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Original article

Social class across the life course and physical activity at age 34 years in the 1970 British birth cohort

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ABSTRACT

Purpose: To examine the associations between social class at ages 0, 5, 10, 30, and 34 years and physical activity at age 34 years using a novel approach to analysis of life course data.
Methods: We used structural equation modeling to compare three competing models in life course epidemiology: the accumulation of risk model with additive effects, the accumulation of risk model with trigger effect, and the critical period model. Data were from a nationally representative prospective cohort of 16,571 British men and women born in 1970. Outcomes were physical activity during leisure time, during transports, and at work.
Results: For all three domains of physical activity, for men and women, the accumulation of risk model with additive effects fit the data best. In this model, social class at ages 0, 5, 10, 30, and 34 years were associated with physical activity at age 34 years, although the magnitude and the direction of the associations for social class at each age varied by physical activity outcome and by sex.
Conclusions: Structural equation modeling appears to be a helpful tool in selecting among competing models in life course epidemiology.

Introduction

A growing body of evidence suggests that poor socioeconomic conditions across the life course act cumulatively to increase the risk of cardiovascular diseases. Physical inactivity is a key cardiovascular risk factor, and its association with socioeconomic conditions across the life course has also been the focus of numerous studies [1–24]. Overall, 13 studies [1–13] have found a statistically significant association between socioeconomic conditions during childhood or adolescence and physical activity in adulthood; 11 have not [14–24]. Drawing on research into life course epidemiology and social inequalities in health, this body of literature has tended to focus on low socioeconomic conditions during childhood as the main causal variable, leisure-time physical activity during adulthood as the main outcome, and socioeconomic conditions during adulthood as either a confounding, intermediate, or interacting variable.

These studies' conflicting results may be explained by a common set of limitations we aimed to address in this study: different indicators of socioeconomic conditions have been used interchangeably across the life course (sometimes within the same study) [5,6,17,19,21], socioeconomic conditions during childhood were often measured retrospectively in cross-sectional designs [4,6,8,9,11,12,14,18,22,24], the ages at which socioeconomic conditions were measured varied widely [1–24], and socioeconomic conditions during adulthood were not always accounted for [2,3,7,8,13,14,17]. Moreover, the life course has been operationalized in most studies as only two points in time (one measurement during childhood and one during adulthood) [1–4,8–24]. Finally, most studies focused on leisure-time physical activity [1,2–4,6–9,11–17,19–24]. Physical activity in other domains of life, such as physical activity during transports or at work, was rarely considered.

This study aimed to address these limitations and to determine how social class across the life course is associated with physical activity during adulthood. Specifically, it aimed to integrate structural equation modeling with life course epidemiology theory to determine which life course model best explains the association between social class across the life course, and physical activity during adulthood. Three life course models were compared: the accumulation of risk model with additive effects, the accumulation of risk model with trigger effect, and the critical period model [25]. Briefly, in the accumulation of risk model with additive effects, each

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exposure increases the risk of exposure in the subsequent period and has an independent effect on the outcome (e.g., a lifelong of smoking). In the accumulation of risk model with trigger effect, each exposure increases the risk of exposure during the subsequent period, but only the last exposure triggers the outcome (e.g., injection drug use increasing risk of needle sharing and human immunodeficiency virus transmission). In the critical period model, exposure occurring during a period where susceptibility is greater has long-lasting and unalterable effects on the outcome (e.g., prenatal drug exposure). Based on the evidence of modest association with socioeconomic conditions during adulthood and weak or inconsistent association with socioeconomic conditions during childhood, we hypothesized that the accumulation of risk model with additive effects would best represent the association between social class across the life course and physical activity during adulthood.

Methods

Study design, setting, and participants

Data were from the 1970 British birth cohort (n = 16,571), a large, ongoing, nationally representative multidisciplinary cohort study. Data were collected at birth, and subjects were followed up successfully four times, at ages 5, 10, 30, and 34 years. Sample sizes (and response rates) at each follow-up were, respectively, 12,981 (78.34%), 14,350 (86.60%), 10,833 (65.37%), and 9665 (58.32%). In 1970 (at birth), data were collected using clinical records, interviews with parents, and a questionnaire completed by the attending midwife. In 1975 (age 5 years) and 1980 (age 10 years), information was gathered from children, their parents, and school teachers. In 1999 to 2000 (age 30 years) and in 2004 to 2005 (age 34 years), subjects answered questions about all major domains of life during face-to-face interviews. Ethical approval has been granted by the UK Medical Research Ethics Council before each data collection cycle of the 1970 British birth cohort.

Variables and measurement

Independent variables were social class at birth and at ages 5, 10, 30, and 34 years. Occupation, a measure of social class, was self-reported by parents during interviews at birth and when subjects were aged 5and 10 years. Occupation was also self-reported by subjects at ages 30 and 34 years during face-to-face interviews. For birth and ages 5 and 10 years, the highest parent's occupation was used as proxy. Occupations were categorized according to the Registrar General's classification into grades I (professional) to V (unskilled). At all ages, less than 2.6% of cases were from social class V (unskilled). Therefore, social classes IV (partly skilled) and V (unskilled) were merged. As grade III (skilled) is split into manual and nonmanual, occupation was thus a categorical variable with five ordered categories. Dependent variables were physical activity during leisure time, physical activity at work, and physical activity during transports. All were self-reported by subjects during interviews at age 34 years. For physical activity during leisure time and physical activity at work, a score representing 8 weeks of habitual physical activity was computed based on answers to three questions (for leisure-time physical activity) and two questions (for physical activity at work) (Appendix). These scores approximated energy expenditure: the higher the score, the more physically active the subjects were and the more energy they expended during leisure time or at work. Both scores were positively skewed and had a mode of 0. They were used separately as the dependent variable for physical activity during leisure time and physical activity at work, and zero-inflated Poisson models were used to account for the large number of zeros and positive skewness. Physical activity during transport was based on a single question about main form of transport. Subjects were asked: "What is your main form of transport?" Answers were: "car/motorcycle/moped," "public transport (i.e., buses and trains)," "cycling," "walking," "other," or "never goes out." Public transport was considered an active form of transport. Answers were recoded into "active" (public transport, cycling, or walking), "inactive" (car/motorcycle/moped), or "missing" (other, do not know, never goes out, or not applicable). Therefore, the main form of transport was a dichotomous variable ("active" or "inactive"). Sex was a dichotomous variable ("male" or "female"). It was a confounder, and all analyses were stratified by sex. Other confounders (for physical activity during transports only) were "time required to travel from home to work" (a categorical variable with eight ordered categories ranging from "under 5 minutes" to "2 or more hours") and "rating of local public transport services" (a categorical variable with five ordered categories ranging from "very good" to "very poor").

Statistical methods

Before analysis, all variables were examined for accuracy of data entry, missing values, and fit between their distributions and the assumptions of multivariate analysis [26]. Social class at age 34 years was missing for 1709 cases (17.8% of the sample). These were mostly "looking after home/family" (975 cases), "permanently sick/disabled" (228 cases), or "unemployed and seeking work" (193 cases). Similarly, social class was missing for 23.4, 14.9, 20.3, and 9.2% of the sample at ages 30, 10, 5, and 0 years, respectively. At age 34 years, leisure-time physical activity was missing for 32 cases (0.3% of the sample), physical activity during transports was missing for 106 cases (1.1% of the sample), and physical activity at work was missing for 1657 cases (17.2% of the sample). Missing data were imputed using full information maximum likelihood. A total of 41 outliers were detected in the sample. Outliers moved from social class IV to V to social class I between ages 30 and 34 years, or reported being in social class I with no education. They were deleted. This left 9624 subjects in the sample (4605 men and 5019 women).

Descriptive statistics were obtained using SPSS 18 (SPSS Inc, IL). Bivariate correlations among social class at ages 0, 5, 10, 30, and 34 years and physical activity were computed using Spearman's rho. Analyses were stratified by sex. For each sex and each physical activity outcome, three models were compared: the accumulation of risk model with additive effects (Fig. 1), the accumulation of risk model with trigger effect (Fig. 2), and the critical period model (Fig. 3). Structural equation models were computed using MPLUS 6.11 (Muthen & Muthen, CA). Each model was run separately with physical activity during leisure time, during transport, or at work as the dependent variable. These three outcomes have all been shown to be associated with socioeconomic conditions [27]. Therefore, they were all considered to be potential confounders. As such, the model with leisure-time physical activity as the outcome was adjusted for physical activity during transports and physical activity at work. The other two models were similarly adjusted. In addition, the model with physical activity during transports as the outcome was adjusted for two more potential confounders: "time required to travel from home to work" and "rating of local public transport services." To improve missing data imputation with full information maximum likelihood, for all estimations, the mean of each covariate was added (these were not included in the tested models).

Because zero-inflated Poisson models were used, we used the Akaike information criterion (AIC) and the Bayesian information criterion (BIC) to compare the fit of the three competing models (lower AIC and BIC values indicate better fit) [26,28]. Both AIC and