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Socioeconomic mobility in adulthood and cardiovascular disease mortality

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ABSTRACT

Purpose: Life course models suggest that socioeconomic mobility is associated with decreased cardiovascular disease (CVD) mortality risk. We examined adult socioeconomic mobility measured by household income in relation to CVD mortality risk among older adults.

Methods: Data from 2691 ($n_{men} = 1157$; $n_{women} = 1534$) Alameda County Study respondents in 1994 were used in these analyses. Latent growth curve models were used to identify income patterns from 1965 to 1994.

Results: Income patterns were categorized as consistently low, moderately low, increasing, and high. Bivariate models showed that membership in the increasing compared with high pattern was associated with decreased hazards of CVD mortality (hazard ratio, 0.15; 95% confidence interval [CI], 0.04–0.53). Controlling for age, race/ethnicity, marital status, and gender, respondents in the consistently low (HR, 2.1; 95% CI, 1.5–3.1) and high pattern (HR, 2.2; 95% CI, 1.1–4.2) had increased hazards of CVD mortality than those in the moderately low income group.

Conclusions: Patterns of association were consistent with social mobility models of socioeconomic position, indicating lower CVD mortality risk for those with increasing or higher incomes. Future work should continue to investigate measures that capture the variation in social mobility over the life course, and how these patterns shape chronic disease risk in later life.

Introduction

Life course research has shown that lower socioeconomic position (SEP) during childhood, adulthood, and older age is associated with greater risk of cardiovascular disease (CVD) [1,2]. The accumulation model of disease risk over the life course is often cited as a potential explanation for the relation between SEP over the life course and CVD mortality risk [3,4]. Long-term exposure to low SEP, often captured by parental measures [5], education [6], and income [1], is associated with increased risk of poor adult health, including CVD mortality risk [1,7]. Social mobility models suggest that variability in SEP or patterns of SEP exposure in addition to absolute measures of SEP are associated with variations in disease risk [8–11]. This area of research commonly examines SEP changes or cumulative effects across childhood to adulthood [1,8], rather than variations throughout adulthood specifically.

Research on social mobility over the adult life course has examined multiple health outcomes, including general health [12], mortality [13], psychological [14], behavioral [15], and cardiovascular-related outcomes [4,16], and suggests positive outcomes [12,14] for upwardly mobile groups. All but two of these studies have used measures of change in income over time [12–14,16] to reflect some aspect of SEP variation over time. Only two of these studies captured patterns of income over time [4,15], but neither study examined CVD mortality. Although findings from these studies suggest that upward mobility is associated with decreased CVD mortality risk, no studies of which we are aware have examined social mobility measured by income specifically over the adult life course in relation to CVD mortality risk.

We examined associations between social mobility measured by income patterns over the adult life course and CVD mortality risk among a population-based cohort of older adults who participated in the Alameda County Study from 1965 to 1994. Our work contributes to the limited body of empirical evidence examining the social mobility model based on patterning and variability of SEP over the adult life course in relation to CVD mortality risk.

Methods

Study population

The Alameda County Study was initiated in 1965 and was designed to collect socio-environmental, behavioral, and health

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data from men and women aged 20 and older or 16 and older if married in Alameda County, California [17–19]. A two-stage, stratified systematic sample was used to gather data on 8023 noninstitutionalized adults from 4452 household units [17]. This study protocol was approved by the University of Michigan Institutional Review Board. The respondents to the baseline survey ($n = 6928$) represented 86% of those sampled. Multiple waves of follow-up were completed in 1974 (85.1% response), 1983 (87.3% response among a 50% sample of those not known to be dead in 1982), and 1994 ($n = 2729$; 93% response rate of respondents from 1974 and 1983). Our sample includes respondents without missing data for age in 1994, race/ethnicity, and marital status ($n = 2691$).

CVD mortality ascertainment

Cause-specific mortality data were collected from state death certificate data as well as gathered using cross-linkage methods with the National Death Index. Deaths of Alameda County Study participants were ascertained through December 31, 2000. All deaths attributable to diseases of the circulatory system (International Classification of Diseases-9 codes 390–459) were included for purposes of this study.

Household income

At each wave of data collection gross household income from all sources for the previous year was reported in categories. Household income in 1965 was categorized into 4 categories, 14 in 1974, 19 in 1983, and 14 in 1994 and 1999. Using demographic data common to both the Alameda County Study and Current Population Surveys [20] of the same year, continuous measures of household income were imputed using IVEware [21] and bounded by the income categories provided by the respondents in the survey [22]. The common data used from the Alameda County Study and Current Population Surveys based on national data to carry out the imputation included age, education, gender, race, marital status, occupation, and number of household members. The Current Population Surveys, conducted monthly by the Census Bureau for the Bureau of Labor Statistics, provides the best national data on income [20]. These continuous measures were constructed to reduce misclassification owing to fluctuations in the income categories throughout the waves and the widths of the income categories, and the utility of this approach has been discussed elsewhere [23]. All respondents were required to have at least three waves of data for household income, and all income measures from each wave were adjusted for household size [24] and to 1993 dollars using the Consumer Price Index.

Covariates

Additional demographic covariates included in the analyses were age (years, <65 vs ≥ 65), race/ethnicity (white, black, other), marital status (married or not married), and gender. All covariate measures reflect data reported in 1994.

Statistical analyses

Trajectories reflect patterns of household income, in 1993 dollars, from 1965, 1974, 1983, and 1994. Income trajectories were created using a group-based trajectory modeling approach within the PROC TRAJ procedure in SAS System V 9.2 (SAS Institute, Cary, NC) [25]. This approach assumes the population is composed of a mixture of underlying trajectory groups. The groups were created based on a parametric model of the household income data and linkage between time and household income. Using a latent variable approach, the method uses polynomial functions of time to estimate the likelihood of an individual having a specific household income [26].

Models with two to six trajectory groups, each with the same polynomial order, were used to determine the appropriate number of trajectory groups. Two to six groups allowed for multiple subgroups to emerge. Among these models, the model with the most negative Bayesian Information Criterion (BIC), which was provided by PROC TRAJ, was selected as the final model [25]. Patterns of the trajectories were determined based on the highest polynomial order that remained significant for each trajectory over time [25]. For each individual, the procedure calculated the posterior probability of membership in each trajectory group, and individuals were assigned to the trajectory for which they had the highest probability. All probabilities were greater than 90%. The resulting classification variable was included as an explanatory variable in the analyses. Although the probability of membership for the respective trajectory classes were greater than 90%, the variability of any individual from the modal values of the trajectories was unaccounted for in the regression models.

Observation time for deaths from CVD was calculated from the date of completion of the survey in 1994, or June 1, 1994, for those with missing data for the date of questionnaire completion until the date of death or the end of follow-up for deaths (December 31, 2000).

Descriptive statistics were calculated for each measure. Proportional hazards regression models using PROC PHREG in SAS were used to examine the associations. Validity of the proportional hazards assumptions was assessed through the inclusion of interaction terms between time and each variable in the models.

Results

There were 2729 men and women in 1994 who had at least three waves of data, and 2691 (98.6%; 1157 men and 1534 women) of these persons provided information on gender, age, race/ethnicity, marital status, and household income. Descriptive information is displayed in Table 1.

Income trajectory patterns

The model with six household income trajectories had the smallest BIC than the five or fewer trajectory models. Membership percentages across these six trajectories were 1.6%, 2.6%, 12.2%, 66.0%, 11.0%, and 6.6% for trajectories with the lowest to highest absolute dollar value in 1965. Owing to the small membership percentages in the lowest two trajectories, these two groups (with proportions 1.6% and 2.6%, respectively) were combined with the trajectory group (12.2%) that shared similarly low income levels across the study period. The resulting four trajectory groups were categorized as consistently low (group 1; $n = 440$, 16.4%; mean age, 67 years; $n_{deaths} = 51$), moderately low (group 2; $n = 1777$, 66.0%; mean age, 64 years; $n_{deaths} = 87$), increasing (group 3; $n = 297$, 11.0%; mean age, 57 years; $n_{deaths} = 3$), and consistently high (group 4; $n = 177$, 6.6%; mean age, 71 years; $n_{deaths} = 11$). The trajectories are shown in Figure. 1, with mean age and income values reported.

Proportional hazards model results

No violations of the proportional hazards were detected across the models. The bivariate model (Table 2, model 1) of household income trajectory groups and CVD mortality showed that those in the consistently low trajectory had increased hazards of CVD mortality (hazard ratio [HR], 1.91; 95% confidence interval [CI], 1.00–3.67), whereas membership in the increasing compared