Life-Course Perspective on Socioeconomic Differences in Carotid Atherosclerosis

Maria Rosvall, Per-Olof Östergren, Bo Hedblad, Sven-Olof Isacsson, Lars Janzon, Göran Berglund

Objective—Socioeconomic status (SES) in adulthood is known to be related to carotid atherosclerosis. However, few studies have tried to assess its association with SES from a life-course perspective.

Methods and Results—We examined the relationship between SES in childhood and in adulthood and carotid atherosclerosis in a general population of Swedish men and women. Carotid stenosis was determined by B-mode ultrasound. Results showed that women whose fathers’ occupations involved unskilled manual labor had higher odds of carotid stenosis than did women whose fathers’ occupations involved high- or medium-level nonmanual labor, even after adjustment for adult occupational status and risk factors (odds ratio 1.8, 95% CI 1.1 to 2.8). No such association appeared in men. Furthermore, the impact of life-course SES on atherosclerosis was examined by using an additive measure of one’s combined SES during childhood and adulthood. Among women, the odds of carotid stenosis increased with a rise in exposure to low SES during the life-course (P for trend <0.001). In men, no such trend was found.

Conclusions—The results indicate that the total life-course exposure to low SES, with contributions from childhood and adulthood, seems to play a role in atherogenesis in women. Such a pattern of association could not be shown in men. (Arterioscler Thromb Vasc Biol. 2002;22:1704-1711.)

Key Words: atherosclerosis ■ carotid arteries ■ life-course ■ socioeconomic status

To enhance our understanding of the social patterning of certain causes of mortality among the adult population of today, it may be of value to consider the role of socioeconomic factors not only in adulthood but across the full life course. The effect of living conditions during a person’s formative years, changing gender roles in society, and the varying social distribution of lifestyle factors are all examples of exposures that need to be taken into account to broaden our understanding of disease etiology.1 The importance of the early childhood socioeconomic environment in the development of coronary heart disease later in life has been the subject of prior studies,2–11 not all of which have taken adult socioeconomic circumstances into consideration. A biological association between the environment of one’s early years and morbidity in adulthood has been proposed.2 Impairment of an infant’s growth and development during the prenatal and early postnatal period is thought to program the functioning of organ systems and lead to a higher risk of cardiovascular disease (CVD) with increasing age.2 Another explanation involves the hypothesis that risk exposure related to socioeconomic status (SES) accumulates over the course of one’s life and contributes to the development of chronic disease in adulthood.1

Because atherosclerosis is a lifelong process, we wished to examine the impact of SES on atherosclerosis from a life-course perspective. Technical advances in ultrasound scanning has made it possible to observe the process of atherogenesis noninvasively at different vascular beds in general populations.12,13 Carotid atherosclerosis assessed by ultrasound has been found to reflect general atherosclerosis and, especially, the extent and severity of coronary atherosclerosis,14 and it has also been found to predict the future occurrence of coronary events.15,16

Carotid atherosclerosis has been shown to have an inverse relationship with adult SES in cross-sectional and prospective studies.17–20 So far, only 1 study (Lamont et al21) has examined the effect of SES during childhood on the atherosclerotic process. In that study, there were limited effects of childhood SES on atherosclerosis, measured as carotid intima-media thickness (IMT). The overall purpose of the present study was to examine the impact of low SES over the course of one’s life on carotid atherosclerosis, ie, to determine whether socioeconomic conditions in childhood as well as in adulthood are related to adult carotid atherosclerosis, as measured by carotid stenosis.

Methods

Subjects
The subjects in the present study constituted a subcohort of the large population-based Malmö Diet and Cancer Study (MDCS).22 A...
random 50% of those born between 1926 and 1945 who entered the MDCS from October 1991 to February 1994 were invited to take part in a study on the epidemiology of carotid artery disease. We included those individuals who accepted the invitation to join the carotid artery disease study and who had completed a self-administered questionnaire (including questions on social and psychosocial factors) that was completed as part of baseline examination (n=4884). Fastig blood samples were taken under standardized conditions. Because of incomplete laboratory test results or because of an excessive time lag between their ultrasound, baseline, and laboratory examinations, 480 potential subjects were excluded. Homemakers (n=116) were also excluded from the analyses. Occupational data proved unavailable for 80 individuals because of missing information. The remaining 4208 subjects (2382 women and 1826 men), aged 46 to 68 years, all of whom lived in the vicinity of Malmö, Sweden, constituted our study population.

Measures of SES
Data on occupation were obtained from the self-administered questionnaire that was proffered at baseline examination. It yielded information on the primary occupation of the subject’s father as well as the subject’s present occupation. Those who were unemployed or who had retired at the time of the baseline examination were coded according to their most recent occupation. Self-employed persons (owners of businesses and those whose fathers had owned a business) and farmers and those whose fathers were farmers were analyzed as separate categories. Occupational status among those currently employed, assessed by answers to questions concerning job titles and work tasks, formed the basis for classification into socioeconomic index (SEI) groups, according to the criteria of Statistics Sweden. Statistics Sweden has used these criteria for national demographic statistics publications over the course of almost 2 decades. SEI classifications take into consideration the educational background needed to qualify for a particular job, additional employment prerequisites, job responsibility levels, and specific duties to be performed. The SEI groups were then combined into 5 SES categories: high-level nonmanual employees, medium-level nonmanual employees, low-level nonmanual employees, skilled manual workers, and unskilled manual workers. Because of the relatively few high-level nonmanual employees in our cohort, the first 2 categories were combined.

The main occupations (for at least 40% of the subjects) in the 4 occupational status categories based on the subject’s own occupation were as follows: high- to medium-level nonmanual employment (engineers with university degrees, teachers, high-level administrative employees, and registered nurses), low-level nonmanual employment (secretaries, office assistants, and salespeople), skilled manual labor (construction workers, metal workers, engineering workers, assistant nurses, and children’s nurses), and unskilled manual labor (janitorial staff, salesclerks, home helpers, nurses’ assistants, and stockroom workers). Likewise, the main occupations in the 4 different occupational status groups based on the father’s occupation were as follows: high-medium nonmanual employment (engineers with university degrees, teachers, high-level administrative stuff, editors or journalists, and clergymen), low-level nonmanual employment (secretaries, salespeople, caretakers, railway employees, policemen, and service men), skilled manual labor (construction workers, metal workers, painters, bricklayers, and blacksmiths), and unskilled manual labor (farm workers, factory workers, truck or tram drivers, stockroom workers, and railway workers).

A cumulative measure of SES during childhood and adulthood was taken by means of a total SES life-course (SES-LC) score ranging from 2 to 8, a combination of the father’s and the subject’s occupational status scores: high- or medium-level nonmanual employees were given 1 point; low-level nonmanual employees, 2 points; skilled manual workers, 3 points; and unskilled manual workers, 4 points.

Atherosclerotic Risk Factors
Risk factors were estimated on the basis of laboratory tests, baseline examinations, and a baseline questionnaire. Prior studies have collected information on smoking habits, alcohol consumption, physical activity, diabetes mellitus, blood pressure levels, LDL cholesterol, HDL cholesterol, and body mass index (BMI). Subjects were considered to have CVD if they confirmed treatment or hospitalization for myocardial infarction, stroke, and/or intermittent claudication in the questionnaire. According to this definition, men had a prevalence of CVD of 7.5% (n=137), and women had a prevalence of 3.1% (n=73).

Carotid Stenosis
Carotid atherosclerosis was assessed by B-mode ultrasound. All ultrasound examinations were performed by certified sonographers. The examination procedure has been described in detail elsewhere. IMT in the bifurcation area was determined offline as the maximum wall thickness. The bifurcation area of the right common carotid artery was further scanned for plaque within a predefined window composed of 3 cm of the distal common carotid artery, the bulb, and 1 cm of the internal and external carotid arteries. The degree of stenosis was judged by online visual estimation of the plaque to determine the extent to which plaque protruded into the lumen. At regular intervals during the ultrasound investigation procedure, intraobserver and interobserver variation analyses were performed. The mean absolute difference in percentage with 1 observer measuring carotid IMT in the bifurcation area was 13.5±12.4% (r=0.90), and it was 14.9±13.1% (r=0.87) when 2 observers were used. Corresponding values for the measurements of carotid stenosis assessed by Kendall τ rank correlation were as follows: τ=0.65 and τ=0.72, respectively.

The carotid artery was categorized as exhibiting either normal/minimal stenosis (<15% reduction of the lumen diameter) or moderate to severe stenosis (≥15% reduction of the lumen diameter; n=963, 24.6% [21.2% for women and 29.1% for men]). In the present study, the latter category is considered carotid stenosis.

Statistical Methods
Differences in continuous risk factor variables by father’s occupation and by own occupation were analyzed by multiple linear regression models (SPSS, version 10.0). Odds ratios (ORs) for the prevalence of carotid stenosis were estimated through logistic regression models. Adjustment for covariates proceeded in 2 steps: First, only age was included in the model. Second, atherosclerotic risk factors (smoking, alcohol consumption, physical activity, diabetes mellitus, systolic blood pressure levels, LDL cholesterol, HDL cholesterol, and BMI) were also included. Linear trends in ORs of carotid stenosis by SES-LC score were investigated by including this measure as an ordinal covariate in the logistic regression model. The interaction of the father’s occupational status with the sex of the individual was investigated by including interaction terms in the regression equations and comparing models by using likelihood ratio tests (for logistic models).

Results
Atherosclerotic Risk Factors
Table 1 shows the age-adjusted means and prevalences (percentages) of atherosclerotic risk factors across categories representing the occupation of one’s father and one’s own occupation. Some of the risk factor levels analyzed were found to vary with the occupation of an individual’s father. Women whose fathers’ occupations involved unskilled manual employment showed more unfavorable levels of BMI, HDL, and systolic blood pressure and a lower alcohol consumption than did women whose fathers’ occupations involved high- or medium-level nonmanual employment. Among men, such patterns of linkage could not be found.
Men whose fathers were farmers were less often physically active during leisure time, whereas the same group in women showed a relatively low alcohol consumption and a high systolic blood pressure. Risk factor levels tended to show a graded relationship with one’s own occupation, so that individuals in lower SES groups had a more unfavorable risk factor pattern compared with individuals in higher SES groups.

Among men, HDL, LDL, systolic blood pressure, and smoking habits were significantly associated with carotid stenosis, even after adjustment for other atherosclerotic risk factors (data not shown). Among women, the same pattern was found for LDL, systolic blood pressure, smoking habits, and low physical activity. These patterns of associations were not changed after adjustment for fathers’ occupations, except for the association between low physical activity and carotid stenosis, found in women, which turned statistically nonsignificant.

### Height

In men and women, the occupational status of the father showed an association with adult height (Table 1). Subjects whose fathers had been manual laborers tended to be shorter than those whose fathers held medium- or high-level non-

#### Table 1. Age-Adjusted Means and Prevalences (%) of Carotid Stenosis and Atherosclerotic Risk Factors by Father’s Occupation and by Own Occupation

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Age, y</th>
<th>Height, cm</th>
<th>Carotid Stenosis, %</th>
<th>BMI, kg/m²</th>
<th>LDL, mmol/L</th>
<th>HDL, mmol/L</th>
<th>Systolic BP, mm Hg</th>
<th>Diabetes, %</th>
<th>Current Smokers, %</th>
<th>Low Physical Activity, %</th>
<th>Alcohol Consumption, g/wk</th>
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</table>

*Five occupational status groups used by Statistics Sweden: High-level nonmanual employees, (eg, engineers with a university degree, high-level administrative employees, and physicians); medium-level nonmanual, (eg, registered nurses, teachers, and physiotherapists); Low-level nonmanual, (eg, office assistants, salespeople, and secretaries); skilled manual workers, (eg, construction workers, metal workers, and assistant nurses); and unskilled manual workers, (eg, janitorial staff, salesclerks, and factory workers).

†The category of self-employed includes both big company employers as well as small shopkeepers.

‡The values for farmers could not be analyzed due to too few subjects in this group.

§Significantly different from the category high/medium-level nonmanual at P<0.05.

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TABLE 2. Adjusted ORs of Carotid Stenosis by Father’s Occupational Status Stratified by Subject’s Own Occupational Status Among Swedish Men and Women

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<th>Father’s Occupational Status*</th>
<th>Subject’s Occupational Status*</th>
<th>OR 95% CI</th>
<th>OR 95% CI</th>
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<td>High/medium non-manual (n=297)</td>
<td>High/medium non-manual (n=65)</td>
<td>1.0†</td>
<td>–</td>
<td>1.1 (0.6, 2.0)</td>
<td>0.8 (0.5, 1.4)</td>
<td>0.6 (0.4, 1.1)</td>
<td>1.2 (0.4, 3.3)</td>
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<td>0.8 (0.5, 1.4)</td>
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<td>Low non-manual (n=220)</td>
<td>Low non-manual (n=111)</td>
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<td>1.2 (0.6, 2.4)</td>
<td>0.8 (0.4, 1.3)</td>
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<td>Skilled manual (n=348)</td>
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<td>1.4 (0.7, 2.6)</td>
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<tr>
<td>Unskilled manual (n=428)</td>
<td>Unskilled manual (n=522)</td>
<td>1.0†</td>
<td>–</td>
<td>1.7 (0.9, 3.4)</td>
<td>1.3 (0.7, 2.4)</td>
<td>2.0 (1.2, 3.7)</td>
<td>2.0 (0.8, 4.9)</td>
<td>2.6 (1.2, 5.5)</td>
<td>2.5 (1.4, 4.5)</td>
<td>2.7 (1.5, 4.7)</td>
<td></td>
</tr>
</tbody>
</table>

Men

Adjusted for age

Adjusted for age plus risk factors‡

Women

Adjusted for age

Adjusted for age plus risk factors‡

*Five occupational status groups used by Statistics Sweden: High-level nonmanual employees, (eg, engineers with a university degree, high-level administrative employees, and physicians); medium-level nonmanual, (eg, registered nurses, teachers, and physiotherapists); Low-level nonmanual, (eg, office assistants, salespeople, and secretaries); skilled manual workers, (eg, construction workers, metal workers, and assistant nurses); and unskilled manual workers, (eg, janitorial staff, salesclerks, and factory workers).

†Reference category.

‡Adjustment for smoking, alcohol consumption, physical activity, systolic blood pressure, prevalent diabetes, BMI, LDL cholesterol, and HDL cholesterol. Smoking, alcohol consumption, physical activity and presence of diabetes were included as categorical variables. All remaining variables were adjusted for as continuous variables.

Social Mobility

Among men in high- or medium-level nonmanual occupations, 42% reported having fathers who held manual occupations, whereas 61% of men in unskilled manual occupations reported fathers having manual occupations (data not shown). Among women, the corresponding percentages were 29% and 57%, respectively. Approximately one third of all men and women in the study population were socially stable. Downward social mobility was less common in men than in women (14% and 27%, respectively). The proportion of self-employed women was less than half (6%) of that seen in men (16%), whereas approximately one fifth of the men and women reported having fathers who were self-employed. Only 10 individuals (0.2%) were farmers, whereas 12% of men and women reported that their fathers were farmers.

Carotid Stenosis

Table 2 shows the age-adjusted and risk factor–adjusted relative odds of carotid stenosis for different socioeconomic life courses for men and women. Subjects were divided into 8 groups according to the occupational status of their fathers and their own occupational status. Nonmanual employees whose fathers held high- or medium-level nonmanual jobs were used as the reference group. Among women, those with manual compared with nonmanual jobs tended to have higher odds of carotid stenosis, irrespective of the occupational status of their fathers. Furthermore, the occupational status of the father showed an inverse association with carotid stenosis among women whose own occupation was nonmanual and also among women who did manual work. No such clear patterns could be observed in men. Women in manual occupations whose fathers’ occupations were high-medium nonmanual or low-level nonmanual showed increased odds of carotid stenosis (OR =1.7 [95% CI 0.7 to 4.0] and OR =2.5 [95% CI 1.3 to 5.0], respectively). Similarly, women in nonmanual occupations whose fathers’ occupations were skilled manual or unskilled manual also showed increased odds of carotid stenosis (OR =1.2 [95% CI 0.7 to 2.1] and OR =1.9 [95% CI 1.1 to 3.3], respectively). Being exposed to low SES in early life and also in later life was associated with a 2-fold increased odds of carotid stenosis. Adjustment for atherosclerotic risk factors did not change the magnitude of the association found in women.

Table 3 shows the results of the age-adjusted and risk factor–adjusted logistic regression analysis of carotid stenosis on the occupation of one’s father and one’s own occupation when included simultaneously in the regression model. Among women, the age-adjusted carotid stenosis prevalence odds were statistically significantly higher for those in unskilled manual occupations than for those in high- or medium-level nonmanual occupations for both their father’s occupational status (OR =1.7, 95% CI 1.1 to 2.6) and their own occupational status (OR =1.6, 95% CI 1.2 to 2.2). Such a pattern of linkage could be discerned only for the association with adult occupational status in men (OR =1.3, 95% CI 0.9 to 1.7). Adjustment for atherosclerotic risk factors did not change the magnitude of the association with the father’s
occupation found in women, whereas the association with the subject’s own occupation was attenuated and turned statistically nonsignificant (OR = 1.4, 95% CI 1.0 to 2.0).

The age-adjusted logistic regression analysis of carotid stenosis on the occupation of one’s father and one’s own occupation (when included simultaneously in the regression model) in a subgroup that excluded 210 men and women with prevalent CVD showed patterns of associations similar to those observed in the whole study population in men and women (data not shown).

We then examined the cumulative effect of SES during childhood and adulthood on carotid atherosclerosis by the use of the total additive SES-LC score. This score ranges from 2 to 8, where high- or medium-level nonmanual employees were given 1 point; low-level nonmanual employees were given 2 points; skilled manual workers were given 3 points; and unskilled manual workers were given 4 points. As shown in the Figure, there was a clear trend in women, with the odds of carotid stenosis rising with an increasing SES-LC score (P for trend < 0.001). Compared with women in high- or medium-level nonmanual occupations whose fathers held high- or medium-level nonmanual occupations (reference group), women with scores of 3, 4, 5, 6, 7, and 8 had the following carotid stenosis prevalence odds: 0.9 (95% CI 0.4 to 1.9), 1.3 (95% CI 0.6 to 2.7), 1.5 (95% CI 0.8 to 2.9), 2.1 (95% CI 1.1 to 4.0), 2.2 (95% CI 1.1 to 4.3), and 2.5 (95% CI 1.3 to 4.8), respectively. For men, no clear pattern could be seen between the SES-LC score and carotid stenosis prevalence odds (P for trend = 0.59).

The result of the test of interaction between the sex of the individual and the father’s occupational status in the analyses of carotid stenosis was statistically significant (test of multiplicative interaction, P < 0.05).

**Discussion**

A large body of evidence indicates that atherosclerosis begins in childhood. It is known that fatty streaks can appear in

<table>
<thead>
<tr>
<th>Father’s occupation</th>
<th>OR (Men)</th>
<th>95% CI</th>
<th>OR (Women)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>High/medium nonmanual employee*</td>
<td>1.0</td>
<td>— §</td>
<td>1.0</td>
<td>— §</td>
</tr>
<tr>
<td>Low nonmanual employee*</td>
<td>0.9</td>
<td>0.5, 1.5</td>
<td>1.4</td>
<td>0.9, 2.3</td>
</tr>
<tr>
<td>Skilled manual worker*</td>
<td>0.9</td>
<td>0.6, 1.3</td>
<td>1.2</td>
<td>0.8, 1.9</td>
</tr>
<tr>
<td>Unskilled manual worker*</td>
<td>0.7</td>
<td>0.5, 1.1</td>
<td>1.7</td>
<td>1.1, 2.6</td>
</tr>
<tr>
<td>Self-employed†</td>
<td>0.8</td>
<td>0.5, 1.2</td>
<td>1.4</td>
<td>0.9, 2.1</td>
</tr>
<tr>
<td>Farmer</td>
<td>0.9</td>
<td>0.6, 1.5</td>
<td>1.0</td>
<td>0.6, 1.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Own occupation</th>
<th>OR (Men)</th>
<th>95% CI</th>
<th>OR (Women)</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>High/medium nonmanual employee</td>
<td>1.0</td>
<td>— §</td>
<td>1.0</td>
<td>— §</td>
</tr>
<tr>
<td>Low nonmanual employee</td>
<td>1.1</td>
<td>0.8, 1.6</td>
<td>1.2</td>
<td>0.9, 1.7</td>
</tr>
<tr>
<td>Skilled manual worker</td>
<td>1.1</td>
<td>0.8, 1.6</td>
<td>1.3</td>
<td>0.8, 2.2</td>
</tr>
<tr>
<td>Unskilled manual worker</td>
<td>1.3</td>
<td>0.9, 1.7</td>
<td>1.6</td>
<td>1.2, 2.2</td>
</tr>
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<td>Self-employed</td>
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<td>1.1</td>
<td>0.6, 1.8</td>
</tr>
<tr>
<td>Farmer</td>
<td>†</td>
<td>†</td>
<td>†</td>
<td>†</td>
</tr>
</tbody>
</table>

*Five occupational status groups used by Statistics Sweden: High-level nonmanual employees, (eg, engineers with a university degree, high-level administrative employees, and physicians); medium-level nonmanual, (eg, registered nurses, teachers, and physiotherapists); low-level nonmanual, (eg, office assistants, salespeople, and secretaries); skilled manual workers, (eg, construction workers, metal workers, and assistant nurses); and unskilled manual workers, (eg, janitorial staff, salesclerks, and factory workers).
† The category of self-employed includes both big company employers as well as small shopkeepers.
‡ For adult occupation the odds ratio of farmers could not be analyzed due to too few subjects in this group, n = 9.
§Reference category.

*Five occupational status groups used by Statistics Sweden: High-level nonmanual employees, (eg, engineers with a university degree, high-level administrative employees, and physicians); medium-level nonmanual, (eg, registered nurses, teachers, and physiotherapy) low-level nonmanual, (eg, office assistants, salespeople, and secretaries); skilled manual workers, (eg, construction workers, metal workers, and assistant nurses); and unskilled manual workers, (eg, janitorial staff, salesclerks, and factory workers).
major arteries in the first and second decades of life. This is a process that may be influenced by living under adverse socioeconomic conditions during those years. Our findings indicate that the atherosclerotic process is affected by low SES in childhood and that this influence is independent of adult SES and atherosclerotic risk factors, although, surprisingly, this could be demonstrated only in women. Moreover, atherogenesis also seems conditioned by the totality of life-course exposure to low SES in women. Thus, these findings are partly consistent with the theory of a cumulative effect of low SES over the life of an individual.

Retrospective data on childhood socioeconomic position based on the occupational status of one's father have been shown to be reliable. The occupational status of the father is thought to serve as a marker of environmental circumstances in childhood, validated by its association with adult height and childhood material circumstances. Although some degree of recall error cannot be ruled out when a retrospective measure is used, it would, if anything, most likely be of a nonsystematic nature, thus attenuating the true association between low childhood SES and outcome. Regarding the socioeconomic classification in adulthood, we used the participants' own occupations as the basis for the classification. An alternative socioeconomic categorization for women would be the household socioeconomic group. Such data were not available in the present study. However, a Swedish study on socioeconomic differences in myocardial infarction risk in Sweden did compare the use of the husband's occupation and the use of a woman's own occupation as the basis for the socioeconomic classification, and the results showed similar incidence trends for the 2 measures. Moreover, misclassification of adult SES would be expected to be nondifferential and would thus lead to an underestimation of an effect on carotid atherosclerosis in men and in women.

The investigation of carotid atherosclerosis in relation to adult SES has often led to the exclusion of individuals with known CVD, because having this disease might affect the adult socioeconomic position of the individual. When childhood SES is the focus, however, excluding this group might weaken any association between childhood SES and carotid atherosclerosis. To investigate whether there was an association between SES in childhood and in adulthood, respectively, and carotid atherosclerosis, even in a healthy subsample, we excluded those individuals who in the baseline questionnaire confirmed treatment or hospitalization for myocardial infarction, stroke, and/or intermittent claudication. However, this exclusion did not lead to any major changes in the initial associations.

Carotid atherosclerosis assessed by ultrasound has been found to predict the future occurrence of coronary events. It has been shown that the presence of carotid IMT is associated with an increased risk of myocardial infarction in men and in women. Moreover, the presence of small or large plaques in the carotid bifurcation area has been shown to be associated with incident CVD in men; the same is true of studies that include women (but not specifically separating women). In our study, reproducibility of the ultrasound method was monitored at regular intervals during the investigation and found to be reasonably good. Because we analyzed a relatively young cohort (with more than half of the population being women, who are known to have lower degrees of carotid atherosclerosis compared with that seen in men of the same age) and because it is known that atherosclerosis in the carotid artery tends to be present first at the bifurcation area, we chose to use an outcome measure of atherosclerosis located in the bifurcation area.

Among women, there were independent effects of childhood and adult SES on carotid atherosclerosis, with the effect of childhood SES being found to be equal to that seen for adult SES. In earlier studies, the observation of an association between the childhood environment and adult cardiovascular morbidity and mortality has been criticized for having been inadequately adjusted for adult SES, thereby leading to an overestimation of the effect of low SES in childhood. The present study, the classification of adult SES was based on information concerning an individual's most recent occupation. The range of occupations was generally more narrow in women than in men; eg, in the high-medium nonmanual occupational status group, 54 different occupations were reported for women, whereas 84 different occupations were reported for men. Even though there were relatively more women than men in unskilled manual occupations, the range of occupations was somewhat more narrow in women (58 occupational groups) than in men (60 occupational groups). The mean time in the latest occupation was 24 years for men and 19 years for women, suggesting that this measure was rather stable over time. Occupational status in adulthood has previously been shown to be associated with carotid stenosis and atherosclerotic risk factors.

Earlier attempts to investigate the impact of SES on CVD during various periods of life have yielded conflicting results. Several studies have found an association between childhood SES and cardiovascular morbidity and mortality, independent of adult SES. However, a recent British study showed only limited effects of childhood SES on atherosclerosis, measured as carotid IMT. In another study from Finland, Lynch et al reported that socially mobile men exhibited the same cardiovascular mortality risk as the class they joined, suggesting a minor importance of childhood SES in predicting adult cardiovascular mortality. In the present study, there was an inverse effect of childhood SES on carotid stenosis among women whose own occupations were nonmanual and among those whose occupations were manual. There were no evident signs of any synergistic effect between childhood and adulthood low socioeconomic position, inasmuch as those being exposed to low SES during both childhood and adulthood showed some impact, but not as much as those being exposed to low SES from each period of time. This pattern of linkage was further illustrated by the use of a cumulative measure of SES in childhood and adulthood. In focusing on the hypothesis of a cumulative effect of the social environment over the life of an individual, we wanted to investigate the impact of lifetime socioeconomic exposure on atherosclerosis. Because atherosclerosis is a lifelong process, we believe that compared with analyses concentrating on the effects of SES during only 1 period of life, such a procedure
gives a fuller picture of the influence of social circumstances on atherosclerosis. A second reason for using a cumulative measure was to avoid the difficulty of having to determine which effects stem from living conditions experienced during childhood and which effects stem from those experienced during adulthood. Our findings indicate that lifetime exposure to low SES, with contributions from both childhood and adulthood, plays a role in the disease process among women. Among men, however, no clear pattern could be discerned between SES-LC score and carotid stenosis.

**Childhood SES and Atherogenesis**

In terms of plausible sociobiological mechanisms, the effect of low childhood SES on atherogenesis could be due to socioeconomically differentiated factors such as nutritional factors and exercise, which all might affect early atherosclerosis. It could also be the result of an influence of early socioeconomic environment through the shaping of individual characteristics, role models, and behaviors. Several studies have shown the importance of parents, siblings, and peers in an individual’s early decision to smoke, to drink, and also to participate in physically active leisure activities. However, these behaviors might be discontinued in later adulthood because of educational influences, for example. In a cohort of British men, Wannamethee et al. found that adverse adult lifestyle behaviors (with the exception of obesity) were predominantly influenced by adult SES. Similar findings were made in a Scottish study, in which behavioral risk factors were found to be more strongly associated with adult socioeconomic position, whereas physiological risk factors were associated with SES in both childhood and adulthood. In the present study, there were limited overall risk factors were associated with SES in both childhood and adulthood. Our findings indicate that among women, the atherosclerotic process is not necessarily be interpreted as if there is no association between SES at birth and the extent of atherosclerosis in women. Some of the explanation of our findings may be related to selection bias. Persons with more pronounced carotid atherosclerosis associated with low SES might have been too ill or might have died from CVD before they could participate in the baseline investigation, making the participants of low SES generally more healthy than the general population. One might expect such a selective effect to be more pronounced among men, because relatively more men than women die from CVD in these age groups. Another potential explanation of our findings might be referred to the socioeconomically reversed pattern of smoking seen from the 1940s through the 1960s in the Western world, including Sweden. If men of high SES had smoked during their youth to a larger extent than women of high SES, this might act to reduce the socioeconomic differences in carotid atherosclerosis based on childhood SES in men. Swedish studies have shown that even though the absolute levels of CVD for women are lower than they are for men (resulting in higher relative risks, given the same absolute SES gradient), research has pointed to a less marked decrease in the incidence of and mortality from ischemic heart disease among female manual workers compared with that seen in male manual workers. Thus, low SES is increasingly associated with bad health in men and in women, but especially among women.

**Study Conclusions**

The results of our investigation suggest that a life-course perspective might increase our understanding of the social causes of the atherosclerotic disease process. Our findings indicate that among women, the atherosclerotic process is affected by low SES in childhood and that this influence is independent of adult SES and atherosclerotic risk factors. Such a pattern of association could not be demonstrated in men.

**Acknowledgments**

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Life-Course Perspective on Socioeconomic Differences in Carotid Atherosclerosis
Maria Rosvall, Per-Olof Östergren, Bo Hedblad, Sven-Olof Isacsson, Lars Janzon and Göran Berglund

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