Experimental Gerontology 113 (2018) 74–79

Contents lists available at ScienceDirect

Experimental Gerontology

journal homepage: www.elsevier.com/locate/expgero

Wealth and occupation determine health deficit accumulation onset in Europe – Results from the SHARE study

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ARTICLE INFO

Keywords:
Health status disparities
Socioeconomic factors
Aged
Healthy aging
Frailty
Health deficit accumulation

ABSTRACT

While socio-economic characteristics have been shown to be associated with health deficit accumulation (DA) trajectories, their effect on the age at DA onset remains unclear. The objective of this study was to compare the median age at DA onset across nine European countries and to investigate the effects of income, occupation and wealth on DA onset after age 50. We used population samples aged 50 years and older from the SHARE (Survey of Health, Aging and Retirement in Europe) study. Participants from nine European countries with longitudinal data from at least three of the 2004/05, 2006/07, 2010/11, 2012/13 and 2014/15 waves were included in the analysis. A Frailty Index (FI, range 0–1) was constructed from 50 health deficits. DA onset was defined as having FI values $>$ 0.08 in at least two consecutive measurements following an initial FI value $\leq$ 0.08. We investigated the effect of income, occupation and wealth on DA onset using a random effects model for time-to-event data. Potential confounding variables were identified using directed acyclic graphs. Out of 8616 (mean age 62 years, 49.0% female) participants initially at risk, 2640 (30.6%) experienced a subsequent DA onset. Median age at onset was 71 years overall, ranging from 66 years (Germany) to 76 years (Switzerland). Wealth and occupation were found to have significant effects on DA onset which decreased with age. In sum, the median age at DA onset differs between European countries. On an individual-level, wealth and occupation, but not income influence the age at DA onset.

1. Introduction

Socio-economic characteristics such as education, income, wealth, and occupation are among the most powerful determinants of health. They may act both as direct (Kondo, 2012) and indirect determinants of health, e.g. by creating environmental hazards related to employment and housing, or by influencing health care utilization and less favourable health behaviors (Adler and Newman, 2002).

Deteriorating health in older age can be summarized using the concept of deficit accumulation (DA) (Mitnitski et al., 2001). Health effects of socio-economic risk factors may accumulate over the course of a lifetime (Ben-Shlomo and Kuh, 2002), possibly until they surmount a threshold after which the impact of external stressors is no longer as easily compensated by regenerative processes as in younger adulthood (Kondo, 2012). Failure to compensate the impact of external stressors leads to the accumulation of what is generally perceived as "age-related" chronic health deficits. Although it was recently found that a targeted intervention may reduce the number of accumulated deficits at any age (Theou et al., 2017), aging populations outside of intervention studies experience mostly stable or deteriorating health patterns (Mitnitski et al., 2007; Stephan et al., 2017). Socio-economic characteristics are associated with the onset of various degenerative health processes in older adults, such as functional limitations (Matthews et al., 2005), heart problems, diabetes, cancer, stroke (Herd et al., 2007), and depression (Koster et al., 2006). Thus, investigating the social determinants of DA onset is of high relevance.

Both socio-economic status and health expectancy vary considerably across Europe. For instance, average wealth ranges from

Abbreviations: CI, Confidence interval; DA, deficit accumulation; DAG, directed acyclic graph; FI, Frailty Index; HR, Hazard Ratio; ISCED, international standard classification of education; SHARE, Survey of Health, Aging and Retirement in Europe

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https://doi.org/10.1016/j.exger.2018.09.021
Received 17 July 2018; Received in revised form 6 September 2018; Accepted 24 September 2018
Available online 25 September 2018
0531-5565/

below 40.000 Euro (Netherlands) to over 280.000 Euro (Switzerland) (Christelis et al., 2009), and healthy life expectancy at the age of 50 ranges from 14 years in Germany to 24 years in Denmark (Jagger et al., 2009). The difference in health expectancy between the lowest and highest educational level has been reported to vary between 2 years in Italy and 5.3 years in Austria (Mäki et al., 2013). For other constituents of socio-economic position, such as income, wealth, or occupation, comparative studies between countries are largely missing.

Therefore, the objective of this study was to investigate the effect of socioeconomic characteristics, especially income, wealth, and occupation on DA onset in people aged 50 years and older in nine European countries.

2. Methods

2.1. Study design, participants and data collection procedures

Data originates from the Survey of Health, Aging and Retirement in Europe (SHARE), which includes representative samples of the populations aged 50 years and older from 20 European countries and Israel.

All SHARE participants are asked to complete a multi-module computer-assisted personal interview. Details about study design, sampling methods and data collection for SHARE can be found elsewhere (Alcser et al., 2005; Börsch-Supan et al., 2013; Börsch-Supan et al., 2008; Malter and Börsch-Supan, 2013; Malter and Börsch-Supan, 2015). Approval for SHARE was obtained from the Ethics Committee of the University of Mannheim until 2011 and from the Ethics Council of the Max-Planck-Society for the Advancement of Science from 2011 onwards. Written informed consent was obtained from all participants.

To obtain a sample with a maximum of follow-ups for longitudinal analysis, we used data from those nine countries (Austria, Belgium, Switzerland, Germany, Denmark, Italy, Spain, France, and Sweden) participating in all five SHARE waves conducted in 2004/05 (wave 1), 2006/07 (wave 2), 2010/11 (wave 4), 2012/13 (wave 5) and 2014/15 (wave 6) [dataset](Börsch-Supan, 2017a; Börsch-Supan, 2017b; Börsch-Supan, 2017c; Börsch-Supan, 2017d; Börsch-Supan, 2017e) and only from participants who had participated in at least three out of the five waves.

2.2. Outcome

2.2.1. Frailty Index

To measure deficit accumulation, we constructed a Frailty Index (FI) following established methods and procedures (Searle et al., 2008). The FI for this study includes in total 50 items, covering 10 diseases, 21 measures of functioning and 19 signs and symptoms. Candidate item were taken into consideration based on two criteria: Use in earlier FIs created for analyses of SHARE data (Romero-Ortuno, 2014; Theou et al., 2013) and being available in all five SHARE waves used for the current analysis. This approach was chosen as previously developed SHARE FIs were based solely on the first two waves of SHARE. As a consequence, neither all items used in the previously published 40-item nor all items used in the previously published 70-item SHARE FI were available in all five SHARE waves used in this analysis. Definite item selection was based on the following standard inclusion criteria: Prevalence increase with age, late saturation (i.e. no prevalence > 80% in any age group) and coverage of different body structures and systems (Searle et al., 2008). The FI for a person results as the number of the person-specific deficits divided by the total number of listed deficits, ranging from 0 (=no deficits present) to 1 (=all deficits present). If information on more than 10 items (20%) were missing for a participant, the FI value was set to missing (Yang and Lee, 2009). For a list of the included and excluded FI candidate items and details on the item selection process see Appendix A.

2.2.2. Definition of onset of DA

Onset of the DA process was defined as having a FI value ≤ 0.08 followed by FI values > 0.08 in at least two consecutive measurements. Thus, to establish a confirmed DA onset, at least three measurements were needed.

The threshold of ≤ 0.08 corresponds to a maximum of four health deficits. It was chosen following published FI thresholds (Song et al., 2010).

2.3. Exposures: Income, wealth and (last) occupation

The total annual household income before tax in euros (Alcser et al., 2005) was adjusted for the square root of household size (OECD, 2013). This adjusted value was then dichotomized using country-specific poverty thresholds according to Eurostat (Eurostat, 2017). Where poverty thresholds for a specific year were unavailable, the threshold of the next available year for this country was applied.

Wealth was measured in euros as the sum of all financial and real household assets minus debts, adjusted for OECD purchasing power parity exchange rates (Organisation for Economic Co-operation and Development, 2012) and recoded into tertiles.

Occupation was measured as the respondent's last job according to the International Standard Classification of Occupations (ISCO-88) by the International Labour Organization (International Labour Office, 1990) in ten major groups of occupation. Under the assumption that elementary occupations include physical strain and may specifically increase the risk for DA onset, we dichotomized the groups into those indicating elementary occupations as compared to all others (International Labour Office, 1990).

2.4. Covariates

2.4.1. Covariate selection

While it is widely known that neglecting important covariates can induce spurious associations in regression analysis (confounding), it is less well-known that covariate over-adjustment in turn increases the risk for collider bias (Shrier and Platt, 2008), i.e. increasing bias by adjustment instead of decreasing it. To avoid both types of bias, we used directed acyclic graphs (DAGs) as covariate selection method. DAGs are constructed based on existing literature and contain the known or assumed associations among all covariates considered for a specific analysis. Ultimately, the DAG also gives the minimal adjustment set, i.e. the most parsimonious set of covariates needed for estimating an unbiased effect (Stang and Knüppel, 2010). Covariates which were entered into the DAG were selected based on their reported association with the exposures or the outcome of interest in the literature. The resulting minimal adjustment set for estimating the total effect of income, wealth and occupation on hazard of DA onset, identified through the program DAGitty, a browser based environment for creating, editing, and analyzing causal models (Textor et al., 2011), included sex, education, marital status, place of living, welfare regime and two interaction terms of income with welfare regime and wealth, respectively. The interaction terms were chosen based on the assumption that both the country-specific welfare regime and individual wealth might buffer the effect of income on DA (see Appendix B for the DAG and its references).

2.4.2. Covariate measurement

Education was measured according to the international standard classification of education (ISCED) (UNESCO, 1997). We collapsed the seven categories into three levels: lower secondary education or less (ISCED levels 0–2), upper secondary education (ISCED level 3) and post-secondary education (ISCED levels 4–6).

Welfare regimes were defined as “conservative” (Germany, Belgium, France, Switzerland, Austria), “Scandinavian” (Sweden, Denmark), or “southern” (Italy, Spain) (Dragano et al., 2011).