may be useful in understanding the early natural history of hypertension. Consider adolescents and young adults who are entering the labor force and/or furthering their education, or consider minority populations that may be vulnerable to discriminatory educational or work practices or may have few resources to invest in educational or occupational growth. In these groups, a single static measure may not give a good estimate of their future SES, ie, their socioeconomic careers. Therefore, efforts to understand hypertension risk in young adults and in minority groups may benefit from taking a more dynamic or prospective view of SES, labeled here socioeconomic trajectories. The merit of the concept of socioeconomic trajectories is supported by several lines of research among the middle-aged and elderly on health outcomes other than hypertension. Income can vary substantially, with 26% to 39% of people 45 to 65 years of age having income reductions of 50% at least once in an 11-year period. In the Panel Study of Income Dynamics, a decline in income by 50% from one year to the next was associated with mortality, especially among the middle-income group. In the Alameda County study, the number of times individuals reported economic hardship across 13 years was linearly associated with difficulties performing independent living activities, activities of daily living, and clinical depression. In a Scottish study of men age 35 to 64, cumulative measures of occupational prestige showed a graded relationship with cardiovascular mortality.

The present study evaluated the relationship between indices of socioeconomic trajectories based on education,
TABLE 1. Characteristics for Participants Who Were Normotensive at Baseline and Reexamined 10 Years Later

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>White</th>
<th>Black</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normotensives at year 0, n</td>
<td>1056</td>
<td>1082</td>
</tr>
<tr>
<td>New hypertensives at year 10, n</td>
<td>22 (2.1)</td>
<td>110 (10.2)</td>
</tr>
<tr>
<td>Age at year 0</td>
<td>25.6±3.4</td>
<td>24.4±3.9</td>
</tr>
<tr>
<td>SBP at year 0</td>
<td>104.4±8.8</td>
<td>107.5±9.0</td>
</tr>
<tr>
<td>BMI at year 0</td>
<td>23.1±4.4</td>
<td>25.7±6.2</td>
</tr>
<tr>
<td>Mean change in BMI at year 10</td>
<td>2.4±3.6</td>
<td>4.1±3.9</td>
</tr>
</tbody>
</table>

Values are n (%) or mean±SD.

Methods

The CARDIA study investigates the natural history of cardiovascular risk development in young adulthood. In 1985 to 1986, 5155 black and white men and women, age 18 to 30 years, were recruited at Birmingham, Ala; Chicago, Ill; Minneapolis, Minn; and Oakland, Cal, to achieve a balance at each site by race (black, white), gender, education (high school degree or less, more than high school), and age (18 to 24 years, 25 to 30 years). All gave informed consent, and the institutional review committees approved the protocol. Participants were examined at study entry and years 2, 5, 7, and 10, with re-examination rates among surviving cohort members of 90.5%, 85.6%, 80.6%, and 78.4%, respectively. This report is based on those 3827 individuals who were normotensive at the time of the initial assessment of SES indices and completed the year-10 examination.

Data Collection and Study Variables

Following a 5-minute rest, a 30-second pulse rate was measured at the brachial artery by palpation, and 3 blood pressure measures using a Hawksley random zero sphygmomanometer (WA Baum Company) were taken at 1-minute intervals with participants seated. The average of the second and third measurements was used in analysis. Self-report data on diagnosis and treatment of hypertension and other chronic conditions were collected by questionnaire. Participants were considered hypertensive if they reported being on medication for hypertension or had examination SBP <140 mm Hg or diastolic blood pressure (DBP) <90 mm Hg. BMI calculated as weight (kg) divided by height squared (m²), was measured at each examination.

Questionnaires assessed age, race, gender, and educational degree (high school or equivalent, 2-year college degree, 4-year college degree, master’s degree, doctorate of philosophy or equivalent, professional degree) at each examination. Individuals were categorized into those with a high school degree or less versus more than high school at study entry. Change in educational attainment was defined as yes/no for obtaining a new degree by year 10. At all examinations except year 5, participants were asked “How hard is it for you (and your family) to pay for the basics, such as food, medical care, and heating?” with responses being very hard, hard, somewhat hard, not very hard, or don’t know. Responses were categorized into not very hard versus somewhat hard, hard, or very hard. The total number of times that participants reported that paying for basics was at least somewhat hard at years 2, 7, and 10 was divided by the number of examinations attended. At years 5 and 10, participants reported total family income for the past 12 months, including wages, veteran’s benefits, help from relatives, and rent from property owners, with 9 income categories available ($<5000, $5000 to $9999, $10 000 to $14 999, $15 000 to $19 999, $20 000 to $24 999, $25 000 to $49 999, $50 000 to $74 999, ≥$75 000, or don’t know). Individuals were categorized at year 5 into three income groups: $<40 000, $40 000 to $49 999, and ≥$50 000. Change in income to year 10 was defined as decreasing, staying the same, or increasing from one of the more differentiated 9 income categories.

Results

A comparison of the 3827 normotensives at study entry who participated in the year-10 examination versus those who did not participate showed that participants were on average 0.8 years older and more likely to have more than a high school degree (83% versus 76%) at study entry. Otherwise, the groups were similar in the other covariates and SES measures.

Of the normotensives at study entry, 255 (6.7%) became hypertensive by year 10 (Table 1). Compared with white women, the rates of hypertension were higher among black women (odds ratio (OR), 5.3; 95% confidence interval (CI), 3.34 to 8.48), black men (OR, 5.8; 95% CI, 3.61 to 9.41), and white men (OR, 2.03; 95% CI, 1.19 to 3.45).

SES Trajectories by Gender and Ethnic Group

Table 2 shows the numbers and proportions of individuals in each ethnic and race group classified according to each SES measure at initial assessment and through year 10. Multiple logistic regression (MLR) models adjusting for age showed that relative to white women, white men had a similar proportion with a high school degree or less at study entry, and both black women and men had a greater proportion with high school degree or less. Adjusting for initial education and age, MLR models showed that fewer blacks and white men reported earning a new educational degree by year 10 than did white women.

At study entry, white men reported less often having difficulty paying for basics than did white women, who reported difficulty paying for basics less often than both black and white women.
women and men. Through year 10, blacks continued to report more often having difficulties paying for basics than did white women, who reported a similar level of difficulties to white men.

At year 5, whites were classified into similar income categories, which were higher than those occupied by blacks. By year 10, white men less often reported a decline in income than did white women, who reported less often a decline in income category than did blacks. The above analyses were repeated among those who entered the study in the older age group, 25 to 30 years old, and the results were essentially the same (data not shown). Taken together, these findings show that the black women and men were disadvantaged relative to whites at study entry and through year 10.

### Hypertension Incidence According to Education and Difficulties Paying for Basics Trajectories Across 10 Years

MRL analyses of risk for hypertension included covariates of age, gender-race group (white women reference), SBP, and BMI at year 0, and center (Birmingham reference) for initial SES and the same covariates plus initial SES in the analyses of the SES trajectories. These analyses showed that low education at study entry (OR, 1.34; 95% CI, 0.94 to 1.90), and those who did not earn a new educational degree by year 10 had a higher risk of hypertension by year 10 (OR, 1.16; 95% CI, 0.82 to 1.65), but neither relationship was statistically significant. On the other hand, in separate models examining the role of difficulty paying for basics, participants who reported at least some difficulty paying for basics at study entry (OR, 1.38; 95% CI, 1.01 to 1.89) as well as subsequent difficulties paying for basics through year 10 (OR, 1.20; 95% CI, 1.03 to 1.38) had elevated risk for hypertension.

Low educational attainment and difficulties paying for basics were substantially associated at study entry (P<0.0001), and no new degree and difficulties paying for basics through year 10 were also associated (P<0.02). When both educational attainment and difficulties paying for basics at study entry were in the model simultaneously, difficulty paying for basics remained associated with elevated risk for hypertension (see Table 3). Similarly when educational attainment and difficulties paying for basics at study entry and new educational degree and difficulties paying for basics through year 10 were in the model simultaneously, difficulties paying for basics through year 10 were also associated (P<0.02).
ties paying for basics at study entry and through year 10 remained significant (see Table 3). Models with change in BMI added to the covariates did not alter the results (OR, 1.61; 95% CI, 1.21 to 2.16 for baseline and OR, 1.18; 95% CI, 1.02 to 1.37 for difficulties paying for basics during the follow-up in the same model). Models with pulse rate at study entry also did not alter the results (OR, 1.49; 95% CI, 1.07 to 2.06 for baseline and OR, 1.59; 95% CI, 1.02 to 2.48 for difficulties paying for basics in the same model along with the educational variables).

Because blacks reported more difficulties paying for basics than whites, there may be some residual confounding with race and difficulties paying for basics. Therefore, we conducted an analysis within blacks only, with the standard covariates as well as gender. Again, those blacks who had difficulties paying for basics at baseline were at greater risk for hypertension at year 10 (OR, 1.60; 95% CI, 1.15 to 2.23). When the difficulties paying for basics during the follow-up was added to the model, initial difficulties paying for basics were no longer significant (OR, 1.33; 95% CI, 0.93 to 1.91), but the difficulties paying for basics during the follow-up were (OR, 1.27; 95% CI, 1.07 to 1.51).

Hypertension Incidence According to Income Trajectories Across 5 Years

Baseline income category was not related to risk of hypertension at year 10 (OR, 1.36; 95% CI, 0.84 to 2.19). Those individuals whose incomes declined at least one category by year 10 had a nonsignificant elevated risk of hypertension by year 10, compared with those whose incomes improved, (OR, 1.50; 95% CI, 0.96 to 2.33). Further adjustments for pulse rate at year 5 slightly reduced the effect of declining income (OR, 1.45; 95% CI, 0.93 to 2.26). When the analyses were repeated adding as covariates the number of individuals in the household at years 5 and 10, the results were virtually identical, with the elevated risk associated with decline in income across 5 years approaching conventional levels of significance, P<0.06.

Discussion

Our results show that socioeconomic trajectories as indexed by initial and continuing difficulties paying for basics throughout the 10-year follow-up period predicted incident hypertension in young adults. Consistent with this pattern was the trend for income decline between years 5 and 10 to be associated with incident hypertension. Although a previous exhaustive review found that statistical adjustment for BMI explained in large part the gradient of SES measured statically and blood pressure or hypertension,3 our analyses showed that the relationships between our more dynamic indicators of SES and hypertension remained significant after adjusting for BMI, change in BMI, gender-race group, age, initial blood pressure, center, education at study entry, and earning a new degree by year 10. This suggests the utility of a more dynamic assessment of SES, especially perhaps in young- to middle-adulthood.

A previous CARDIA report showed that having a high school degree or less by year 10 was related to elevated blood pressure, defined as SBP ≥130 mm Hg, DBP ≥85 mm Hg, or self-report of antihypertensive treatment at any examination in white men and women and black women taken separately.12 In our analyses including educational level at study entry, earning a new degree by year 10 did not predict incident hypertension. A new educational degree, although important, is a relatively insensitive marker of socioeconomic trajectory in young adulthood. A more subjective measure, ie, difficulties paying for basics, is more useful than the often-used measures of education and income.
The findings showed that the socioeconomic trajectories varied substantially by ethnicity. Independent of initial SES status, blacks less often reported a new educational degree, continued having difficulties paying for basics, and experienced income declines through year 10, relative to white women and men. This underscores the importance of measuring the socioeconomic trajectories in minority populations to obtain a better estimate of health risk.

Why should economic difficulties confer extra risk for hypertension among young adults? Perhaps individuals who have economic difficulties are less likely to have adequate health care than those without difficulties are. The CARDIA protocol included questions at years 7 and 10 regarding access to health insurance. Those who reported no access were not at greater risk for incident hypertension (data not shown), but the follow-up period was very short so we cannot completely discount this explanation. Perhaps individuals who have economic difficulties are prone to depression such that our socioeconomic trajectories are actually secondary to depression. We have reported elsewhere that depressive symptoms do predict hypertension incidence in CARDIA, but analyses controlling for depression scores did not eliminate the relationship between economic difficulties and incident hypertension (data not shown).

Another explanation is that those who are repeatedly challenged by economic difficulties are under chronic stress. Chronic stress exposure may lead to sustained sympathetic activation, leading to episodic elevations in catecholamines, blood pressure and heart rate. These elevations can result in structural changes in the vasculature, damaging the ability of the vessels to dilate in response to an increased pressure load. Another possible sympathetically mediated mechanism may be through decreases in renal blood flow because of renal vascular vasconstriction. Note that statistical controls for pulse rate did not alter our results.

Our study has several limitations. First, there are very few incident cases of hypertension among whites so we could not test separate models for whites. Second, not all SES trajectories were measured at the same point in the study so direct comparisons among the indices could not be made. Third, we did not statistically control for physical activity. However, physical inactivity was not a consistent predictor of 10-year elevated blood pressure in this sample.

On the other hand, our study has a number of strengths. First, the nature of the sample, young adults, including a substantial number of blacks, was well suited to our study objective to test the utility of the concept of socioeconomic trajectories. Second, the design of CARDIA allowed for the prospective assessment of SES status. Most previous epidemiological studies have had to rely on concurrent or retrospective recall. Third, the population-based sample supports the generalization of the findings to other similar age- and SES-groups.

In conclusion, the present study suggests that cumulative economic difficulties are associated with incident hypertension. It argues for the importance of measuring socioeconomic trajectories, especially in populations like young adults or minority groups where a single static measurement of SES is not likely to represent the future SES trajectory. Economic policies that reduce cumulative disadvantage may not only improve quality of life but may also reduce the national health burden associated with hypertension.

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References
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