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Socioeconomic position and sedentary behavior in Brazilian adolescents: A life-course approach

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ABSTRACT

Socioeconomic position (SEP) is a potential correlate of sedentary behavior in adolescents. The aim of this study was to examine the associations between SEP and self-reported and objective measures of sedentary behavior in adolescents, using a life-course approach. Data from the 1993 Pelotas (Brazil) Birth Cohort Study were analyzed (N = 5249). Cross-sectional and longitudinal associations between multiple SEP indicators (maternal education, family income, SEP composite, cumulative family income) at birth, 11, 15 and 18 years, and five sedentary behavior outcomes (≥ 4 h/day screen time; ≥ 4 h/day TV; ≥ 2 h/day computer; ≥ 2 h/day video game; ≥ 12.7 h/day objectively measured sedentary time) at 11, 15 and 18 years, were examined. In cross-sectional analyses, higher SEP was positively associated with more screen time at ages 11 and 15 years. There was a consistent and positive association between higher SEP with time spent using a computer, and with sedentary time assessed through accelerometry. SEP at birth had a positive and direct effect on screen, computer and total sedentary time at 18 years. Participants in the highest cumulative income group had higher odds of high sedentary behavior in screen (OR: 2.40; 95% CI: 1.50–3.54), computer (OR: 7.35; 95% CI: 4.19–12.89) and total sedentary time (OR: 5.40; 95% CI: 3.53–10.35), respectively, compared with their counterparts with lower cumulative income. Our findings showed that SEP is an early determinant of sedentary behavior in adolescents.

1. Introduction

Adolescents spend a large proportion of their awake time sedentary (Sherar et al., 2016). Data from the International Children's Accelerometry Database study, which includes information from > 11,000 children and adolescents from nine countries, shows that around two thirds of young people spend > 2 h/day in screen-based activities (Atkin et al., 2014). In Brazil, the National Adolescent School-based Health Survey (Malta et al., 2014), found that approximately 80% of adolescents spent more than 2 h/day watching television.

Our recent systematic review and meta-analysis of the association between socioeconomic position (SEP) and sedentary behavior in adolescents showed that the SEP-sedentary behavior association differs in high and low-middle income countries and varies by domain of sedentary behavior and by measure of SEP (Mielke et al., 2017). Most studies included in that review used self-report measures and were cross-sectional in design. Few studies have investigated prospective associations between SEP and sedentary time in adolescents (Kipping et al., 2015; Dumith et al., 2012).

This paucity of prospective data makes it difficult to evaluate whether SEP in specific periods of life has an impact throughout life, independent of circumstances through childhood and adolescence. Also, no studies have explored different models commonly used in life-course epidemiology, such as accumulation, or direct and indirect effects (Kuh et al., 2003) on the association between SEP and sedentary behavior in adolescents. To our knowledge, no studies have investigated the association between SEP and sedentary behavior in adolescents using measures of SEP at different ages from birth to late adolescence.

The aim of this study was to examine associations between multiple indicators of SEP and multiple domains of sedentary behavior (including an objective measure) in adolescents from the 1993 Pelotas Birth (Brazil) Cohort Study. The specific purposes were to: (1) examine if cross-sectional associations between SEP and sedentary behavior domains vary during adolescence; (2) investigate the potential longitudinal association between early SEP and sedentary behavior in late

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adolescence; (3) examine the association between cumulative family income during childhood and adolescence with sedentary behavior at 18 years.

2. Methods

2.1. Design and participants

Data were from participants enrolled in the 1993 Pelotas (Brazil) Birth Cohort Study. The original cohort included 5249 of the 5265 children born in 1993 in Pelotas, a medium-sized city in the state of Rio Grande do Sul, Brazil. All participants from the original cohort were invited to follow-ups in 2004, 2008 and 2011, when they were aged 11, 15 and 18 years. Of the 5249 participants included in the original cohort (50.6% females), 87.5% (n = 4452), 85.7% (n = 4349) and 81.3% (n = 4106) attended the 11, 15 and 18-year follow-ups, respectively. Before participating in the study, written parental consents were obtained. The study protocols were approved by the Ethics Committee of the Medical School from the Federal University of Pelotas. More details of the methods have been reported previously (Victora et al., 2008; Goncalves et al., 2014).

2.2. Socioeconomic position indicators

At all measurement visits information about maternal education and family income was collected. Maternal education was categorized as number of years of formal education (0–4; 5–8; 9–11; 12 +). Family income was categorized in quartiles.

A composite score of maternal education and family income was created, by assigning the lowest category of each variable a score of zero and the highest category a three. Scores for each indicator were summed, resulting an SEP composite score ranging from 0 to 6, where the lowest group was participants with 0–4 years of maternal education and in the lowest quartile of family income.

A cumulative family income score was also created, by summing family income scores (0 to 3) at each survey (at birth, 11, 15 and 18 years). This ranged from 0 to 12, where a score of 0 indicates the lowest quartile of family income at every age and 12 the highest.

2.3. Sedentary behavior outcomes

Information about sedentary behavior was collected when adolescents were 11, 15 and 18 years. Sedentary behavior was self-reported through face-to-face interviews using a standardized questionnaire, including questions about time spent watching television, using a computer and playing video games, on a normal weekday. Total screen time was calculated as the sum of time spent in these three domains. The following cut-offs were used to define high sedentary behavior in each domain: a) screen time ≥ 4 h/day; b) television viewing time ≥ 4 h/day; c) computer time ≥ 2 h/day; d) video game time ≥ 2 h/day. These cut-offs were based on data distribution have been broadly used in the literature (Mielke et al., 2017).

Objectively measured sedentary time was obtained using the GENEActive accelerometer (ActivInsights, Kimbolton, UK) at 18 years of age. Each participant wore the accelerometer on their non-dominant wrist for 4–7 days, for 24 h a day, including at least one weekend day. Data from participants with activity recordings for at least 2 days were analyzed. Measured acceleration was first calibrated and referenced to local gravity (van Hees et al., 2014), from which acceleration due to physical activity was extracted (van Hees et al., 2013) and activity intensity time-series in 5-s epochs generated. From these time-series, sedentary time was estimated as time spent below a threshold of 50 milligrams (mg) (1000 mg = 1 g = 9.79 m/s^2), which discriminates between sitting/standing and slow walking (Hildebrand et al., 2014). Nonwear periods defined as prolonged (> 60 min) non-variability in acceleration (sd < 13 mg in all three axes) were flagged and imputed using each person's diurnal pattern. The hours between 11:00 p.m. and 7:00 a.m. (assumed to be sleeping) were excluded from analysis. Accelerometer data in binary format were analyzed with R-package GGIR (http://cran.r.project.org0, van Hees et al., 2013). Further information about the accelerometer procedures is available elsewhere (Knuth et al., 2013; da Silva et al., 2014). Total sedentary time was divided into quintiles, with the top quintile categorized as high sedentary time, which corresponded with > 12.7 h/day sedentary.

2.4. Statistical analysis

To elucidate the associations between SEP and sedentary behavior, the analyses were performed in four steps. First, cross-sectional analyses between maternal education, family income and sedentary behavior were conducted using data collected at ages 11, 15 and 18. Second, longitudinal analyses of the association between maternal education and family income at each survey (birth, 11 and 15 years), with sedentary behavior variables at 18 years, were performed. Analyses of associations between each SEP indicator (maternal education and family income) and each individual sedentary behavior measure were conducted using series of logistic regressions. Only linear trend coefficients are presented. The descriptive analyses and categorical coefficients (comparing highest SEP with lowest SEP), can be found in the online appendix. Unadjusted and adjusted analyses were performed, with simultaneous adjustment for each SEP indicator. As there was no evidence of any gender-interaction in the relationships between SEP and the outcomes, data from boys and girls were combined, with gender included as a covariate in the models. There was no evidence of collinearity in the adjusted models, with variance inflation factors ranging from 1.07 to 1.32.

Third, path analysis by structural equation modeling was used to explore whether the association between SEP at a specific age (for example, at 11 years) and sedentary behavior at age 18 is mediated by SEP at age 15 or 18, or whether there is a direct effect of SEP at each age (i.e. an effect that operates through pathways other than through SEP at other ages). The theoretical model and hypothesized associations between variables are shown in Fig. 1 in the online appendix.

Fourth, the associations between cumulative income, from birth to age 18, and the sedentary behavior variables at age 18 were examined. The odds of high sedentary behavior were calculated for each level of the cumulative income variable, compared with participants in the lowest cumulative income score, which was defined as being in the lowest quartile of income at all surveys. Odds ratios and 95% confidence intervals are presented.

All analyses were conducted using STATA 12.1. Assumptions of logistic regression, and path analysis models were checked and there was no evidence of violation of the assumptions.

3. Results

3.1. Sample characteristics and sedentary behavior

Descriptive characteristics of the sample are presented in Table 1. There was a slight increase in the proportion of participants who spent more than 4 h/day in total screen time from 11 (43.2%) to 15 years old (52.7%) ($p < 0.0001$); this then remained constant until 18 years. At 18 years, adolescents spent, on average, 5.1 h/day in screen time, mainly as television viewing (2.3 h/day) and computer use (2.3 h/day). At 11 and 15 years, time spent watching television was higher than in the other domains. From 11 to 18 years, there was a decrease in television time, notably between 15 and 18 years. In contrast, there was a sharp increase in time spent in computer use during both the 11 to 15, and 15 to 18-year periods. Time spent playing video games remained constant. Accelerometer data showed that adolescents spent, on average, 11.5 h of their daily awake time in sedentary activities at age 18.