Compression of disability – privilege of the well-educated

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Abstract

The debate about whether compression of morbidity and disability occurs in the older population is now 25 years old, but still undecided. This paper takes the stance that no general rule exists, but that subgroups of the population experience compression or expansion of disability, depending on their socio-demographic status. Little insight exists into factors that affect longitudinal trajectories of disability other than age and sex. This contribution examines a variety of trajectories of both self-reported functional limitations and performance on tests of physical ability, using three cycles (t_1-t_3) of the Longitudinal Aging Study Amsterdam, the Netherlands. The initial cohort of 55-85-year-olds (n=3107) was followed for six years. Trajectories were determined among both the survivors and the deceased. For self-reported limitations, eight trajectories were distinguished, among which the trajectories "not limited, died t_3" (8%) and "late increase" (5%) were considered to reflect most closely the ideal of compression of disability, in addition to "stable not limited" (53%). For physical test performance, 10 trajectories were distinguished, among which "good, died t_2" (7%), "stable good, died t_3" (4%), and "late decline" (13%) were considered to reflect compression of disability most closely, in addition to "stable good" (36%). Unfavourable trajectories showing a prolonged period of disability were observed in 34% and 40% for self-reports and performance, respectively. Controlling for age, sex, and partner status, the predictive ability of low education and low income was evaluated for all trajectories compared to the reference trajectory of "stable no limitations" and "stable good" for self-reports and performance, respectively. Whereas both socio-economic indicators predicted the unfavourable trajectories, in most cases they did not distinguish the favourable trajectories from the reference trajectory. These data support the view that compression of disability is happening, but only in those with higher education and higher income levels.

Introduction

With the aging of the population, it is increasingly important to obtain insight into possibilities to prevent or delay the onset of disability. Regarding changes in the timing of onset of disability during the life course, two conflicting hypotheses have been debated now for 25 years: compression of disability and expansion (or decompression) of disability (Fries 1980, Kramer 1980). So far, no definite evidence has been brought up to support either the one or the other. This paper examines the possibility that subgroups of the population experience compression or expansion of disability, depending on their socio-demographic status. As in particular, education has been shown to affect disability-free life expectancy (Kaneda 2005, Manton 1997, Van Herten 2002), subgroups of the population characterised by high socio-economic status are expected to experience compression of disability, whereas those with low socio-economic status are expected to tend to expansion of disability.

To examine compression or expansion of disability in an individual's life course, data are needed on longitudinal trajectories with more than two time points and including death. However, studies with more than two points in time available tended to focus on transitions from non-disabled to disabled or back. Most commonly, deceased subjects are excluded from the analyses. Multi-state models include death as a state in addition to incidence and recovery, but are usually based on only two points in time (Laditka 1998). Previous studies of trajectories on onset of disability and including death found a wide variety of trajectories, but could examine no other determinants than age and sex (Barberger-Gateau 2000, Ferrucci 1996, Romoren 2003, Rudberg 1996).

So far, the majority of studies on onset of disability were based on self-reports (Stuck 1999). To obtain further insight into issue of compression or expansion of disability, however, self-reports may not be sufficient, as they may be contaminated by personality characteristics (Kempen 1996). To complement the evidence, performance tests of physical ability may be useful. Moreover, they have been shown to be more sensitive to change than self-reports (Guralnik 1994).

This study describes trajectories of both self-reports of disability and performance-based physical ability over a period of six years, including trajectories leading to death, and assesses the predictive ability of education and income for these trajectories, in order to examine the occurrence of compression and expansion of disability in socio-economic subgroups of the population.

Methods

Study sample

Data were derived from the Longitudinal Aging Study Amsterdam (LASA). LASA is a population-based study among persons aged 55 to 85 years in the Netherlands (Deeg 1994). A random probability sample was drawn from the population registries of 11 municipalities, stratified for age and sex so that older ages and men were oversampled. This sample was first recruited for the NESTOR-study on Living Arrangements and Social Networks of older adults (LSN), which had a response rate of 62,3% (N=3,805) (Knipscheer 1995). About eleven months after the LSN interview the respondents were approached for the first LASA cycle, which forms the baseline for the current study. In total, 3,107 subjects were enrolled in the baseline LASA-interview, which took place between September 1992 and September1993 (t_1) (response rate: 81.7%). Attrition was significantly associated with age ($p<0.001$) but not with gender. The first follow-up cycle of LASA was performed in 1995/1996 (t_2) and the second follow-up cycle was performed in 1998/1999 (t_3). In both follow-up cycles all surviving respondents who participated in the baseline LASA-interview were approached for an interview. The interviews were conducted in the homes of the respondents by well-trained and intensively supervised interviewers. All interviews were audio-taped in order to monitor interviewer behaviour.

At the first follow-up after 3 years, 2,545 subjects took part in the study, 417 had died, and 145 were lost to follow-up for other reasons (Deeg 2002). At the second follow-up after 6 years, 2,076 subjects participated, 344 subjects had died, and 125 were lost to follow-up for other reasons. Among the 2,076 participants, data from three cycles were available for 1,988

subjects on self-reports of functional limitations and for 1,673 on performance tests of physical ability. Among the 344 subjects who died after t_2, 325 and 258 subjects had complete data for t_1 and t_2 on self-reports and performance tests, respectively. In comparison with subjects with complete data and subjects who died, subjects lost to follow-up and subjects with item non-response were more often female, were slightly older, had lower education, and had more often cognitive impairment at baseline (chi-square tests, $p<0.05$).

Measures

Rather than on disability, the end stage of the disablement process, this study focuses on functional limitations, which conceptually precede disability (Verbrugge 1994). The measure of *functional limitations* was based on self-reports assessing the degree of difficulty with the following three activities: climbing stairs, cutting ones own toenails, and use of own or public transportation (Kriegsman 1997). The response categories ranged from 0 = no difficulty to 3 = not able to perform. The items were summed to a functional limitations score ranging from 0 to 9. The *performance tests* measured the number of seconds needed to complete three tasks, for example to walk three meters back and forth along a line. The quartiles of the time needed were coded as 1 = fast, through 4 = slow. Those who could not do the test were assigned the code 5. The scores were summed to a scale ranging from 3 to 15 (Guralnik et al 1994, Penninx et al 2000).

Socio-demographic covariates included age, sex, living arrangements, education, and income. Data on age and sex were derived from the population registries at baseline. Partner status was defined as living with one's partner in one household versus no partner in the household. Institutionalisation was defined as living in a residential home for the aged or in a nursing home versus living in the community. Education was assessed by asking the respondent for the highest educational level completed, which was converted into equivalent years of education (range, 5 to 18 years). For the descriptive analyses, education was dichotomised as elementary schooling or less versus higher than elementary schooling, and income, as less than state pension + €100 versus higher.

Statistical method

In order to distinguish patterns among functional limitation scores across time, termed course types, two sets of cluster analyses were performed. One, using functional limitation scores at t_1, t_2, and t_3 in the survivors, and another, using functional limitation scores at t_1 and t_2 in those who died before t_3. See Deeg (2005) for a detailed description.

Differences among the clusters according to socio-demographic baseline characteristics were tested using chi-square tests. The clusters were also used as the dependent variable in multinomial regression models, with education or income as the independent variable, and adjusting for sex, age, and partner status. The course type “stable not limited” as the reference in the analyses of self-reported trajectories, “stable good” as the reference in the analyses of performance trajectories. Increased risk of a socio-economic indicator for a specific course type compared to the reference was established when the 95% confidence interval of the relative risk did not include 1; more generally, increased risk for one course type compared to a second course type was established when the 95% confidence interval of the first course type did not include the relative risk estimate of the second course type.

Results

Description of course types

- TABLE 1 ABOUT HERE -

There were eight six-year trajectories of self-reported limitations. The trajectory that occurred most frequently was “stable not limited”: 53% of older persons could be categorised in this type (table 1). The second most frequent course type consisted of those who died before t_2 (15%). Their average functional limitations score at baseline was 3. The third and fourth most frequent course type each occurred in 8% of the sample, and were labelled “stable mild”,

with subjects showing an average score of 3 to 4, and “not limited, died t_3”, with subjects dying between t_2 and t_3 without having reported functional limitations. The course type fifth in size (5%) was “delayed increase“, with subjects showing an increase from 1-2 points on the functional limitations scale at t_1 and t_2 to on average 7 points at t_3. The other course types occurred in 3-4% of the respondents. They were “increase t_1-t_2, died t_3“, with a score increase from 6 to 8 points on the functional limitations scale between t_1 and t_2, “gradual increase”, with average scores increasing from 3 at t_1 to 8 points at t_3, and “stable severe”, with scores around 7 or 8 throughout the six-year period.

Based on performance tests of physical ability, there were 10 trajectories. The most frequent trajectory was “stable good”, observed in 36% of the cohort. Because performance tests are more sensitive to change at all levels of functioning, this percentage is lower than that for self-reported limitations. For the same reason, more trajectories could be distinguished using performance tests than using self-reported limitations. Nevertheless, the performance-based trajectories were generally the same ones as the self-reported limitations trajectories. There are two exceptions: among those who died between t_2 and t_3, in addition to “stable good, died” (4%) and “decline, died” (2%) a third trajectory was found indicating “stable poor, died” (5%). Furthermore, among those who died before t_2, two trajectories were distinguished: “good, died” (7%) and “poor, died”(8%).

The Spearman correlation coefficient among the two sets of trajectories was 0.51.

The trajectories based on self-reports of functional limitations that were considered to reflect most closely the ideal of compression of disability were “stable not limited” (53%), “not limited, died t_3” (8%) and “late increase” (5%). For physical test performance, the trajectories considered to be indicating compression of disability were “stable good” (36%), “good, died t_2” (7%), “stable good, died t_3” (4%), and “late decline” (13%). Expansion of disability was considered to be reflected in several unfavourable trajectories showing a prolonged period of disability, which were observed in 34% and 40% for self-reports and performance, respectively.

Socio-economic predictors

- TABLE 2 ABOUT HERE -

Combining the trajectories indicative of compression of disability, it was found that among those with high socio-economic status, 66-75% experienced one of these course types. In contrast, this was the case for only 40-55% of those with low socio-economic status. These differences were highly significant ($p < 0.001$). Moreover, using multinomial regression models, adjusting for age, sex, and partner status, these differences remained highly significant (data not shown).

Discussion

This study shows that during at least six years, just over half of the population in the age group 55-85 years remained free from functional limitations, and more than one-third kept performing well on tests of physical ability. The socio-economic indicators showed that the favourable course types, including “stable not limited”, “late decline”, and “not limited, died by t_3”, were overrepresented among the highly educated, and those with a reasonable to high income. Among these, high education is an asset than cannot be lost, and therefore the highly educated subgroup of the population is most likely to experience the ideal of compression of morbidity.

Several limitations of this study should be discussed. First, this study spans a period of only six years, and did not follow each subject until death. Moreover, information on time since onset of the disability before baseline was not incorporated. However, by piecing together both initially non-limited and limited course types not ending in death and course types ending in death, an overview of course types from disease-related onset of functional limitations to death can be seen to emerge.

The three-year interval between observation cycles is a second limitation, as three years may a long time for the development of disability. Also, the level of functional limitations may fluctuate, with episodes of more severe and milder limitations (Gill 2003). Thus, the line drawn between compression and expansion may be too crude and induce misclassification.

A final limitation is that 12% (functional limitations) to 26% (physical performance) of the sample was lost to follow-up due to other reasons than mortality. These reasons were associated with higher age and cognitive impairment, but not with other chronic conditions. It is possible that the prevalence of cognition-related trajectories is underestimated.

Despite its limitations, this study contributes new data on the differential experience of compression and expansion of disability in subgroups of the population.

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Table 1. Six-year trajectories of self-reported functional limitations (FL) and performance-based ability (PA)

	FL		PA	
	N	%	N	%
stable not limited / good	1444	52.9	813	35.5
stable mild / moderate	223	8.2	278	12.1
stable severe / poor	84	3.1	113	4.9
gradual increase / early decline	96	3.5	163	7.1
delayed increase / late decline	141	5.2	306	13.4
stable not limited / good, died t_3	215	7.9	90	3.9
poor, died t_3	-		112	4.9
increase / decline t_1-t_2, died t_3	110	4.0	54	2.4
good, died t_2	-	-	169	7.4
poor, died t_2	-	-	190	8.3
died t_2	417	15.3	-	-

Table 2. Trajectories indicating compression and expansion (%), by socio-economic indicators

	Education		Income	
	Low	High	Low	High
Functional limitations				
Compression	51.0	66.6	47.4	72.7
Expansion	49.0	33.3	52.6	27.3
Performance-based ability				
Compression	55.0	74.5	40.6	75.2
Expansion	45.0	25.5	59.4	24.8