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ORIGINAL ARTICLE

Repeatedly measured material and behavioral factors changed the explanation of socioeconomic inequalities in all-cause mortality

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Abstract

Objectives: We examined whether using repeatedly measured material and behavioral factors contributed differently to socioeconomic inequalities in all-cause mortality compared to one baseline measurement.

Study Design and Setting: Data from the Dutch prospective GLOBE cohort were linked to mortality register data (1991−2013; $N = 4{,}851$). Socioeconomic position was measured at baseline by educational level and occupation. Material factors (financial difficulties, housing tenure, health insurance) and behavioral factors (smoking, leisure time physical activity, sports participation, and body mass index) were self-reported in 1991, 1997, and 2004. Cox proportional hazards regression and bootstrap methods were used to examine the contribution of baseline-only and time-varying risk factors to socioeconomic inequalities in mortality.

Results: Men and women in the lowest educational and occupational groups were at an increased risk of dying compared to the highest groups. The contribution of material factors to socioeconomic inequalities in mortality was smaller when multiple instead of baseline-only measurements were used (25%−65% vs. 49%−93%). The contribution of behavioral factors was larger when multiple measurements were used (39%−51% vs. 19%−40%).

Conclusion: Inclusion of time-dependent risk factors contributes to understanding socioeconomic inequalities in mortality, but careful examination of the underlying mechanisms and suitability of the model is required.

Keywords: Socioeconomic inequalities; Mortality; Health behaviors; Material factors; Repeated measurements; Time-dependent covariates

1. Introduction

There have been consistent reports of socioeconomic inequalities in mortality [1,2]. Explanations for socioeconomic gradients in mortality have steadily increased since the landmark publication of the Black Report in 1980, in which the main explanations mentioned were greater exposure to unfavorable material and behavioral factors among those in lower socioeconomic groups [3,4].

Observational studies examining explanations for socioeconomic inequalities in mortality mainly used explanatory factors measured once at baseline. Recently, studies estimated the contribution of health behaviors modeled as time-varying risk factors [5−7]. The main rationale for this approach is that inequalities in health behaviors may widen or decrease over time, which is not taken into account when only baseline measures are used. Accounting for such changes over time may provide a more accurate estimation of the contribution of these factors to inequalities in mortality. Studies that have taken this approach suggest that the contribution of some health behaviors was greater when measured at multiple times during the life course than when measured at only one point in time, although results differed between countries [5−9].

Previous studies have shown that material factors contribute most to socioeconomic inequalities in mortality [10,11], but none of these studies have included both time-varying material and behavioral factors in order to assess their contributions to the explanation of socioeconomic inequalities in mortality. Clearly, both behavioral

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What is new?

Key findings

- The contribution of behavioral factors to socioeconomic inequalities in mortality is larger in time-varying models, whereas the contribution of material factors is smaller.

What this adds to what was known?

- Repeatedly measured material and behavioral factors change the explanation of socioeconomic inequalities in all-cause mortality compared to baseline-only measurements.

What is the implication and what should change now?

- Inclusion of time-dependent mediators contributes to understanding socioeconomic inequalities in mortality in a life course perspective, but careful examination of the underlying mechanisms and suitability of the model is required.

and material risk factors may change over time. Further, not controlling for material factors may have overestimated the explanatory role of time-varying health behaviors in recent studies, since living in suboptimal material conditions may induce unhealthy behavior [3,4,10–12]. Finally, since the association between socioeconomic position and mortality and the socioeconomic distribution of risk factors can differ between men and women [13–16], it is important to asses potential differences between men and women. In order to fill these lacunae, we investigated how material and behavioral factors measured three times during adulthood contributed to the explanation of socioeconomic inequalities in mortality. To do so, we used a prospective cohort of Dutch adults with 23 years of follow-up. The main objective of the study was to investigate differences between models with only baseline measurements of the risk factors and models with time-varying risk factors. Given the potential gender differences, all analyses were carried out separately for men and women.

2. Methods

2.1. Study population

The GLOBE study (Dutch acronym for ''Health and Living Conditions of the Population of Eindhoven and surroundings'') is a prospective cohort study in the southern part of the Netherlands. At baseline (1991), a postal questionnaire was sent out to a random sample, stratified by age, degree of urbanization, and socioeconomic status, of noninstitutionalized Dutch persons aged 14–75 years living in Eindhoven and surrounding municipalities (response rate 70.1%, $N = 18{,}973$). From this sample, two subsamples were invited for subsequent stages of data collection. One subsample was chosen randomly from the baseline survey participants (response 79.3%, $N = 2{,}800$), and the other subsample included an overrepresentation of chronically ill persons (response 72.3%, $N = 2{,}867$). Both subsamples were stratified on age with an overrepresentation of persons aged 45 years and older. These two subsamples formed the longitudinal GLOBE cohort ($N = 5{,}667$) and were used in the analyses for this paper. Specifically, data from the baseline postal survey and additional interviews in 1991, data from the second postal survey and additional interviews in 1997, and data from the third postal survey in 2004 were used. In-depth details about the study design and sampling methods of the GLOBE study are provided elsewhere [17,18]. The use of personal data in the GLOBE study is in compliance with the Dutch Personal Data Protection Act and the Municipal Database Act and has been registered with the Dutch Data Protection Authority (number 1248943).

2.2. Measures

All-cause mortality data up to December 31, 2013, were obtained from Statistics Netherlands. We were able to link 5,344 participants to the register data (94%). Participants were censored at their date of death or at the end of follow-up. We restricted all analyses to participants 25 years or older at baseline because younger persons may not have finalized their education, leaving 4,851 participants for the analyses.

Socioeconomic position was measured by both educational and occupational level. From information on the highest attained educational level of the participant at baseline, four categories were defined according to the International Standard Classification of Education (ISCED): 1—high (higher professional education and university; ISCED 5–7); 2—middle (intermediate professional and higher general education; ISCED 3–4); 3—low (lower professional and intermediate general education; ISCED 2); and 4—lowest (primary education; ISCED 0–1). Occupation was classified in three categories according to the Erikson, Goldthorpe, and Portocarero scheme: [19] 1—professionals (top-level management, advanced academic competencies, high level of independence); 2—white-collar (middle management, routine nonmanual work); and 3—blue-collar occupations (skilled and unskilled manual work). We used occupation for men and occupation of the head of the household for women. Those not in workforce were excluded from the analyses, since these included noncomparable categories such as retirees, rentiers, and unemployed participants (men: $N = 33$; women: $N = 343$).

Material factors included financial difficulties, housing tenure, and type of health insurance, three measures which have been applied in several studies among the GLOBE cohort [10,11,20]. Financial difficulties were measured by