Household Disposable Income and Long-Term Survival After Cardiac Surgery

A Swedish Nationwide Cohort Study in 100,534 Patients

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ABSTRACT

BACKGROUND Lower socioeconomic groups face higher mortality risk, possibly due to a higher burden of cardio-vascular risk factors. The independent association between income and survival following cardiac surgery is not known.

OBJECTIVES This study sought to investigate the association between household disposable income and long-term mortality after cardiac surgery.

METHODS In a Swedish nationwide population-based analysis, we included all patients who underwent cardiac surgery between 1999 and 2012 using a large national registry. Information regarding income, education, marital status, medical history, and cardiovascular risk factors was obtained from data managed by the National Board of Health and Welfare and Statistics Sweden. The adjusted risk for all-cause mortality was estimated using Cox regression by quintiles of household disposable income.

RESULTS We included 100,534 patients and, during a mean follow-up of 7.3 years, 29,176 (29%) patients died. There was a stepwise inverse association between household disposable income and all-cause mortality: the adjusted hazard ratio was 0.93 (95% confidence interval [CI]: 0.89 to 0.96), 0.87 (95% CI: 0.84 to 0.91), 0.78 (95% CI: 0.75 to 0.82), and 0.71 (95% CI: 0.67 to 0.75), for the second, third, fourth, and fifth income quintiles, respectively, compared to the first (and lowest) income quintile. The inverse association between income and mortality was consistent through the study period and in selected subgroups, although it was slightly attenuated in older patients.

CONCLUSIONS We found a strong inverse association between income and mortality following cardiac surgery in Sweden that was independent of other socioeconomic status variables, comorbidities, and cardiovascular risk profile. Ways to better implement secondary prevention measures should be explored in low-income patient groups. (HeAlth-data Register sTudies of Risk and Outcomes in Cardiac Surgery [HARTROCS]; NCT02276950)

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There is a well-known association between low socioeconomic status (SES) and higher risk for cardiovascular disease (CVD) and all-cause mortality (1–3). It remains uncertain exactly how this association is mediated, although it may partly be explained by the inverse relationship between SES and prevalence of classic cardiovascular risk factors (1); lower socioeconomic groups experience a clustering of multiple risk factors (4).

SES also has been associated with differences in access to and quality of care (1,2,5-7). In countries without universal health care coverage, insurance status highly correlates with SES. Therefore, it is of interest to examine the relationship between SES and mortality in a population with universal tax-financed health care independent of individual SES (8). Despite this, most studies demonstrating an association between SES and mortality have been conducted

in populations without universal tax-financed health care (5,6,9). Furthermore, very few studies have examined the association between SES and mortality in patients undergoing cardiac surgery (4,9–11).

We performed a nationwide population-based cohort study to determine whether SES measured by household disposable income was associated with mortality in all adult patients who underwent cardiac surgery in Sweden during a 14-year period.

METHODS

This was a nationwide population-based observational cohort study that was approved by the regional Human Research Ethics Committee in Stockholm, Sweden.

We identified all patients in the country who underwent cardiac surgery using the SWEDEHEART (Swedish Web-system for Enhancement and Development of Evidence-based care in Heart disease Evaluated According to Recommended Therapies) registry, which records details on patient background and surgical procedures for all patients undergoing cardiac surgery in Sweden since 1992. The registry has proved to have a high validity and completeness (12–14). Using unique personal identity numbers, assigned to all residents (15), information from SWEDEHEART was linked with data from several other nationwide health care registries as previously described (16). The Cause of Death Register was used to ascertain dates and cause of death, the National Patient Register (17) was used to determine previous relevant medical history, and the LISA (Longitudinal integration database for health insurance and labor market studies) database (18), managed by Statistics Sweden, a government agency, was used to obtain details regarding educational level, country of birth, and marital status. Record linkages were performed by the Swedish National Board of Health and Welfare. The International Classification of Diseases codes used for extraction of concurrent important medical conditions are listed in Online Table 1 and codes used for definition of cardiovascular death are listed in Online Table 2. Level of education was categorized as <10 years, 10 to 12 years, and >12 years. Marital status was categorized as married, not married, divorced, and widowed.

HOUSEHOLD DISPOSABLE INCOME. Using the LISA database, we acquired information regarding household disposable income in all patients from 1999 to 2012. The LISA database contains individual- and family-level data regarding demographics, education, employment, and income, including that from salaries and benefits from social welfare. The LISA database is updated annually with new information for the past year. The personal identity number is the unique identifier in the LISA database, making it possible to link individual-level data with other national health care registries. The household disposable income in LISA is calculated as the sum of all taxable and tax-free income minus final tax and other negative transfers. Taxable income consists of total earned income (the sum of income from services and business income) and capital income. Tax-free income consists of housing and child benefit, student aid including student loans, financial aid, and introductory benefits for refugees. Negative transfers consist of repayment of student loans and paid alimony. We calculated the household disposable income as the mean of all yearly household disposable income figures registered for each patient until, and including, the calendar year of surgery.

STATISTICAL ANALYSES. The household disposable income was categorized according to quintiles from lowest to highest income. Each quintile represents 20%, or one-fifth, of all patients. Quintiles of household disposable income were set across all study years. Baseline characteristics were described with frequencies and percentages for categorical variables and mean ± SD for continuous variables, by quintile of income. The primary outcome measure was death from any cause. Person-time in days was counted from the date of surgery until the date of death or the end of follow-up (March 24, 2014). The crude incidence rates and 95% confidence intervals (CIs) were calculated and the Kaplan-Meier method was used to calculate cumulative survival. We used Cox proportional hazards regression with and without multivariable adjustment to model survival. The association between quintiles of household disposable income and all-cause mortality was estimated by hazard ratios (HRs) and 95% CI. The multivariable Cox model included all variables listed in Table 1 and was stratified by calendar year of surgery and hospital. Patient age was modeled using restricted cubic splines and all other variables were included as categorical terms. The association between income and all-cause mortality was also investigated in selected subgroups.

Missing data (educational level [5%], left ventricular ejection fraction [32%], renal function [11%], urgency of the procedure [32%], and body mass index [12%]), were handled using multiple imputation by