

RESEARCH REPORT

Measuring inequalities in health: the case for healthy life expectancy

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Objective: To evaluate healthy life expectancy (HLE) as a measure of health inequalities by comparing geographical and area-based deprivation-related inequalities in healthy and total life expectancy (TLE).

Design: Life table analysis based on ecological cross-sectional data.

Setting and population: Council area quarters and postcode sector-based deprivation fifths in Scotland.

Main outcome measures: Expectation of life in good self-assessed general health, or free from limiting long-term illness, and TLE, for females and males at birth.

Results: Women in Scotland have a life expectation of 70.3 years in good health, 61.6 years free from limiting long-term illness, and a TLE of 78.9 years. Comparable figures for men are 66.3, 58.6 and 73.5 years. TLE and HLE decrease with increasing area deprivation. Differences are substantially wider for HLE. A 4.7-year difference is seen in TLE between women living in the most and least deprived fifth of areas. The difference in HLE is 10.7 years in good health and 11.6 years free from limiting long-term illness. The degree of deprivation-related inequality in HLE is 2.5 times wider for women and 1.8 times wider for men than in TLE.

Conclusions: Differences in TLE underestimate health inequalities substantially. By including morbidity and mortality, HLE reflects the excess burden of ill health experienced by disadvantaged populations better. Inequalities in length of life and health status during life should be taken into account while monitoring inequalities in population health.

Reducing inequalities in health is an integral part of health policy in Britain, and monitoring progress is an essential part of this agenda.^{1–3} Socioeconomic inequalities in total life expectancy (TLE) have been well documented,⁴ and current targets and indicators for tackling health inequalities generally include measures of TLE. In England, differences in TLE between local authority areas form the basis of one of the two national health inequality targets.⁵ Until recently, differences in TLE between different deprivation groups in Scotland were included in regularly monitored national indicators of inequality.⁶

Inequalities in TLE are clearly important, but they only reflect differences in mortality experienced by different subgroups of the population and do not capture differences in health status while people are still alive. All years of expected life are included in TLE estimates, regardless of whether they are enjoyed in good health or with considerable disability. To reflect the morbidity better, as well as the mortality experienced by populations, a variety of measures have been derived for incorporating a “healthy” element into life expectancy, including disability-adjusted life-years, quality-adjusted life expectancy and healthy life expectancy (HLE).⁷ HLE represents the number of years that an individual can expect to live in good health. It is usually calculated in a similar way as TLE, using a life table approach augmented to include estimates of the proportion of the population at each age group that is “healthy”.⁸

Robine *et al*⁹ produced estimates of disability-free life expectancy for 12 European union countries using data from the first wave of the European Household Community Panel. These were subsequently updated on an annual basis by Eurostat and are the subject of an ongoing review.¹⁰ They show, however, that intercountry variations in HLE can be substantially different from those in TLE. In the past few years, HLE estimates have been published for UK countries and geographical areas within them.^{11–13} These series use

survey data to estimate the health status of the population with the attendant problems of sampling variability.

None of the current health inequality targets or indicators in Britain includes health-adjusted life expectancy measures. However, policy makers have indicated that they would consider HLE estimates if measurement and monitoring issues could be resolved.^{2–5} An important question therefore arises about how HLE compares with TLE as a measure of health inequalities.

There are as many potential measures of HLE as there are definitions of “healthy”—for example, one measure may be calculated as the expectation of life free from ischaemic heart disease, whereas another may be the expectation of life without disability. In practice, many of the difficulties inherent in producing estimates of HLE relate to defining “healthy”, and the subsequent availability of the required health status data for the population under consideration.

In this paper, we measure and compare inequalities in robust estimates of HLE and TLE using health status data derived from the decennial population census for 2001. The measures of HLE that we use are the expectation of life in (a) good or fairly good self-assessed general health and (b) free from limiting long-term illness. Although self-reported, these two measures of generic health status have been used widely to summarise the health of the population and distinguish differences between population groups. The use of two alternative measures increases the robustness of our findings. We focus on the population of Scotland as it experiences wider inequalities than elsewhere in the UK and so is a useful setting in which to compare the level of inequalities.¹⁴

METHODS

We obtained mid-year population estimates for 2001, and data on all deaths during the calendar year 2001, from the

Abbreviations: HLE, healthy life expectancy; TLE, total life expectancy

Table 1 Total and healthy life expectancy estimates in females, Scotland 2001

Population	TLE (years)	Self-assessed health			Limiting long-term illness		
		HLE (years)	TLE-HLE (years)	HLE/TLE (%)	HLE (years)	TLE-HLE (years)	HLE/TLE (%)
Scotland	78.9	70.3	8.7	89.0%	61.6	17.3	78.1%
Area deprivation fifths							
1 (least deprived)	81.1	75.0	6.1	92.5%	66.9	14.2	82.5%
2	80.6	73.5	7.0	91.3%	64.8	15.8	80.4%
3	79.2	70.9	8.4	89.4%	62.1	17.1	78.4%
4	77.9	68.2	9.6	87.6%	59.2	18.7	76.0%
5 (most deprived)	76.4	64.3	12.1	84.2%	55.3	21.1	72.4%
Least minus most deprived	4.7	10.7	-6.0	8.3%	11.6	-6.9	10.1%
Council area quarters*							
1 (highest TLE)	80.9	74.1	6.7	91.7%	65.6	15.3	81.1%
2	80.1	72.8	7.3	90.9%	64.0	16.1	79.9%
3	78.8	70.4	8.4	89.4%	61.5	17.3	78.0%
4 (lowest TLE)	77.3	67.5	9.8	87.3%	58.8	18.5	76.0%
Highest minus lowest	3.6	6.6	-3.1	4.4%	6.8	-3.2	5.1%

HLE, healthy life expectancy; HLE/TLE, total life expectancy spent in healthy state; TLE, total life expectancy; TLE-HLE, expectation of life in an unhealthy state.
*Formed by grouping the 32 council areas into four groups of eight based on ranked TLE.

General Register Office (Scotland). We obtained data on health status for the whole population from the 2001 census. The rate of non-response to the health questions was 3.7%, varying across council areas from 1.7% to 6.3%.¹⁵ Non-response was higher in more urban and more deprived council areas. However, the census data were fully adjusted for under-enumeration based on an intensive, dedicated Census Coverage Survey, which undertook targeted field work around census day.¹⁶

Self-assessed health is a measure of perceived general health status that has been collected in many surveys and was included in the census for the first time in 2001. Census respondents were asked to rate their own health using the question "Over the last 12 months would you say your health has on the whole been good, fairly good, or not good?" The nature of self-assessed general health is inherently subjective; however, it has been shown to be a good predictor of mortality in several studies.¹⁷ Moreover, it has been shown to capture the prevalence of a wide variety of health conditions.¹⁸ Importantly, further analysis has also shown that this predictive ability does not vary across socioeconomic groups,¹⁹ although it does vary by sex and age.²⁰ Using this measure, we categorised respondents reporting "good" or "fairly good" health as healthy.

Limiting long-term illness is a measure of serious and chronic ill health that has been collected in many surveys and was included in the decennial census for the first time in

1991. In the 2001 census the question was "Do you have any long-term illness, health problem or disability which limits your daily activities or the work you can do?"

Detailed studies of responses to questions on limiting long-term illness have shown that it is predominantly a measure of physical functioning²¹ and that, although the question asks respondents to focus on long-term conditions, many people no longer report limiting long-term illnesses at 7-year follow-up.²² Using this measure, we define an absence of limiting long-term illness as healthy.

We used a Chiang II life table²³ to calculate TLE and HLE for females and males separately at birth. The life table approach involves applying age-specific death rates to a standing cohort population to determine the number of years lived through each age interval. To calculate HLE, further information on the proportion of the population in good health in each age group is incorporated into the calculations to determine the number of years lived in good health through each age interval.²⁴ From the estimates we calculated the expectation of life in an unhealthy state (TLE-HLE) and the percentage of TLE spent in good health (%HLE/TLE).

We used 5-year age bands to construct the life tables except for the youngest age band, which was split into 0-2 and 3-4 year olds. The top age band included all of the population aged ≥ 85 years. We made conventional assumptions on the basis of single-year life tables that, on average, people who die within a certain age interval survive for half of the length

Table 2 Total and healthy life expectancy estimates in males, Scotland 2001

Population	TLE (years)	Self-assessed health			Limiting long-term illness		
		HLE (years)	TLE-HLE (years)	HLE/TLE (%)	HLE (years)	TLE-HLE (years)	HLE/TLE (%)
Scotland	73.5	66.3	7.2	90.2%	58.6	14.9	79.7%
Area deprivation fifths							
1 (least deprived)	77.6	72.6	4.9	93.7%	65.2	12.4	84.0%
2	75.5	69.6	5.9	92.2%	62.0	13.5	82.1%
3	73.8	66.9	6.9	90.7%	59.1	14.7	80.1%
4	72.5	64.5	8.1	88.9%	56.5	16.0	77.9%
5 (most deprived)	69.1	59.0	10.1	85.4%	51.2	17.9	74.1%
Least minus most deprived	8.5	13.6	-5.2	8.3%	14.0	-5.5	9.9%
Council area quarters*							
1 (highest TLE)	76.1	70.3	5.7	92.5%	62.6	13.5	82.3%
2	74.5	68.0	6.5	91.2%	59.9	14.6	80.4%
3	73.8	67.2	6.6	91.1%	59.6	14.2	80.8%
4 (lowest TLE)	71.3	63.4	7.9	88.9%	55.8	15.6	78.2%
Highest minus lowest	4.8	6.9	-2.2	3.6%	6.8	-2.1	4.1%

HLE, healthy life expectancy; HLE/TLE, total life expectancy spent in healthy state; TLE, total life expectancy; TLE-HLE, expectation of life in an unhealthy state.
*Formed by grouping the 32 council areas into four groups of eight based on ranked TLE.

of that age interval. For the youngest age group, we assumed that the average death occurred just 10% into the age interval to reflect perinatal mortality. For the oldest age group, we assumed that the average age at death was 87.5 years.

We calculated life expectancy estimates for the entire population of Scotland and for the 32 local council areas. Council areas represent the geographical local authority organisations responsible for raising local taxes and delivering social services, and have an average population size of 158 000. For presentational purposes, we grouped the 32 council areas into four groups (quarters) of eight based on ranked TLE. We also grouped the Scottish population into five equal-sized groups (fifths) based on deprivation scores for postcode sectors of residence. Postcode sectors are small geographical areas, of which there were 1010 in 2001 with an average population count of 5012. We use the deprivation index originally created by Carstairs and Morris,²⁵ and updated by McLoone,²⁶ using 2001 census data.

We summarised the level of inequality in life expectancy between council area quarters using the Gini coefficient, and between area deprivation fifths using the concentration coefficient.²⁷ Both are measures of inequality between zero (no inequality) and one (maximum inequality) that reflect the entire distribution of health (and deprivation) across the whole population.

RESULTS

In 2001, females at birth had an expectation of 70.3 years in good or fairly good health and 61.6 years free from limiting long-term illness compared with a TLE of 78.9 years (table 1). HLE and TLE for males were substantially lower, at 66.3, 58.6 and 73.5 years, respectively (table 2). Females thus have a longer expectation of life in an unhealthy state than males, and spend a slightly lower proportion of their lives in a healthy state.

For both females and males there is a clear trend towards decreasing TLE and HLE with increasing deprivation (tables 1, 2). The differences are larger however, for HLE. For example, there is a 4.7-year difference in TLE between the females living in the most and least deprived fifth of areas of Scotland, but differences of 10.7 in expected years in good or fairly good health and 11.6 in expected years free from limiting long-term illness. Wider gaps in HLE compared with TLE are also seen in the results for the council areas (tables 1, 2). For example, males living in the quarter of council areas with the lowest total life expectancies have a TLE that is 4.8 years shorter than that for males living in the highest quarter, but a HLE that is almost 7 years shorter.

Disadvantaged sections of the population with lower TLE spend longer in ill health. For example, females living in the most deprived areas of Scotland can expect to spend 12.1 years in not good health and 21.1 years with limiting long-term illness, compared with just 6.1 and 14.2 years respectively for females living in the least deprived areas (table 1). Differences in HLE are wider than differences in TLE because population groups with higher TLE also have higher proportions of life spent in a healthy state.

Formal analysis of the degree of inequality across the whole population confirms that inequalities in HLE are substantially wider than inequalities in TLE. By using self-assessed health, deprivation-related inequalities in HLE are 2.5 and 1.8 times wider than inequalities in TLE for females and males, respectively (table 3). Using limiting long-term illness, geographical inequalities in HLE are 3 and 2 times wider than inequalities in TLE for females and males, respectively. Overall, inequalities in TLE and HLE are narrower for females than males, but taking account of health status has a larger effect on the inequality measures for females.

DISCUSSION

Principal findings

This paper shows that area-based inequalities in HLE are substantially wider than inequalities in TLE. Disadvantaged sections of the population have shorter TLE and much shorter HLE. They can expect to spend a lower proportion of their lives in good health, and a longer period of time in poor health.

Strengths and weaknesses of the study

This study produced estimates of HLE using whole population health status data derived from the 2001 census. The estimates are therefore robust and not subject to the sampling biases and variability inherent in using surveys as the source of population health status data. Indeed, when the health status information is taken from the entire population, the level of uncertainty in HLE estimates has been shown to be smaller than in TLE estimates.¹²

However, use of the census restricts the definition of “healthy” that can be used to produce the estimates. For the purposes of this paper, we focused on two self-reported measures of generic health status. Both measures generate a similar conclusion that inequalities in HLE are wider than inequalities in life expectancy.

Relationship with other work

Previous studies in various countries have examined differences in a variety of measures of HLE between geographical areas and social groups.^{28–31} Despite the very different populations and measures of HLE examined, the findings concurred with those of this study: inequalities in HLE are considerably wider than inequalities in TLE. The study closest to this study is the one by Bajekal,³² who calculated two HLE measures for tenths of the English population using a population survey. Her results also indicate that disadvantaged populations have shorter life expectancy and higher numbers of years and proportions of life in an unhealthy state. Our study reinforces these findings with robust HLE estimates based on a complete population census.

Interpretation and implications

It is not inevitable that inequalities in HLE would be substantially wider than inequalities in TLE. Various plausible patterns of morbidity and mortality experienced by different subgroups of the population could result in

Table 3 Inequality measures for total and healthy life expectancy, Scotland 2001

Population	Females			Males		
	TLE	HLE (SAH)	HLE (LLI)	TLE	HLE (SAH)	HLE (LLI)
Council areas*	0.010	0.025	0.030	0.016	0.029	0.032
Deprivation fifths†	0.012	0.030	0.037	0.022	0.039	0.045

HLE, healthy life expectancy; LLI, limiting long-term illness; SAH, self-assessed health; TLE, total life expectancy.

*Gini coefficient calculated by ranking council areas by TLE or HLE.

†Concentration coefficient calculated by ranking population fifths by deprivation level.

What is already known on this topic

- Health inequalities between different geographical areas and deprivation groups have been shown using a wide range of health measures.
- Total life expectancy (TLE) estimates have been commonly used as a summary measure for monitoring health inequalities.
- Unlike healthy life expectancy, TLE takes account of only variations in mortality and not variations in health status during life.

What this study adds

- Inequalities in healthy life expectancy (HLE) are substantially wider than those in total life expectancy.
- People from more deprived areas experience both a shorter life and a greater proportion of their life spent in poor health.
- HLE provides a practical and meaningful summary measure for monitoring health inequalities that reflects both mortality and morbidity.

inequalities in HLE being narrower, comparable or wider. This study has shown that the worst-case scenario of wider inequalities is correct. Deprivation deals the double blow of an early death preceded by an extended period of ill health.

We suggest that HLE be incorporated as one of the key measures for monitoring progress in tackling inequalities in health in the UK. Including both morbidity and mortality reflects the excess burden of ill health experienced by disadvantaged sections of the population more completely than TLE, and provides a useful and meaningful summary measure of health inequalities. In addition, the development of new large sample population-based surveys in the UK (eg, see <http://www.scotland.gov.uk/>) means that the regularly updated information on population health status required to produce HLE estimates between census years is becoming available.

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