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The enduring effect of education-socioeconomic differences in disability trajectories from age 85 years in the Newcastle 85+ Study

Andrew Kingston [a,*], Karen Davies [a], Joanna Collerton [a], Louise Robinson [a], Rachel Duncan [a], Thomas B.L. Kirkwood [b], Carol Jagger [a,**]

[a] Institute of Health and Society, Newcastle University, Baddiley-Clark Building, Richardson Road, Newcastle upon Tyne NE2 4AX, United Kingdom
[b] Insititue of Cellular Medicine, William Leech Building, Newcastle University, Newcastle upon Tyne NE2 4HH, United Kingdom

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ABSTRACT

Objective: Little is known about disability progression in very old age despite this being vital for care planning. We investigate whether distinct trajectories of disability are evident from age 85 to 90 and their association with socio-economic status (SES).

Methods: The Newcastle 85+ Study recruited people born in 1921 through participating general practices in Newcastle and North Tyneside. Participants underwent a health assessment (HA) at baseline, 18, 36 and 60 months and a GP record review (GPRR) at baseline, 36 and 60 months. Disability was measured via difficulty in 17 Activities of Daily Living. Trajectory identification was assessed by gender stratified, mortality adjusted, group-based trajectory modelling (GBTM) and the impact of life-course SES (level of education; occupational class; deprivation) on trajectory membership evaluated (adjusting for confounding variables).

Results: 851 participants agreed to HA and GPRR, 840 (98.7%) with complete disability data. Four distinct trajectories were evident for both sexes. A disability-free trajectory between age 85 and 90 was identified in men only (9% of the sample). The most disabled trajectories had severe disability at age 85 progressing to profound disability by age 90. After adjusting for confounders education remained significant; men and women with most education being less likely to be in the most disabled trajectory (Men: OR = 0.80, 95% CI 0.65–0.98; women: OR = 0.59, 95% CI 0.42–0.83).

Conclusion: Distinct disability trajectories are evident in the very old and these are influenced by education, suggesting SES disadvantages cumulate throughout the life-course to create health and mortality inequalities later.

1. Introduction

Knowledge of how disability changes with advancing age is important not only for allocating the health and care resources required for our rapidly growing aging populations, but also for individuals and families to plan for increasing dependency and moves to assisted living environments. Disability in later life is affected by experiences throughout the life course, including socio-economic status as measured by education, income, or occupation (Verbrugge, Reoma, & Gruber-Baldini, 1994). SES is a strong predictor of disability onset and mortality, as well as the combined measure of disability-free life expectancy (Jagger et al., 2007; Lynch, 2008; Marmot, Shipley, Brunner, & Hemingway, 2001; Marmot & Martin, 1996; Montez, Hayward, Brown, & Hummer, 2009; Stringhini et al., 2011). More years of education are particularly associated with slower declines in disability prevalence, lower incidence and greater recovery over time (Jagger et al., 2007). Education is one factor that will change predictably as statutory school leaving ages in the United Kingdom have increased and future cohorts of older people, especially women, who have had greater access to higher education.

Mechanisms linking education and disability are ostensibly associated with behaviors that impact risk factor decision-making, mastery over one's life and/or postponed gratification (Freedman & Martin, 1999). Two popular hypotheses seek to explain the

* Corresponding author at: Biogerontology Research Building, Institute of Health and Society, Newcastle University, Campus for Ageing and Vitality, Newcastle upon Tyne NE4 5PL, United Kingdom. Tel.: +44 0191 2481107; fax: +44 0191 2481101.
** Corresponding author at: Biogerontology Research Building, Institute of Health and Society, Newcastle University, Campus for Ageing and Vitality, Newcastle upon Tyne NE4 5PL, United Kingdom. Tel.: +44 0191 2481117; fax: +44 0191 2481101.
E-mail addresses: andrew.kingston@ncl.ac.uk (A. Kingston), carol.jagger@ncl.ac.uk (C. Jagger).

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mechanisms driving the impact of SES on health in old age: the 'cumulative disadvantage' hypothesis and the 'age-as-leveler' hypothesis. The cumulative disadvantage hypothesis posits that socio-economic disparities amplify across the life course, largely as a result of differential exposure to risk factors associated with low SES, for example smoking, alcohol consumption, occupation, education and physical exercise (O'Rand, 2002). The cumulative insult of negative health behaviors/circumstances associated with low SES creates the health and mortality discrepancy. In contrast, the effect of differential SES exposures may be leveled out over the life course, perhaps due to those with low SES dying. In addition, age can bring with it many challenges in terms of sustaining homeostatic equilibrium across many body systems. This could serve to outweigh the differential impact of SES exposures which produces divergent health trajectories in younger cohorts as, in older cohorts, age-related biological forces become more influential determinants of poor health and mortality. This is known as the 'age-as-leveler' hypothesis (Lynch, 2008).

Most disability research focuses on onset/incidence, prevalence, or transition, and has been conducted mainly in the younger old age group (Chiu & Wray, 2011; Taylor, 2004; Verbrugge et al., 1994). There is limited research addressing disability from a pathway or trajectories perspective, particularly in the very old (aged 85 and older). The majority of previous trajectory analyses have used growth curve modeling or subjective pathway classification, both of which have limitations (Ferrucci et al., 1996; Taylor & Lynch, 2004; Zimmer, Martin, Nagin, & Jones, 2012). Furthermore, many studies fail to fully account for loss to follow up (through death or withdrawal, both of which occur more often in the very old) with a resulting bias (Wolinsky, Armbrecht, & Wyrwich, 2000). In this paper we explore associations between SES and disability trajectories, specifically in the very old, using data from the Newcastle 85+ Study; we use group-based trajectory modelling to improve upon previous analyses (Nagin, 2005). The common underlying assumptions of the majority of previous analyses center on the distribution of trajectory parameters and require these to follow a continuous multivariate normal distribution. The technique we use (GBTM) is less restrictive and allows for clusters of unique developmental trajectories that are potentially a function of different disability aetiologies, thus giving scope to further understand the disability process in the very oldOur paper has two objectives. Firstly, we investigate for the first time whether distinct trajectories of disability are evident in a cohort of the very old, after accounting for mortality. Secondly, we examine the extent to which early, mid and/or late life SES predicts specific disability trajectories. We hypothesise that if the age-as-leveler theory is true, then early-life markers of SES will not prove differential across trajectories in the very old. Conversely, if the cumulative disadvantage hypothesis is true then SES throughout the life course will associate with disability patterns in the very old.

2. Methods

2.1. Participants

Data were drawn from the Newcastle 85+ Study; full details of the study design, protocol and participant recruitment have been described previously (Collerton et al., 2009). In brief, this is a longitudinal study of adults in Newcastle upon Tyne and North Tyneside (North-East England) who was born in 1921, who turned 85 years of age in 2006 when recruitment commenced, and who were registered with a participating general practice. At baseline (wave 1), trained research nurses carried out a detailed multidimensional health assessment (MDHA) of participants in their own home or other permanent place of residence (including institutional care settings) together with a detailed review of their general practice medical records (GPRR). Follow up MDHAs were carried out at 18, 36 and 60 months post-baseline with a further GPRR at 36 and 60 months.

2.2. Disability

Disability was assessed at baseline and all follow-up MDHAs through participants' self-report of their ability to perform 17 Instrumental and Basic Activities of Daily living (IADLs and BADLs) (Katz, Ford, Moskowitz, Jackson, & Jaffe, 1963; Lawton & Brody, 1969) (Supplementary Fig. 1). Participants scored one for each activity they had any difficulty with and zero for each activity performed without difficulty; summation over the 17 activities produced a total disability score (range 0–17) with a higher score indicating a higher level of disability. Activities which predominantly involved mobility (getting around the house, getting in and out of a chair, shopping, going up and down stairs, walking at least 400 yards) were highly correlated with objectively measured timed-up-and-go test times for both men and women (Jagger et al., 2011).

2.3. Mortality

Date and cause of death were obtained through the Health and Social Care Information Service Centre. Survival time was constructed from date of baseline MDHA to date of death and censored at wave 4 (60 months from baseline). For the purposes of this analysis we considered all-cause mortality.

2.4. Measures of socio-economic status

Early-life SES was measured through the number of years of full-time education. Mid-life SES was assessed by main working life occupation, classifying participants through the National Statistics Socio-economic Classification system (NS-SEC) into three categories (routine and manual occupations, intermediate occupations and higher managerial, administrative and professional occupations) (ONS, 2010). As a proxy for current (late-life) SES we derived the area Index of Multiple Deprivation (IMD) from participants' postcodes; this combines a number of indicators chosen to reflect a range of economic, social and housing issues into a single deprivation score with higher scores representing those living in more deprived areas (and therefore greater disadvantage) (Office of the Deputy Prime Minister, 2004).

2.5. Confounding variables

Models were adjusted for some of the major factors associated with both disability and SES: disease burden, Body Mass Index (BMI); and depressive symptomatology. Presence of specific diseases during the participants' lifetime was recorded in the GPRR and disease burden calculated as the number of diseases present from a list of the eight most prevalent (Kingston et al., 2014) (Supplementary Fig. 2). BMI was calculated from height (derived from demi-span) and weight. Depressive symptomatology was measured using the 15 item Geriatric Depression Scale (Yesavage & Brink, 1983).

2.6. Statistical methods

Gender differences in SES and key health characteristics were assessed as follows: education, IMD (ordinal logistic regression); NS-SEC (multinomial logistic regression); disease count, BMI (*t*-test); and disability (Tobit regression to account for the floor effects (Austin, Escobar, & Kopec, 2000)). To explore patterns of