Research Article

Are Advances in Survival Among the Oldest Old Seen Across the Spectrum of Health and Functioning?

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Abstract

Background: Mortality rates have been reduced by half over the last 60 years for nonagenarians, and the progress is continuing. The greater survival might be due to overtreatment of severely physically and cognitively disabled individuals, which is a big concern for societies and individuals.

Methods: The study population comprised two Danish birth cohorts: the 1905 Cohort and the 1915 Cohort. At age 95, all from the two cohorts who were still alive and living in Denmark were invited to participate in a health survey that used the same assessment instrument. A total of 2,670 (56.8%) persons participated in the two surveys and survival was assessed through a 7.3-year follow-up period during which 2,497 (93.5%) had died, and with virtually no loss to follow-up.

Results: Despite the increasing chance of surviving to age 95, the 1915 Cohort had significantly better health and functioning than the 1905 Cohort. The survival advantage in the 1915 Cohort continued in the follow-up period after age 95: Median survival length was 2.4 months longer, $p = .011$. This advantage was not statistically associated with different levels of activities of daily living, physical performance, cognitive functioning, self-rated health and life satisfaction. However, the advantage tended to be more pronounced among people with better health.

Conclusions: Life span and health increases among the oldest old. The improvement in survival for 95-year olds born in 1915 compared with 1905 was seen across the whole spectrum of health and functioning, with a tendency towards bigger improvement among those in good health.

Keywords: Improvement, Nonagenarians, Cohort effects, Spectrum of Health

Background

For every 10 years since 1950, 20%–40% more people from a birth cohort make it into their 10th decade in most high-income countries with Japan being the forerunner with an increase of 57% (1). Furthermore, mortality rates for nonagenarians have also been cut by half from 1950 to 2010 (2). This development has increased the number of nonagenarians and centenarians in the world to approximately 12.5 and 0.35 million, respectively, in 2010 (3).

There is a general concern among researchers, care takers, and decision makers, and also in the general population, that this

increase is primarily due to overtreatment of the most disabled, resulting in a large proportion of oldest old with very poor health and very low life satisfaction. This concern was based largely on studies conducted in the beginning of the 21st century showing an increase in future prevalence of dementia in America and a marked increase in cognitive impairment among the oldest old in Sweden (4,5). Another Swedish study using the same data also showed a decreased mortality among men with complex health problems (6). A Finnish study of nonagenarians showed no difference in the prevalence of disability in activity of daily living (ADL) between 2001

and 2007, which implies that the number of disabled people will increase as a result of the growing fraction of people surviving to the highest ages (7). However, recent studies have shown that later-born cohorts have better cognitive functioning. An American study showed that later-born cohorts between the ages of 50 and 80 years had better cognitive functioning and lower decline in cognition with age (8). We have previously shown that this cognitive improvement continues into very old age: 95-year olds born in 1915 performed significantly better cognitively than 93-year olds born in 1905 (9). A recent English study further supported these findings by showing that the prevalence of dementia had declined in 65+-year olds over two decades (10). Recent studies have shown an improvement in ADL among the oldest old, but also an increase in morbidity, musculoskeletal pain, and impaired mobility (9,11,12). However, most of these recent studies only compared the prevalence of cognition and disability between the cohorts.

This study comprises two whole Danish birth cohorts born 10 years apart and followed from the age of 95. The aim of this study was to investigate whether the improvement in survival from age 95 in the two cohorts was seen primarily in those with poor cognition, ADL disability, impaired physical performance, and low self-rated health and life satisfaction, or whether the improvement in survival for nonagenarians was seen across the spectrum of health and functioning.

Methods

Study Population

The 1895, 1905, 1910 and 1915 Danish Birth Cohort Studies were all population-based nationwide studies of nonagenarians and centenarians that included all individuals born in the respective birth year and living in Denmark at the time of the studies. The aim of these studies was to assess secular trends and the general health and functioning of nonagenarians and centenarians in Denmark. The exact numbers of persons in the four different cohorts were identified through the Danish Civil Registration System. There were no exclusion criteria for participating in the studies and a proxy responder (typically an offspring) was encouraged to participate in the interview if the cohort member was considered unable to participate. More details of the surveys can be found in an overview article describing the surveys (13).

In this study, we will focus on a comparison between the 95-year olds from the second wave of *The Danish 1905 Cohort study* and the 95-year olds from the first wave of *The Danish 1915 Cohort study*. As these surveys use the same methodology, it will enable us to compare secular trends in survival among the oldest old stratified for health and functioning (Figure 1). The second wave of *The Danish 1905 Cohort study* took place from September 4, 2000, which was the date of the first interview in the survey. At that point, a total of 2,118 people from the cohort were still alive and living in Denmark, and of these, 1,086 (51%) participated in the survey, which ran until January 2001. Only participants from the first wave were invited to participate. However, to be able to compare with the first wave of *The Danish 1915 Cohort study*, we calculated the participation rate against both those who refused to participate and the nonparticipants from the first survey who were still alive, that is, the denominator was all Danes born in 1905 who were alive at the time of the second survey. The first wave of *The Danish 1915 Cohort study* was conducted from September 6, 2010 (the date of the first interview in the survey), and at this date, a total of 2,580

was living in Denmark. Of these, 1,584 (61%) participated in the survey, which ran until November 2010 (Figure 2). The assessments were conducted by trained lay interviewers from the Danish Institute of Social Research and the same survey instrument was used in the two surveys. The ethical committee system in Denmark approved the studies (*The 1905 Cohort study*: VF-20040240; *The 1915 Cohort study*: S-20100011), and all participants provided informed consent to participate.

Health and Functioning Measures

Activity of daily living was assessed by five questions regarding basic tasks: bathing, dressing, toileting, transfer, and feeding. The responses were converted to the three-level Katz disability score: severely disabled, moderately disabled, and not disabled (14). This simple measure of ADL has been shown to be highly predictive of mortality among the oldest old and is widely used among care takers (15,16). Physical performance was evaluated by the ability to rise from a chair, which has been shown to be associated with lower body strength, disability, and mortality in the oldest old (15,17,18). The test was done as single chair stand,

Figure 1. A Lexis diagram of the 1895, 1905, 1910, and 1915 Danish Cohorts. The circles indicate surveys conducted by a geriatrician and a nurse. The squares indicate surveys conducted by trained lay interviewers. The survey in 2015 for the 1915 Cohort was for half of the Danish population assessed by a geriatrician and a nurse and for the other half by trained lay interviewers. The two diamonds indicates the two surveys used in this study.

Figure 2. Methods of selection of participants for the two studies of the Danish 1905 and 1915 Cohorts. The 95-year olds in the Danish 1905 Cohort are a follow-up study of 93-year-old participants, and the Danish 1915 Cohort are an intake study. Age ranged at interview from 94.7 to 95.9 years of age in both surveys.

wherein the participants were asked to rise from an armless chair placed against a wall. Three outcomes were registered: unable to rise, able to rise using hands, and able to rise without using hands. The cognitive function was measured using the Mini-Mental State Examination (MMSE), which has a scale from 0 to 30 (19). It was divided into three categories: 0–17 (severe cognitive impairment), 18–23 (mild cognitive impairment), and 24–30 (no cognitive impairment) (20). Self-rated health was evaluated using the question: “How do you consider your health in general?”, which was divided into three categories: very poor/poor, acceptable, good/excellent (21). Furthermore, the life satisfaction of the participants was evaluated by the question: “Do you feel happy and satisfied with life at present?”, which was divided into three categories: never/almost never, now and then, and mostly/always. Proxy interview was only used in the assessments of ADL, which have previously been shown to be compatible to the person in question’s own evaluation (22).

Survival

All the members of the Danish 1905 Cohort were followed from September 4, 2000 through January 1, 2008, and all the members of the Danish 1915 Cohort were followed from September 6, 2010 through January 1, 2018. The reason for these different censoring dates was that we wanted to have compatible length of

follow-up between the two cohorts. Survival was obtained from the Danish Civil Registration system, which registers date of death or emigration of all Danish citizens. Only two persons emigrated in the follow-up period and were lost to follow up at the emigration date.

Statistical Analysis

Fisher’s Exact Test was performed to study whether nonparticipation, interview by proxy, and health and functioning measures differed between the 1905 Cohort and the 1915 Cohort at age 95. Survival analyses using a Laplace regression were performed to study the association between median survival and the health and functioning measures for the two cohorts separately (23). In short, a Laplace regression is a quantile regression capable of handling censored data, and in case of no censored data, the Laplace regression and the quantile regression would be equivalent. The chance of surviving to age 100 was evaluated using a binomial regression model. Birth cohort difference in survival was then conducted and interaction models were used to investigate whether the difference between the two cohorts was associated with gender, nonparticipation, interview by proxy, or the health and functioning measures. In the Laplace regression, survival time was assessed from the interview date to the date of death or the end of follow-up, and the analysis was adjusted by age and gender.

Table 1. Summary Statistics for Each Gender and Cohort

	Men			Women		
	1905 cohort	1915 cohort	<i>p</i> -value*	1905 cohort	1915 cohort	<i>p</i> -value*
All†	(<i>n</i> = 430)	(<i>n</i> = 582)		(<i>n</i> = 1688)	(<i>n</i> = 1998)	
Participation, <i>n</i> (%)			.004			<.001
No	178 (41.4)	188 (32.3)		854 (50.6)	808 (40.4)	
Yes	252 (58.6)	394 (67.5)		834 (49.4)	1190 (59.6)	
Participants	(<i>n</i> = 252)	(<i>n</i> = 394)		(<i>n</i> = 834)	(<i>n</i> = 1190)	
Age at interview			.225			.225
Mean (<i>SD</i>)	95.3 (0.3)	95.3 (0.3)		95.3 (0.3)	95.3 (0.3)	
Proxy, <i>n</i> (%)			.487			.056
Yes	32 (12.7)	58 (14.7)		165 (19.8)	279 (23.4)	
No	220 (87.3)	336 (85.3)		669 (80.2)	911 (76.6)	
Katz disability, <i>n</i> (%)			.019			.246
Disabled	44 (17.5)	68 (17.4)		214 (25.8)	270 (22.9)	
Moderately	101 (40.1)	117 (29.9)		326 (39.2)	463 (39.2)	
Not disabled	107 (42.5)	206 (52.7)		291 (35.0)	448 (37.9)	
Chair stand, <i>n</i> (%)			.201			.066
Not able	16 (7.7)	30 (9.0)		72 (11.3)	97 (10.9)	
With use of hands	96 (46.2)	127 (38.3)		318 (49.9)	397 (44.5)	
Without use of hands	96 (46.2)	175 (52.7)		247 (38.8)	398 (44.6)	
MMSE, <i>n</i> (%)			.016			<.001
Score 0–17	49 (23.1)	53 (16.0)		179 (27.1)	156 (17.5)	
Score 18–23	58 (27.4)	74 (22.3)		211 (31.9)	283 (31.8)	
Score 24–30	105 (49.5)	205 (61.7)		271 (41.0)	452 (50.7)	
Self-rated health, <i>n</i> (%)			.002			<.001
Very poor or poor	22 (10.0)	19 (5.7)		52 (7.8)	54 (5.9)	
Acceptable	74 (33.6)	78 (23.3)		236 (35.3)	245 (26.9)	
Good or excellent	124 (56.4)	238 (71.0)		381 (57.0)	612 (67.2)	
Life satisfaction, <i>n</i> (%)			.058			<.001
Never/almost never	17 (7.8)	14 (4.2)		48 (7.2)	46 (5.1)	
Now and then	32 (14.7)	35 (10.6)		119 (17.9)	88 (9.8)	
Mostly/always	169 (77.5)	282 (85.2)		499 (74.9)	767 (85.1)	

Note: *This is a test of equal mean or equal proportions between the two cohorts estimated from a *t* test or Fisher exact probability test.

†These are the numbers of those alive September 4, 2000 and September 6, 2010 for the 1905 Cohort and the 1915 Cohort, respectively.

MMSE = Mini-Mental State Examination.

Since participation rates differed between the two cohorts and participation was predictive of survival, the Laplace regressions and the binomial regressions were performed using inverse probability weighting (IPW) in which more weight was put on those who had a short life span. The probabilities were estimated for each cohort by analyzing the association between participation and life span using a logistic regression adjusted by gender. This was done to make the analysis of the participants of each cohort reflect the whole population (both participants and nonparticipants). This was important to make the analysis less biased to the different participation rates (Supplementary Figure 1). Statistical analysis was done using Stata 14.2 (STATA Corp, College Station, TX).

Results

The participation rates were higher for the 1915 Cohort than for the 1905 Cohort. For men, the rates were 58.5% and 67.5% in the 1905 Cohort and the 1915 Cohort, respectively, and for women, the rates were 49.3% and 59.3% (Table 1). The proportion of proxy interviews did not differ significantly between the cohorts, and the main reason for using a proxy respondent in these two studies was mental disabilities for both cohorts: 57% of the 197 proxy interviews for the Danish 1905 Cohort and 54% of the 337 proxy interviews for the Danish 1915 Cohort was due to mental disabilities. At the age of 95, the members of the 1915 Cohort performed better in the health and functioning measures than members of the 1905

Cohort despite the higher participation rates in the 1915 Cohort (leaving less room for selection bias toward healthy participants, see Figure 2). This was most pronounced for cognition, where males and females in the 1915 Cohort scored significantly better on MMSE (score 24–30: 61.7% of males and 50.7% females) compared with the 1905 Cohort (score 24–30: 49.5% of males and 41.0% females). This improvement was seen despite the potential practice effect in the 1905 Cohort since they have 2 years prior gotten familiar with the tests. Furthermore, a significant improvement was seen in self-rated health for both genders, where the percentage of males who considered their health in general to be good or excellent increased from 56.4% in the 1905 Cohort to 71.0% in the 1905 Cohort. For women, the percentage increased from 57.0% in the 1905 Cohort to 67.2% in the 1915 Cohort.

For both the 1905 Cohort and the 1915 Cohort, the 95-year olds participating had a higher median survival and higher chance of surviving to 100 years compared with those not participating (Table 2). For those participating, there was an increased survival in both cohorts among nonproxy interviews. Katz disability, chair stand, MMSE, self-rated health, and life satisfaction were all associated with survival, and all associations were in the expected direction with better scores predicting better survival. Especially Katz disability showed a strong association with survival in both cohorts (Table 2). Those not being disabled had over twice the medium survival compared with those being disabled, and the chance of surviving to 100 was only 4%–5% for the disabled, but the chance

Table 2. Association Between Survival and Participation, Interview by Proxy and the Health Measures done Separately for the 1905 and 1915 Cohorts

	Medium survival (years)		Chance of surviving to 100 years (%)	
	1905 cohort (95% CI)	1915 cohort (95% CI)	1905 cohort (95% CI)	1915 cohort (95% CI)
Participation [†]				
No	1.8 (ref)	2.0 (ref)	13 (ref)	15 (ref)
Yes	2.5 (2.3–2.7)	2.5 (2.4–2.6)	20 (17–22)	21 (18–23)
Proxy				
Yes	1.2 (ref)	1.3 (ref)	6 (ref)	5 (ref)
No	2.4 (2.2–2.6)	2.8 (2.6–2.9)	19 (16–23)	23 (20–26)
Katz disability				
Disabled	1.2 (ref)	1.4 (ref)	4 (ref)	5 (ref)
Moderately	2.0 (1.8–2.3)	2.1 (1.9–2.3)	11 (8–14)	14 (12–17)
Not disabled	3.3 (3.0–3.6)	3.5 (3.2–3.8)	31 (26–37)	32 (27–36)
Chair stand				
Not able	1.4 (ref)	1.7 (ref)	3 (ref)	8 (ref)
With use of hands	2.3 (2.0–2.6)	2.5 (2.2–2.8)	14 (11–18)	18 (15–22)
Without use of hands	3.4 (3.1–3.8)	3.8 (3.4–4.2)	32 (26–38)	31 (26–35)
MMSE				
Score 0–17	1.7 (ref)	1.7 (ref)	9 (ref)	13 (ref)
Score 18–23	2.4 (2.0–2.7)	2.4 (2.0–2.9)	17 (12–22)	19 (15–23)
Score 24–30	3.1 (2.9–3.3)	3.3 (2.9–3.6)	28 (23–32)	30 (27–34)
Self-rated health				
Poor/very poor	1.7 (ref)	1.9 (ref)	10 (ref)	9 (ref)
Acceptable	2.2 (1.9–2.5)	2.4 (2.0–2.9)	15 (11–19)	19 (15–23)
Good or excellent	2.8 (2.6–3.0)	3.1 (2.8–3.4)	24 (20–28)	27 (24–30)
Life satisfaction				
Never/almost never	1.6 (ref)	1.9 (ref)	14 (ref)	16 (ref)
Now and then	2.3 (1.7–2.8)	2.2 (1.6–2.7)	14 (8–19)	16 (9–23)
Mostly/always	2.6 (2.4–2.8)	2.9 (2.7–3.2)	22 (18–25)	26 (22–29)

Note: The analysis was adjusted for gender and age and the results are shown as a marginal effect compared to the reference group (ref) at the age of 95. CI = Confidence interval; MMSE = Mini-Mental State Examination.

[†]In this analysis, September 4, 2000 and September 6, 2010 was used as origin for all person in the 1905 Cohort and the 1915 Cohort, respectively.

increased to 31%–32% for those not disabled. MMSE also showed an association with median survival which increased from 1.7 years for those having an MMSE below or equal to 17 to 3.1–3.3 years for those having an MMSE above or equal to 24.

According to the Human Mortality Database, the chance of surviving from birth to age 95 increased by 32% for the 1915 Cohort compared with the 1905 Cohort (1). Furthermore, the median survival time from September 4, 2000 (the start of the survey), for the 2,118 people from the 1905 Cohort was 2.17 years, and from September 6, 2010 (the start of the survey), it was 2.32 years for the 2,580 members of the 1915 Cohort. The chances of surviving to 100 years from age 95 years had increased from 17.2% to 19.3%. This improvement in survival for 95-year olds over a 10-year period was statistically significant according to a Laplace regression analysis adjusted for gender and age (median survival was 2.4 months longer, 95% confidence interval = (0.5–4.2), $p = .011$).

This improvement in survival observed for the 1915 Cohort compared with the 1905 Cohort were not statistically different with increasing levels of the health or functioning measures (Table 3). However, there was a tendency for the increase in survival over the 10-year period to be most pronounced among those with better health, except in one analysis. For those who were disabled, there was only a 0.6-month increase in median survival from the 1905 Cohort to the 1915 Cohort. However, for those who were not disabled, there was a 2.2-month increase in median survival. For those who had an MMSE between 0 and 17, the increase in median survival was of only 0.2 months from the 1905 Cohort to the 1915 Cohort, whereas the increase for those who had an MMSE between 24 and 30 was

of 2.4 months. The increase in the chance of surviving to 100 years for the 1915 Cohort compared with the 1905 Cohort was also more pronounced among those with better self-rated health and better life satisfaction. However, for chair stand, the increase was primarily seen among those with worse scores. These analyses were performed using IPW, and the overall results did not change even when the IPW was excluded from the analysis (Supplementary Table S1).

Discussion

We found that for 95-year olds born in 1905 and 1915, the later-born cohort had significantly better health and functioning measured as ADL, MMSE, self-rated health, and life satisfaction than the earlier-born cohort, and they also had better survival. This advance in survival among the oldest old was not statistically associated with different levels of ADL, physical performance, cognitive functioning, self-rated health, and life satisfaction. However, there was a tendency that the advance was more pronounced among those with better health, suggesting that the advances in survival are mostly seen as a result of people in better health living longer.

These results support previous findings that the prevalence of ADL disability, cognitive impairment and dementia has decreased among the oldest old in later-born cohorts in England and Denmark (8–10). In Finland, two studies reported an improvement in disability in the age range of 65–84 years, but in a study among nonagenarians, there was no difference in disability between the years 2001 and 2007 (7,24,25). This could, however, be a question of timing: In Sweden, a study reported an increase in disability between the years

Table 3. The Difference in Survival for the 1915 Cohort Compared with the 1905 Cohort for Each Level of the Health Measures Including Information on Proxy Interview

	Difference in medium survival for the 1915 vs the 1905 cohort (months)		Absolute difference in the chance of surviving to 100 years for 1915 vs the 1905 cohort (%)	
	Estimate (95% CI)	p -value [†]	Estimate (95% CI)	p -value [†]
Proxy		.20		.07
Yes	0.8 (–2.1–3.7)		–1.2 (–4.7–2.3)	
No	3.2 (1.0–5.4)		3.3 (–0.1–6.6)	
Katz disability		.66		.79
Disabled	0.6 (–2.6–3.9)		0.8 (–2.0–3.6)	
Moderately	0.4 (–2.1–2.9)		1.8 (–2.0–5.6)	
Not disabled	2.2 (–2.3–6.7)		–0.9 (–6.5–4.8)	
Chair stand		.45		.14
Not able	1.5 (–3.6–6.7)		4.9 (–1.0–10.9)	
With use of hands	3.0 (0.6–5.4)		3.8 (–0.7–8.3)	
Without use of hands	4.1 (0.2–7.9)		–1.4 (–7.5–4.6)	
MMSE		.40		.98
Score 0–17	0.2 (–3.6–4.0)		1.2 (–4.5–7.0)	
Score 18–23	2.0 (–1.5–5.5)		1.7 (–4.0–7.3)	
Score 24–30	2.4 (–0.8–5.6)		1.2 (–4.3–6.6)	
Self-rated health		.94		.19
Poor/very poor	2.8 (–3.6–9.3)		–3.4 (–9.7–2.8)	
Acceptable	1.7 (–1.8–5.3)		2.6 (–2.6–7.9)	
Good or excellent	2.5 (–0.6–5.6)		2.4 (–2.2–7.0)	
Life satisfaction		.29		.71
Never/almost never	4.1 (–3.4–11.6)		0.8 (–10.9–12.5)	
Now and then	–2.6 (–7.6–2.3)		2.8 (–4.6–10.1)	
Mostly/always	3.8 (1.2–6.4)		3.3 (–0.7–7.2)	

Note: The analysis was adjusted for gender and age. CI = Confidence interval; MMSE = Mini-Mental State Examination.

[†]The p -values are from tests if the estimates are increasing or decreasing significantly with increasing health.

1992 and 2002, but a subsequent study showed a decrease between the years 2002 and 2011 among the oldest old (11,26). Similarly, in the United Kingdom, one study found an increase in disability from 1992/1993 to 1996/1997, but in a subsequent study, the results indicated a decrease in limitation of usual activity from the years 1996 to 2006 (27,28). In the United States, mixed results have been found regarding the change in disability rates over time (29,30).

In our study, we further found a marked improvement in self-rated health and life satisfaction among the oldest old. In the previous studies, however, it was not investigated whether the association between health measures and mortality varied over cohorts. These studies only compared prevalence across cohorts, and even though the studies found improvement over time, it is still possible that people with poor health are living longer over time. Here, we found that those in poor health generally had a small improvement in survival over the 10-year period. This could be due to better treatment or assistance in helping these people maintain or regain some of their function. However, it could also be a consequence of keeping the very old alive for a longer time in very poor health. This, combined with the increasing number of people making it to very high ages, could, in the years to come, increase the number of disabled old people and the length of time that they are in need of care, despite the overall positive tendency that the improvement in survival was more pronounced for the healthier individuals.

The strength of our study is that information on date of death and emigration for all members of the Danish 1905 and 1915 Cohorts is attained through the Danish Civil Registration system, making it possible to compare mortality between participants and nonparticipants. A weakness of the study is that the methods of selection of participants in the two studies are different, resulting in lower participation rate in the 1905 Cohort compared with the 1915 Cohort. The 95-year olds in the 1905 Cohort are part of the follow-up study of the participants from the intake survey 2 years previously, and the 95-year olds in the 1915 Cohort are the intake study. Hence, there are two possibilities of being a nonresponder in the 1905 Cohort compared with only one possibility in the 1915 Cohort. To handle this difference, we used an IPW approach in the survival analysis giving more weight to those who had a short life span in the analysis. As shown in [Supplementary Figure 1](#), when using IPW, we could better describe the difference in survival between the two cohorts, and since survival is a good predictor of the health measures in the very old, the analyses were less biased than would have been the case had we not been using IPW (31). The analysis result generally showed that the advance in survival was seen across the spectrum of health and functioning ([Supplementary Table S1](#)). Also, since those not participating generally have poorer health compared with those participating, this would imply that the tendency of a higher advance in survival among those in better health might be even more pronounced compared to our results due to the fact that the 1905 Cohort had a lower participation rate.

In conclusion, there was an improvement in health and survival when comparing the two Danish cohorts of 95-year olds born 10 years apart, and the advances in survival were primarily seen among those in better health and functioning, even though it did not reach significance. This indicates that the increasing life expectancy of the oldest old is not driven by better survival of the most disabled, but in fact by healthier people making it to higher ages.

Supplementary Material

Supplementary data is available at *The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences* online.

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Conflict of Interest

None reported.

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