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Sitting too much: A hierarchy of socio-demographic correlates☆

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ABSTRACT

Too much sitting (extended sedentary time) is recognized as a public health concern in Europe and beyond. Time spent sedentary is influenced and conditioned by clusters of individual-level and contextual (upstream) factors. Identifying population subgroups that sit too much could help to develop targeted interventions to reduce sedentary time. We explored the relative importance of socio-demographic correlates of sedentary time in adults across Europe.

We used data from 26,617 adults who participated in the 2013 Special Eurobarometer 412 "Sport and physical activity". Participants from all 28 EU Member States were randomly selected and interviewed face-to-face. Self-reported sedentary time was dichotomized into sitting less or >7.5 h/day. A Chi-squared Automatic Interaction Detection (CHAID) algorithm was used to create a tree that hierarchically partitions the data on the basis of the independent variables (i.e., socio-demographic factors) into homogeneous (sub)groups with regard to sedentary time. This allows for the tentative identification of population segments at risk for unhealthy sedentary behaviour. Overall, 18.5% of the respondents reported sitting >7.5 h/day. Occupation was the primary discriminator. The subgroup most likely to engage in extensive sitting were higher educated, had white-collar jobs, reported no difficulties with paying bills, and used the internet frequently. Clear socio-demographic profiles were identified for adults across Europe who engage in extended sedentary time. Furthermore, physically active participants were consistently less likely to engage in longer daily sitting times. In general, those with more indicators of higher wealth were more likely to spend more time sitting.

"We seem busier than ever, but in a sedentary way"

[*Sally Norton*]

1. Introduction

Sedentary behaviours – defined as behaviours that involve sitting or reclining positions and low levels of energy expenditure (≤1.5 metabolic equivalents) during waking hours (Sedentary Behavior Network, 2012) – have emerged as a public health concern in Europe (Owen et al., 2010; Owen et al., 2011). Sedentary behaviours have been associated with a range of detrimental health outcomes such as depression, obesity, type 2 diabetes, cardiovascular disease, and all-cause mortality (Biswas et al., 2015; Chau et al., 2012). These outcomes are often independent of physical activity levels (Owen et al., 2010; Chau et al., 2013; Bennie et al., 2013; Sjöström et al., 2006). Especially in western society, substantial time is spent sedentary (Owen et al., 2010). Investigating the prevalence and correlates of sedentary behaviours is important to monitor and understand population levels as well as to identify at-risk populations to be targeted by interventions.

So far, studies on correlates of sedentary behaviour in adults have mainly focused on association of single socio-demographic correlates (risk-factors) rather than clusters of socio-demographic variables (risk-profiles) with sedentary time. For example, previous studies were consistent in finding that higher-educated people were more likely to sit too much (e.g. (Bennie et al., 2013; Sjöström et al., 2006;

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Bauman et al., 2011). Whereas most of these studies used multivariable models taking other variables into account, they did not explore who of those highly educated people sit more or less. The interrelations across factors need to be taken into account in order to untangle *who* is sitting too much in *what* contexts, and *how* these factors cluster.

In Europe, recent studies have estimated the prevalence and correlates of sedentary time using the Eurobarometer surveys. These surveys are conducted biannually across the European Union and occasionally include questions about sedentary behaviour. To date, these Eurobarometer surveys are the most comprehensive source of data on population levels of sedentary time across all countries in Europe (Loyen et al., 2016a). Previous studies have used the Eurobarometer to study socio-demographic correlates associated with sedentary time, suggesting that males, younger and highly educated people engage in high levels of sedentary behaviour (i.e., >7.5 h/day) (Bennie et al., 2013; Sjöström et al., 2006; Loyen et al., 2016b). Bauman et al. showed similar results for a worldwide sample for young and highly educated adults, (Bauman et al., 2011) but they found no difference according to gender with regard to sedentary time. In a systematic literature review, Rhodes et al. also suggested that gender was not significantly associated with sedentary time (Rhodes et al., 2012) Furthermore, living in rural areas or small/medium-sized towns - as compared to more urbanized areas - was identified to be inversely correlated with sedentary time in the Eurobarometer studies (Sjöström et al., 2006; Loyen et al., 2016b). The Eurobarometer survey wave from 2013 included additional socio-demographic factors that we recently used to describe the prevalence and correlates of self-reported sitting time in the 28 European Union member states (Loyen et al., 2016b). The findings suggested that in addition to the factors mentioned above, white-collar employment may be important for extended sedentary time, as well as being widowed and having a low life satisfaction (Loyen et al., 2016b).

Our aim is to move beyond the evaluation of distinct individual-level correlates. Rather, we use a data driven approach to assess the concurrence between and clustering of potential risk factors for extended sedentary time, i.e., we seek to identify risk profiles.

2. Methods

This study was undertaken as part of the DEterminants of DIet and Physical Activity (DEDIPAC) Knowledge Hub, a joint action as part of the European Joint Programming Initiative 'a Healthy Diet for a Healthy Life' (Lakerveld et al., 2014). For the current study, data from the cross-sectional Special Eurobarometer 412 "Sport and physical activity" were used (European Commission, 2014). The Eurobarometer surveys are conducted biannually in the 28 European Union Member States on behalf of the European Commission. In November and December 2013, the survey was carried out by TNS Opinion & Social among approximately 1000 participants per country. A multistage random sampling design was used to sample participants per country, based on population size and density. Each initial address was selected at random; further addresses were selected by randomly selected route. In each household, the respondent with the closest birthday to the date of the interview was selected. In total 27,919 participants were interviewed face-to-face in their mother tongue.

2.1. Sitting time

Sitting time was assessed with the question: "How much time do you spend sitting on a usual day?" which is part of the validated short International Physical Activity Questionnaire (IPAQ) (Rosenberg et al., 2008). The IPAQ sitting question was adapted as they opted to have answering categories instead of an open ended question. There were eleven response categories: 1 h or less, 1 h to 1.5 h, 1.5 h to 2.5 h, 2.5 h to 3.5 h, 3.5 h to 4.5 h, 5.5 h to 6.5 h, 6.5 h to 7.5 h, 7.5 h to 8.5 h, >8.5 h, and 'don't know'. The response categories were dichotomized into sitting ≤7.5 h/day and sitting >7.5 h/day to study low versus extended sedentary time. This cut-off was chosen based on a meta-analysis of Chau et al. (2013) in which it was suggested that the risk of all-cause mortality increases when adults self-reported to sit more than approximately 7–8 h/day.

2.2. Socio-demographic variables

The following socio-demographic variables were assessed: 1) gender, 2) age, 3) country of residence, 4) marital status, 5) level of education, 6) current occupation, 7) type of community, 8) number of children in the household, 9) car ownership, 10) computer ownership, 11) internet use frequency, 12) difficulties paying bills, and 13) life satisfaction. All data were self-reported except for country of residence, which was reported by the interviewer. For trend analyses purposes, Eurobarometer still distinguishes West- and East Germany, and we combined these into Germany. Furthermore, we combined England and Northern Ireland into the United Kingdom. Marital status was recoded into five categories: (re-)married, single living with a partner, single, divorced or separated, and widowed. The level of education was measured by the question "How old were you when you stopped full-time education?" and was recoded into four possible categories: up to 15 years, 16–19 years, >20 years, and still studying. Current occupation was recoded into seven categories: self-employed (farmer/fisherman, professional, owner of a shop, craftsmen, business proprietors), managers (employed professional, general management, middle management), white-collar (employed position at desk, employed position travelling), manual worker (employed position service job, supervisor, skilled manual worker, unskilled manual worker), house persons, unemployed, retired, and students. Three 'types of community' were distinguished: rural area or village, small or medium sized town, large town. The number of children aged <10 years and aged 10 to 14 years were combined in the variable 'Children aged <15 years living in the household' and coded into four categories: none, one, two, three or more. Internet use frequency was measured in six categories: everyday/almost every day, two or three times in a week, about once a week, two or three times a month, less often, never/no access. Difficulties paying bills was measured in three categories: almost never/never, from time to time, most of the time. Life satisfaction was measured by the question "On the whole, are you satisfied with the life you lead" and included four response categories: very satisfied, fairly satisfied, not very satisfied, or not at all satisfied.

2.3. Physical activity

Total physical activity was assessed using the IPAQ-short. This questionnaire asks about the number of days and the average time respondents participated in moderate and in vigorous physical activity, and walking in the last seven days. Response options were: 30 min or less, 31 to 60 min, 61 to 90 min, 91 to 120 min, >120 min, 'never', and 'don't know'. We calculated MET-minutes/week using the following formula: (days of vigorous PA * time in vigorous PA * 8.0) + (days of moderate PA * time in moderate PA * 4.0) + (days walking * time walking * 3.3) (Loyen et al., 2016a; The IPAQ group, 2017). In this process, we took the midpoint of each category to represent the time (e.g. the '31 to 60 min' category was transformed into '45 min') and capped the '>120 min' category at 135 min.

2.4. Statistical analyses

Participants were excluded from the analyses when they were aged younger than 18 years old and/or when they answered 'don't know' on the sitting question. Descriptive statistics were used to describe the characteristics of the total sample and the groups sitting less and >7.5 h/day. To identify the relative importance of correlates associated with sitting too much, we employed the CHi-squared Automatic Interaction Detection (CHAID) algorithm (Kass, 1980). CHAID creates a