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BMJ Open

Changes in life expectancy and lifespan variability by income quartiles in four Nordic countries: a study based on nationwide register data

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ABSTRACT

Objectives Levels, trends or changes in socioeconomic mortality differentials are typically described in terms of means, for example, life expectancies, but studies have suggested that there also are systematic social disparities in the dispersion around those means, in other words there are inequalities in lifespan variation. This study investigates changes in income inequalities in mean and distributional measures of mortality in Denmark, Finland, Norway, and Sweden over two decades.

Design Nationwide register-based study.

Setting The Danish, Finnish, Norwegian and Swedish populations aged 30 years or over in 1997 and 2017.

Main outcome measures Income-specific changes in life expectancy, lifespan variation and the contribution of 'early' and 'late' deaths to increasing life expectancy.

Results Increases in life expectancy has taken place in all four countries, but there are systematic differences across income groups. In general, the largest gains in life expectancy were observed in Denmark, and the smallest increase among low-income women in Sweden and Norway. Overall, life expectancy increased and lifespan variation decreased with increasing income level. These differences grew larger over time. In all countries, a marked postponement of early deaths led to a compression of mortality in the top three income quartiles for both genders. This did not occur for the lowest income quartile.

Conclusion Increasing life expectancy is typically accompanied by postponement of early deaths and reduction of lifespan inequality in the higher-income groups. However, Nordic welfare societies are challenged by the fact that postponing premature deaths among people in the lowest-income groups is not taking place.

Strengths and limitations of this study

- ► The strength of the study is that it is based on register data for the entire Danish, Finnish, Norwegian and Swedish populations aged 30+ with high-quality data on mortality and income.
- ► Individual income was defined as equivalised disposable income adjusting for different consumption possibilities depending on household size and constitution. Income was grouped into quartiles.
- ► The hypothetical nature of the income-quartile-specific period life tables indicates interpretation limitations as the life tables do not reflect future changes in mortality or transitions between income quartiles during individual life courses.

INTRODUCTION

In recent years, all the Nordic countries have demonstrated a growing interest in making efforts to reduce social inequality in health and mortality.[1] These policy efforts have to a significant degree been informed by studies estimating trends in social inequalities in life expectancy and mortality.[2–6] However, life expectancy is a population-level measure that indicates the average length of life given the age-specific mortality at one point in time and changing levels of life expectancy may be generated through a number of different processes.[7 8] In order to better understand how inequalities in life expectancy changes are generated, information on the variation of age at death within social strata is a key issue.[9] Taking lifespan variation into account has important implications for policy, both regarding preventive measures and the design of pension systems and health services. Life expectancy increases when deaths at any age are postponed while change in lifespan variation depends on the age of the postponed deaths. While postponing early deaths reduces lifespan variation, postponing late deaths enlarges it. A formula for a threshold age permits to determine how lifespan variation relates to 'early' and 'late' deaths.[10]

The purpose of this study was to investigate and compare changes in life expectancy as well as lifespan variation by income quartile in Denmark, Finland, Norway and Sweden from 1997 to 2017. Characteristics of the distribution of age at death was studied and differences between income quartiles in the contributions of 'early' and 'late' deaths to increasing life expectancy were assessed.

Studies have demonstrated a correlation between increasing life expectancy and decreasing lifespan variation.[11 12] However, this relationship is not observed universally,[8 13] and the deviance becomes particularly clear in studies of social differentials in changes in the age-at-death distribution.[8 14–17] In Finland, trends in lifespan variation differed between occupational groups, as for instance lifespan variation stagnated among manual workers during almost 40 years while the higher occupational groups experienced reduced variation resulting in compression of mortality.[8] The standard deviation of the average age at death in Swedish men and women with basic education increased since 2000, whereas it decreased slightly among Swedes with tertiary education.[14] A Danish study showed a slight increase in lifespan variation among men and women in the lowest income quartile, while the other income quartiles experienced a clear decline.[15] The time period and the specific indicator of lifespan variation and socioeconomic position differed across these studies, making it difficult to compare changes or trends directly between the Nordic countries. Different trends in lifespan variation by socioeconomic position have also been documented in the USA[16] and in Spain.[17] Although some studies have shown socioeconomic inequality in patterns and trends in lifespan variation, this study is the first to assess changes in lifespan variation in the Nordic countries from a comparative perspective. Education is often a chosen indicator in analyses of socioeconomic differences in mortality. However, information on education is often incomplete for the elderly population, and over time and between countries. In addition, the educational distributions vary, making comparisons difficult to interpret. To avoid these problems, this study divides the population into income quartiles. The study derives advantage from access to register data of the four countries covering the entire populations. These registers comprise tax administrative data on income and mortality data for all residents.

MATERIALS AND METHODS

The study was based on register data for 1996–1997 and 2016–2017 (1997 and 2017 in short) in Denmark, Finland, Norway and Sweden. Income data were extracted from the Tax and Customs Administration in Denmark, Tax Administration and Social Insurance Institution in Finland, the Tax and Income Register in Norway and the Tax and Income Register in Sweden. Systematically collected population data and data on deaths in all countries were linked at the individual level by a unique personal identification number. Income for all individuals aged 30 and above was based on equivalised disposable household income as defined by Eurostat and calculated as the total household income after deduction of taxes and social contributions divided by the number of 'equivalent adults' reflecting the size and the age composition of the household by weighting all members of the household: 1.0 to the first adult, 0.5 to the second adult and each subsequent person aged 14 and over and 0.3 to each child aged under 14. These weights were based on population information registers (http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Equivalised_disposable_income). For every combination of two consecutive years, income grouping was established by dividing individuals into income quartiles within each combination of gender and age. Life tables were then constructed for each quartile. For ages above 100 no difference in death rates between income quartiles was assumed. The effect of this assumption is negligible as only very few people reach the age of 100. An alternative approach for grouping into income quartiles could be made by first dividing into income quartiles defined on the basis of the aggregate population aged 30+ and then calculating death rates by gender and age in the four income quartiles. This method makes more jagged age-at-death distributions. However, the two methods of division of the age-specific death rates by income quartiles yield similar results, as illustrated in the online supplemental figure A1, where both methods are presented for Swedish data (Sweden was chosen because the country has the largest population size and thus more stable death rates). The online supplemental table A1 and table A2 also present data on population sizes and number of deaths by country, period, gender and income quartile.

The definition of lifespan variation used in this study measures the 'average years of life lost to death' or 'the average remaining life expectancy at death'.[18 19] There are several other indices of lifespan variation, all of which are highly correlated with each other.[20–22] The reason for the choice of index in this study is the mathematical property that allows the estimation of a threshold age that separates early and late deaths. The threshold age varies over time and between countries and income groups and is useful to catch the dynamics of mortality particularly for analyses of changes in inequalities.

The age-at-death density function, $d(x)$, where x denotes age, is the life table function of the proportion of deaths, $\sum d(x)=1$. Lifespan variation, $e^{\dagger}$, measures lifetime losses and $e^{\dagger}(a)$ is defined as the average number of life years lost due to death at older ages than a (a=30 in this study):

$$e^{\dagger}(a) = \frac{1}{l(a)} \int_a^{\infty} e(x)d(x)dx$$

approximated by the formula

$$e^{\dagger}(a) = \frac{1}{l(a)} \sum_a^{110} ½[(e(x) + e(x+1))]d(x)$$

where l is the survival function, and e is life expectancy.

In 2009, Zhang and Vaupel[10] introduced a threshold age, $a^{\dagger}$, defined as the solution to the equation

$$e^{\dagger}(a) = e(a)(1 - H(a))$$

where H is the cumulative hazard function

$$H(\mathrm{a}) = \int_0^{\mathrm{a}} \mu(\mathrm{x})\,\mathrm{dx} \approx \sum_0^{\mathrm{a}} \tfrac{1}{2}\left[\mu(\mathrm{x}) + \mu(\mathrm{x}+1)\right]$$

and $\mu(\mathrm{x}) = \frac{d(\mathrm{x})}{l(\mathrm{x})}$ is the age-specific hazard of death.

If mortality decrease (or increase) in all ages it has been shown that the solution is unique and that $a^\dagger$ separates 'early deaths' and 'late deaths' in the sense that saving lives at 'early' ages, that is, postponing deaths before age $a^\dagger$ reduces lifespan variation and thereby compresses mortality, while deaths after that age expand the variation.[23]

Increasing life expectancy can be decomposed by age in order to estimate contributions from early and late life mortality components, where 'early' and 'late' is defined in relation to the level of life expectancy at the start of the observation period.[10] This decomposition will give us a better opportunity to understand the mortality dynamics in different income groups. Note that the threshold age is defined directly from the specific life table and thus linked to it. It has the special property that it can be used to identify whether a death contributes to compression of mortality or not and how this differs between income groups. The results from a decomposition of life expectancy at age 30, $\dot{e}(30)$, are presented for each income quartile in all countries by the formula

$$\dot{e}(30) = \sum_{30}^{a^\dagger_{1997}} \tfrac{1}{2}[e_{1997}(x) + e_{2017}(x)] \cdot \tfrac{1}{2}[d_{1997}(x) + d_{2017}(x)] \cdot \rho(x) + \sum_{a^\dagger_{1997}}^{110} \tfrac{1}{2}[e_{1997}(x) + e_{2017}(x)] \cdot \tfrac{1}{2}[d_{1997}(x) + d_{2017}(x)] \cdot \rho(x),$$

where $a^\dagger_{1997}$ is the threshold age in 1997 and $\rho(\mathrm{x}) = \frac{\mu_{1997}(\mathrm{x}) - \mu_{2017}(\mathrm{x})}{\frac{1}{2}\left[\mu_{1997}(\mathrm{x}) + \mu_{2017}(\mathrm{x})\right]}$, the age-specific rate of mortality reduction from 1997 to 2017.

Shi *et al* [24] have recently proposed measuring differences between socioeconomic groups according to the degree of (non-)overlap in age-at-death distributions, referred to as mortality stratification. They defined the mortality stratification index (the proportion of non-overlapping of the age-at-death distributions for two groups *i* and *j*) by the formula

$$S_{ij} = 1 - \frac{\int_a^{110} \min\left[d_i(\mathrm{x}),\ d_j(\mathrm{x})\right] dx}{\int_a^{110} \max\left[d_i(\mathrm{x}),\ d_j(\mathrm{x})\right] dx} \approx 1 - \frac{\sum_a^{110} \min\left[d_i(\mathrm{x}), d_j(\mathrm{x})\right]}{\sum_a^{110} \max\left[d_i(\mathrm{x}), d_j(\mathrm{x})\right]}$$

S_{ij} varies between 0 and 1. The *i* and *j* groups have equal age-at-death distributions if S_{ij}=0, while S_{ij}=1 is reached if the distributions have no overlap. As a summary measure, mortality stratification captures in one number differences in both life expectancy and age-at-death distribution between groups. We present this index for the income quartiles 1 and 4 (*i* and *j*), S_{14}, and with a=30.

RESULTS

Online supplemental figure A2 shows median income within income quartiles by country and period. An increasing income gap is evident for all four countries. For instance, inflation-adjusted median income among Danes in the lowest quartile increased by 33% during the 20-year period, while the increase for those in income quartiles 2, 3 and 4 was 38%, 49% and 60%, respectively.

Table 1 shows life expectancy (e) and lifespan variation ($e^\dagger$) at age 30 in 1997 and 2017 for the four Nordic populations divided into income quartiles. Table 2 shows changes in life expectancy (Δe) and lifespan variation ($\Delta e^\dagger$) from 1997 to 2017. It appears that life expectancy differed between income quartiles and increased with different speed. In Denmark, the difference in life expectancy between the highest and the lowest income quartile increased by 1.3 years [(54.3–44.5)−(48.2–39.7)] for men and decreased by 0.2 years [(56.7–51.0)−(51.6–45.7)] for women. The largest increase in life expectancy was seen for Danish men in income quartiles 3 and 4 (by 6.0 and 6.1 years) (table 2). Swedish and Norwegian women in the lowest income quartile had the smallest increase by only 1.0 and 1.6 years, which is in contrast to Danish women in quartile 1, who experienced the largest increase in life expectancy among women at 5.3 years. In all income quartiles, Danes had the highest increase in life expectancy during the period (table 2). It should be noted, however, that within each quartile Danes had the lowest life expectancy in 1997 apart from Finnish men in quartiles 2–4.

Lifespan variation decreased from 9.4 years in 1997 to 7.6 years in 2017 for Danish men and women in the highest income quartile but increased slightly from 11.0 to 11.5 years for men and from 9.9 to 10.5 years among women in the lowest income quartile (table 1). A similar pattern of income differentials in lifespan variation was seen for men and women in Finland and among Swedish women. No change in lifespan variation was seen for Swedish men and Norwegian women in the lowest income quartile. An exception from the general pattern is that Norwegian men in the lowest income quartile experienced a decline in lifespan variation, from 10.9 in 1997 to 10.3 in 2017 (table 1). For all countries and for both genders in income quartiles 2, 3 and 4 lifespan variation declined (table 2) reflecting a compression of mortality for these population groups. The changes were roughly similar across all income quartiles, but the social gradient was clear—the higher income the lower lifespan variation and the higher life expectancy.

The age-at-death distributions in 1997 and 2017 by country for men and women in the lowest and the highest income quartiles is shown in figures 1 and 2, respectively. In all countries and for both genders it is evident that people in the highest income quartile experienced compression of mortality while this was not the case for people in the lowest income quartile. Furthermore, a shift to the right of the curves were much clearer for people in the highest income quartile. Differences between the highest and the lowest income quartile (quartile 4 minus quartile 1) in life expectancy, Δe, and lifespan variation, $\Delta e^\dagger$, are also presented in figures 1 and 2. Furthermore, the mortality

Table 1 Life expectancy (e) and lifespan variation ($e^{\dagger}$) at age 30 by country, gender and income quartile in 1997 and 2017*

		Equivalised disposable income quartile							
		1 (low)		2		3		4 (high)	
	Indicator	1997 Years	2017 Years	1997 Years	2017 Years	1997 Years	2017 Years	1997 Years	2017 Years
Men									
Denmark	e	39.7	44.5	44.2	49.3	46.1	52.1	48.2	54.3
	$e^{\dagger}$	11.0	11.5	10.5	9.2	9.7	7.9	9.4	7.6
Finland	e	40.1	43.9	44.0	49.1	45.5	50.8	47.2	52.8
	$e^{\dagger}$	11.9	12.2	10.4	9.3	9.6	8.4	9.4	7.9
Norway	e	43.7	47.7	47.2	52.0	48.1	53.7	49.8	55.4
	$e^{\dagger}$	10.9	10.3	9.6	8.7	8.9	8.1	8.8	7.7
Sweden	e	43.7	46.0	47.0	51.3	48.2	53.1	49.7	54.3
	$e^{\dagger}$	10.7	10.7	9.5	8.4	8.8	7.8	8.4	7.4
Women									
Denmark	e	45.7	51.0	49.2	52.5	50.1	54.1	51.6	56.7
	$e^{\dagger}$	9.9	10.5	10.5	9.2	10.2	7.8	9.4	7.6
Finland	e	48.6	52.6	51.2	53.9	51.3	54.5	52.3	56.0
	$e^{\dagger}$	9.0	10.3	8.9	8.3	8.7	7.3	8.4	7.2
Norway	e	50.3	51.9	52.2	55.2	52.8	56.5	53.8	57.7
	$e^{\dagger}$	9.6	9.6	9.0	8.3	8.8	7.8	8.4	7.5
Sweden	e	49.8	50.8	51.5	53.7	52.5	55.7	53.6	56.8
	$e^{\dagger}$	9.5	9.9	8.9	8.1	8.6	7.5	8.3	7.3

*Based on life table data for two consecutive calendar years 1996–1997 and 2016–2017.

stratification (the proportion of non-overlapping of the age-at-death distributions), S_{14}, are shown. The measurements of changes in the mortality pattern between the lowest and the highest income quartiles all demonstrate increasing inequality in life expectancy (Δe) (except for Danish and Finnish women) and lifespan variation ($\Delta e^{\dagger}$) from 1997 to 2017. In all countries the proportion of non-overlapping of the age-at-death distributions (S_{14}) was larger for men than women and largest in Denmark in both years. S_{14} increased for all groups except for Danish women, where it decreased slightly from 0.37 in 1997 to 0.34 in 2017.

The shape of the age-at-death curves in figures 1 and 2 gives the full information of the mortality patterns of the highest and the lowest income quartiles in 1997 and 2017. The unlike baseline age-at-death distributions in 1997 changed differently between the four income quartiles, countries and genders. This is why the threshold ages in 1997 were suitable for analysing how the early and late deaths contributed to the increasing life expectancy

Table 2 Life expectancy increase (Δe) and change in lifespan variation ($\Delta e^{\dagger}$) from 1997 to 2017 at age 30 by country, gender and income quartile*

		Equivalised disposable income quartile							
		1 (low)		2		3		4 (high)	
		Δe Years	$\Delta e^{\dagger}$ Years	Δe Years	$\Delta e^{\dagger}$ Years	Δe Years	$\Delta e^{\dagger}$ Years	Δe Years	$\Delta e^{\dagger}$ Years
Men	Denmark	4.8	0.5	5.1	−1.3	6.0	−1.8	6.1	−1.9
	Finland	3.8	0.3	5.1	−1.1	5.3	−1.2	5.6	−1.6
	Norway	4.0	−0.6	4.8	−0.8	5.6	−0.8	5.6	−1.1
	Sweden	2.3	0.0	4.3	−1.1	4.9	−1.0	4.6	−0.9
Women	Denmark	5.3	0.7	3.3	−1.3	4.0	−2.4	5.1	−1.8
	Finland	4.0	1.3	2.7	−0.6	3.2	−1.4	3.7	−1.2
	Norway	1.6	0.0	3.0	−0.7	3.7	−1.0	3.9	−0.9
	Sweden	1.0	0.4	2.2	−0.8	3.2	−1.0	3.2	−1.0

*Based on life table data for two consecutive calendar years 1996–1997 and 2016–2017.

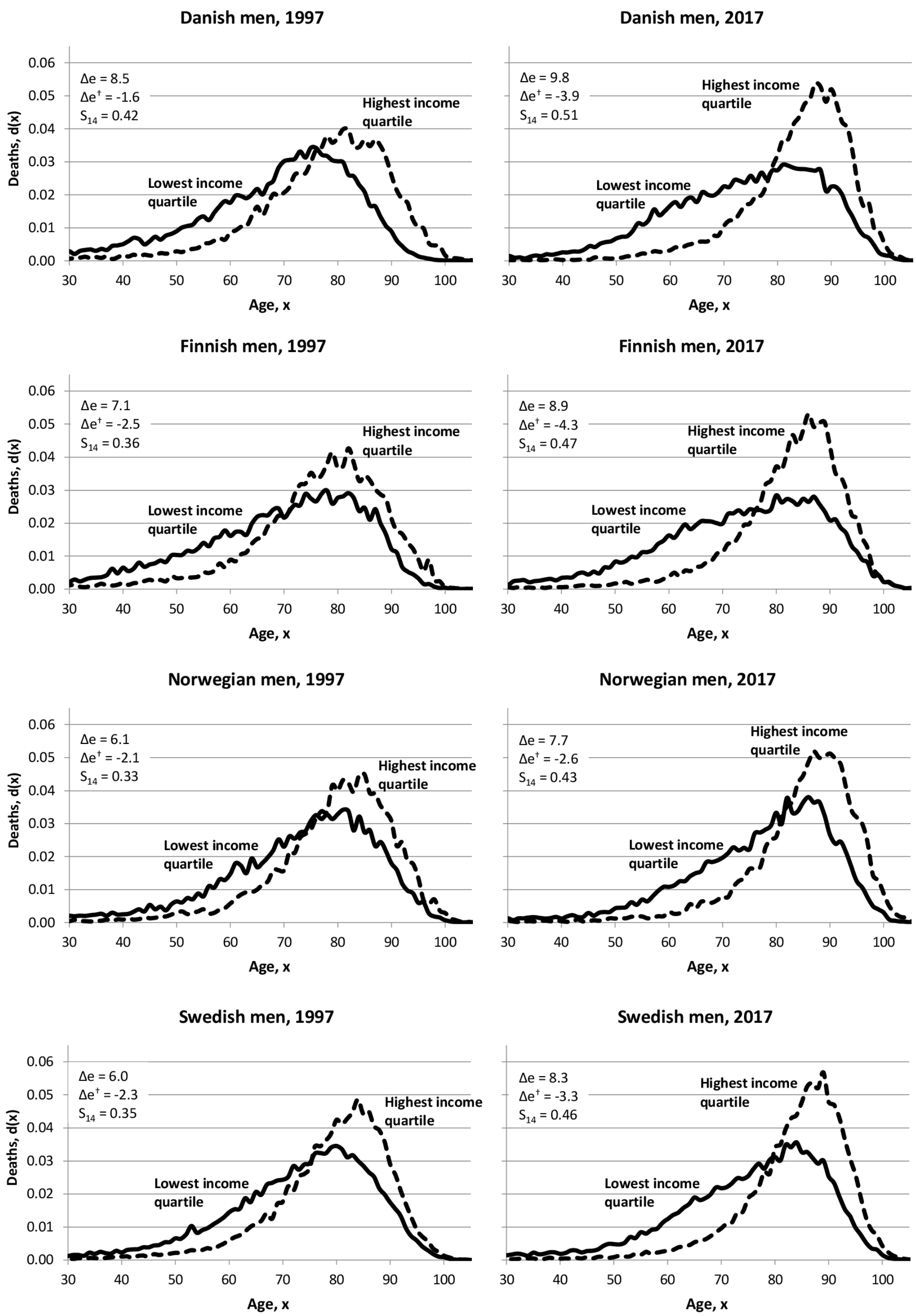

Figure 1 Age-at-death distributions for men in the lowest and highest income quartiles in 1997 and 2017 by country.

from 1997 to 2017. Obviously, the threshold age differs between the 32 groups (four income quartiles × four countries × two genders). It is inappropriate to define a fixed age as an alternative to the threshold age. Simple supplemental tables (online supplemental table A3 online supplemental table A4) show life expectancy at age 65 and changes from 1997 to 2017 by country, income quartile, and gender.

Decomposing the increase in life expectancy at age 30 by the contribution of group-specific early and late deaths separated by the threshold age in 1997 reveals that among Danish men, early and late deaths accounted for 2.4 and 2.4 years in the lowest income quartile and by 4.2 and 1.9 years, respectively, in the highest income quartile (figure 3). Similar patterns are seen for men in all four countries and elucidate clearly that the postponement of early deaths increased by income. Among Danish and Finnish women in the lowest income quartile, the contribution of late deaths to increasing life expectancy was high (2.8 years and 2.6 years) in agreement with the relatively high increase in lifespan variation (table 2). Overall, as for men the same pattern of increasing postponement of early deaths by increasing income was observed among women. In general, figure 3 shows that the compression

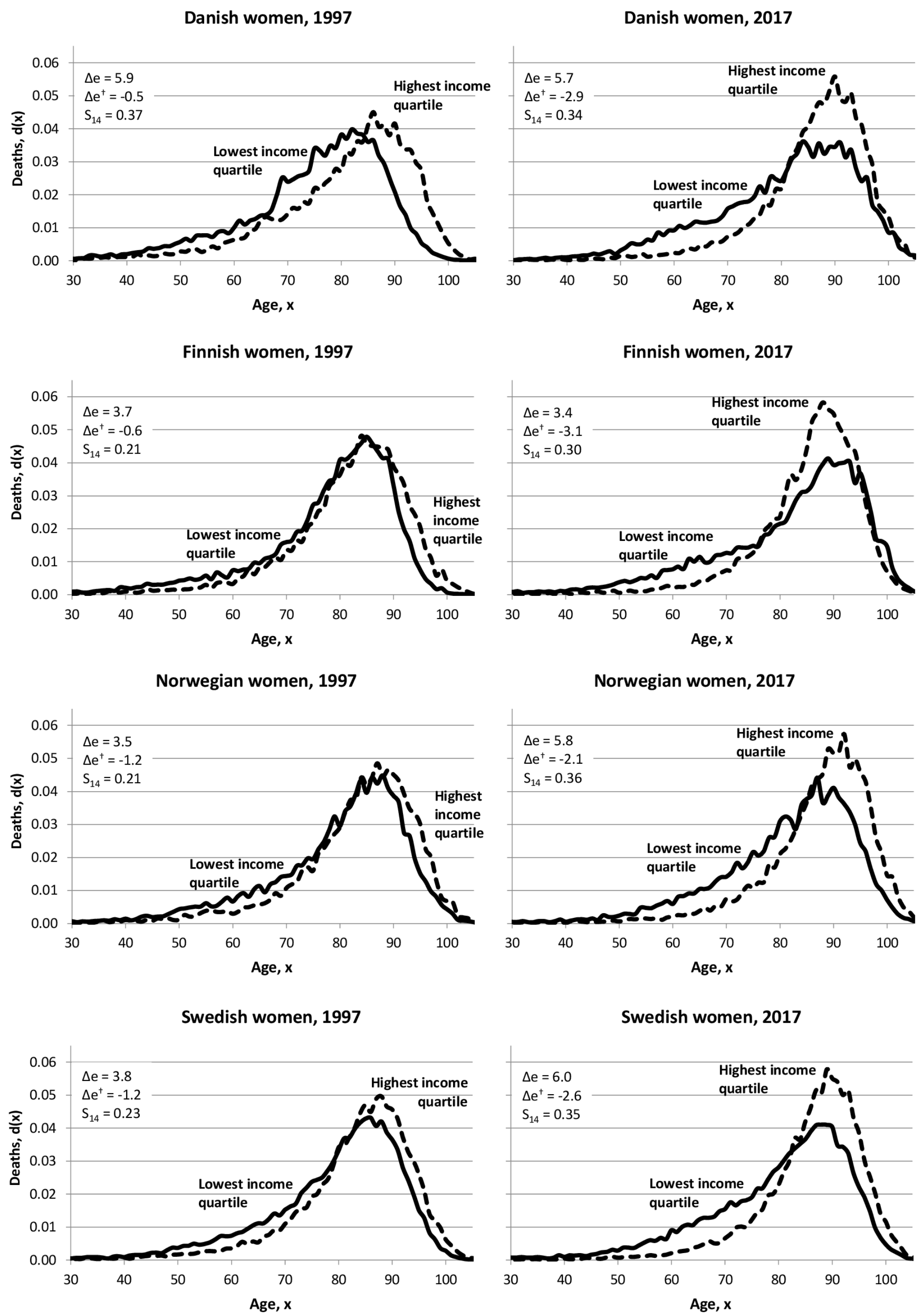

Figure 2 Age-at-death distributions for women in the lowest and highest income quartiles in 1997 and 2017 by country.

of mortality increased by income, as the contribution of early deaths to the growing average lifespan increased by income.

DISCUSSION

Life expectancy at age 30 is higher in Sweden and Norway than in Finland and Denmark, but the increase from 1997 to 2017 was highest in Finland and Denmark. These overall observations, commonly available from statistical bureaus, do not reveal the marked differences that we observe in the changes of life expectancy between income quartiles in the four Nordic countries. For Danish men in the two lowest income quartiles life expectancy at age 30 increased by almost 5 years, whereas the increase was about 6 years in the two highest income quartiles. Among Danish women life expectancy increased most in the lowest and highest income quartiles (by a little more than 5 years) and least in quartile 2 (by 3.3 years) and the difference between the highest and lowest income quartile decreased slightly. The smallest increase in life expectancy (by only 1.0 year) was observed for Swedish women in the lowest income quartile and as the decomposition

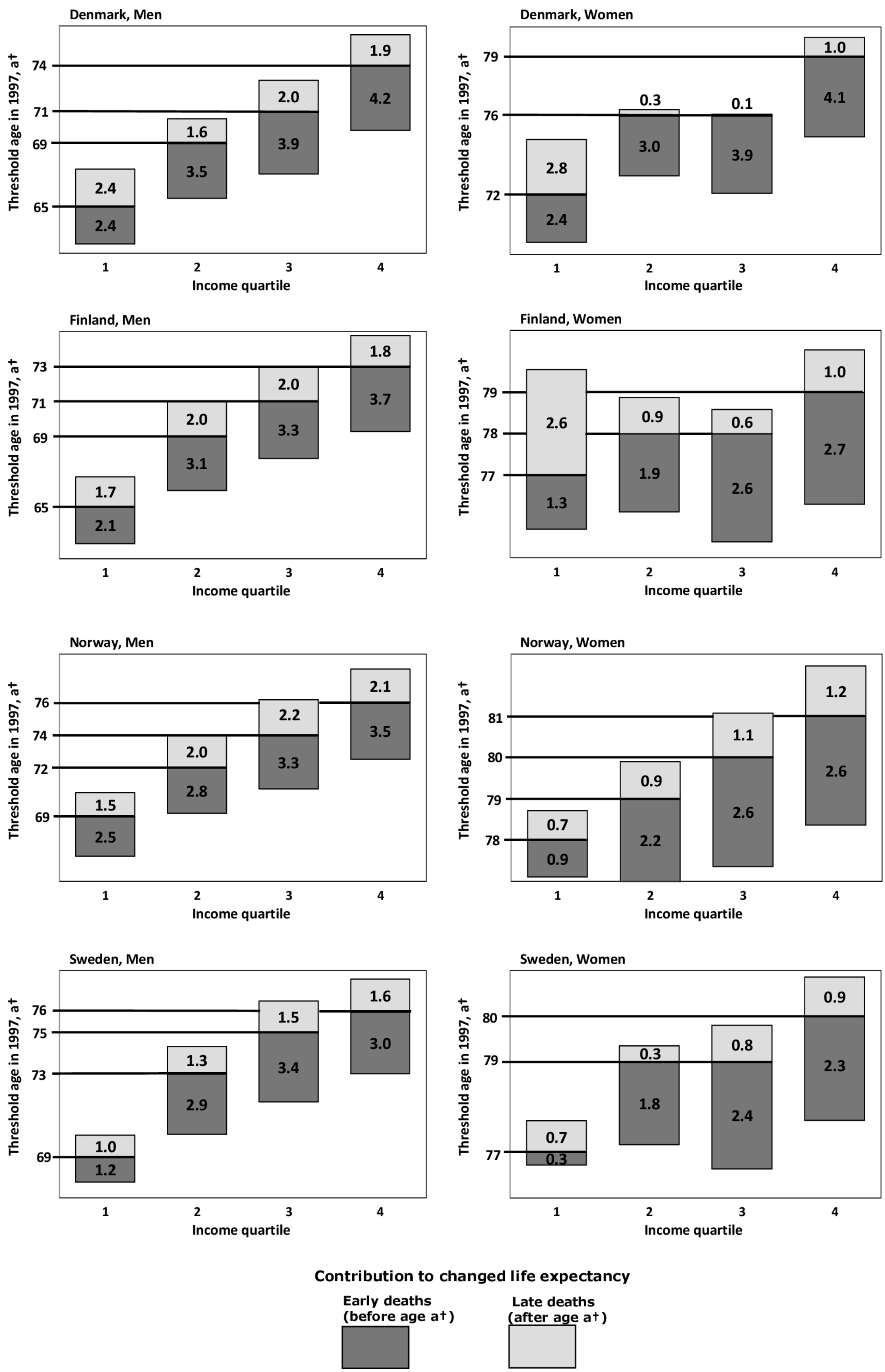

Figure 3 Contributions of early and late deaths to increasing life expectancy from 1997 to 2017 by country, gender and income quartile.

analysis demonstrated only 0.3 years improvement in life expectancy was before age 77. In comparison the improvement in life expectancy among Finnish women in the lowest income quartile was larger (3.9 years) but with a similar share of the improvement before age 77 (by 33%).

In all four countries, the expected patterns of increasing life expectancy coupled with decreasing lifespan variation[11 12 22] were not observed among people with low income. Among men and women in the lowest income quartile a decrease in lifespan variation only appeared among Norwegian men. For all other groups than the lowest income quartile lifespan variation declined. The overall similarity of the changes in income inequality in mortality between the four Nordic countries is striking and none of the countries present a development towards reducing health inequality. Even a decline in life expectancy from 2005 to 2015 among Norwegian women in the lowest income quartile has been reported.[6] In our study this group had the lowest increase in life expectancy (since 1997) next to Swedish women in income quartile 1 (table 2). Among women in all income quartiles, Danish women in the lowest income quartile had the highest gain in life expectancy. A new German study on income inequality in life expectancy also found that women in the lowest-income group (below 60% of average income) had the highest increase in life expectancy since 2005.[25]

The Nordic countries are recognised by their universal and relatively generous social protection which contributes to limit socioeconomic inequalities. Like most European countries, they also have universal healthcare. Given the assumed role of socioeconomic resources and access to healthcare in dampening social inequalities in health, the relatively large and increasing mortality inequality in the Nordic social democratic welfare states has puzzled public health researchers for many years and has fuelled speculations about the 'Nordic paradox' of public health.[26] Even if larger proportions of the population in 2017 than in 1997 had enjoyed the benefits of an expanding welfare state in the post-war years, other developments may have counteracted the supposed equalising effect of the welfare state. In particular, previous research point at the retraction of the smoking epidemic, which has been much stronger for higher socioeconomic groups in the Nordic countries.[26] The findings presented here add some new pieces of evidence that may help to solve the puzzle. Among higher-income groups, the improvement in life expectancy has been achieved through an increasing degree of concentration of deaths around a higher age. Among low-income groups, the reductions in 'early' mortality has been far less impressive. Where high-income earners have become more homogenous in terms of age at death, the opposite tends to be true for low-income earners. This points to the impact of diseases and causes of death that are important in the ages between 40 and 65, cardiovascular disease and cancer being the most prevalent. This study thus adds to previous research findings that an essential part of the increase in social inequality in mortality can be explained by smoking-related and alcohol-related diseases.[27–29] Still, the results suggest that certain subgroups within the lowest income quartiles may be particularly vulnerable.

It is a strength of the study that the register data used to link income and mortality comprise consistent information on the entire populations of all the countries. Furthermore, the register data enable to calculate equivalised disposable income for all individuals and to construct unbiased income-quartile-specific life tables by gender in the four countries.

The interpretation of the results must take into account the hypothetical nature of the period based approach and the employment of income-quartile-specific life table data, as these do not reflect the dynamics of cohorts. Thus, for each life table, mortality rates are assumed not to change during the life course and there will be no transitions between income quartiles, that is, all persons are fixed into the same income quartile from age 30. An alternative approach would be to construct cohort life tables assuming changes in future mortality rates that most likely depend on country, gender and how differential income is expected to develop. The magnitude of future upward and downward movements between income quartiles depends on labour market conditions and policy, social and healthcare policy and reforms, which differs between countries and effect living conditions and health. Another alternative approach would be to measure socioeconomic position by educational level. However, information is not available for the elderly population in all four countries. Furthermore, the marked increase in the educational level, particularly among women, is a challenge for studies on changes in social inequality in mortality. More considerations of the limitations of employing period-based life table data are discussed by van Raalte *et al*.[8]

The results were based on current income in 1996–1997 and 2016–2017, respectively, and did not take into account that diseases with high mortality in preretirement ages may cause income reduction, and particularly so among lower socioeconomic strata.[30] This possible reverse causal pathway might give rise to an inverse association between income and mortality. However, the robustness of results with regard to whether income was chosen to be current or lagged was validated in a Danish study and no noticeable change was seen when using data on income 5 years before.[15] This is due to a modest change in disposable income in the case of illness because of the relatively high degree of economic security provided by the welfare system.[31]

CONCLUSION

This comparative study including four Nordic countries displays the same overall pattern of increasing gap between income quartiles in mortality since the mid-1990s. The results demonstrate that compression of mortality due to postponement of early deaths is *not* a general phenomenon and not apparent in low-income groups. This insight provides a first step towards a more complete understanding of the dynamics of mortality inequalities that may provide a basis for more specific policy responses. Furthermore, the period covered has been one where income inequalities have widened, but lifespan variation has decreased consistently, with the clear exception of the lowest income quartile. A worrying observation is therefore that a desirable health policy goal of postponing premature deaths among people in the lowest-income groups has not been achieved (with the exception of Norwegian men). Like many ageing societies, all the Nordic countries have made changes to their pensioning systems, where cohort's life expectancy affects the annual payments (Norway and Sweden) or is linked to increasing pension age (Denmark and Finland). In light of our results, disadvantaged people are not only deprived of life, but also economically as pension systems increasingly work in favour of advantaged groups postponing the time of death. This poses a challenge to health and social policymakers alike.

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Contributorship Statement HB-H planed and designed the study. HB-H, LT, ÅH and OÖ processed the register data from Denmark, Finland, Norway and Sweden, respectively. HB-H conducted the analysis and drafted the work. HB-H, OÖ, LT, ÅH, PM, KAvdW and OL contributed with interpretation of the results and revision of the manuscript.

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