

## DECOMPOSITION OF CHANGES TO DISEASE AND DISABILITY LIFE EXPECTANCY IN ENGLAND

**Domenica Rasulo**, Office for National Statistics

**Les Mayhew and Ben Rickayzen**, Cass Business School, City University

There is an emerging debate about how increasing longevity influences health and whether the additional years of life are spent with morbidity. However, despite increasing life expectancy, there are competing theories that seem to point in different directions as to whether a greater or lesser proportion of life is being spent in ill-health (Karlsson *et al.*, 2006).

In the UK, the official measure of life expectancy with morbidity is the disability life expectancy, which is the number of years spent with limiting long-term illness (Kelly *et al.*, 2000), a measure obtained by partitioning the life expectancy with and without disability by applying disability prevalence rates (Sullivan, 1971). A recent method has been proposed which enables the identification of the effects of morbidity and mortality changes in disability life expectancy between points in time (Nussleder and Looman, 2004).

Disability life expectancy is obtained through responses to survey questions. There is substantial controversy in the literature over the use of self-reported disability on the grounds that a respondent may inflate the severity of his/her health problems in order to justify labour force non-participation and disability benefits (Benitez-Silva *et al.*, 2004). Also, disability rates do not include morbidity conditions which are not limiting but nevertheless require regular access to health services. It is possible to suffer from a long-term disease such as hypertension or diabetes without necessarily being 'disabled' to the extent that it restricts activities of daily living and thus disrupts normal life. A person with a long-term disease will nevertheless make demands on health services, but not necessarily on social care. A person suffering from a disability could, on the other hand, be expected to make demands upon both health and social care services. It therefore seems important to provide measures of morbidity that take into account the fact that diseases may not be 'limiting' and see how different measures of morbidity change, either for better or worse.

Any morbidity life expectancy (or life expectancy with diseases not necessarily limiting) is influenced by a range of conditions whose effect is unknown unless decomposition or cause-elimination techniques are applied to determine their individual contributions in comparable units (e.g. years). Identifying the main conditions which trigger the greatest numbers of years spent with morbidity would help to assess and target areas where the most intervention is needed. A decomposition method which enables the identification of the main causes influencing disability life expectancy is available. Up to now, the method has only been applied to obtain the effects attributable to each main disease separately. This was the approach applied to Dutch data by Nussleder and Looman (2004).

The focus on single diseases, as opposed to co-morbidity, can hide, however, significant information in an ageing population such as that in the UK; at older ages people might suffer, in fact, from multiple disease conditions (Corroni-Huntley *et al.*, 1991; Guralnik, 1996) which are not accounted for by decomposition performed on single disease categories.

In response to these key issues, the project aimed to compute, along with the standard measure of disability life expectancy, a measure that could provide a more objective and wider coverage of a population's health that takes into account the fact that diseases may not be 'limiting'. In the study, this is called 'disease life expectancy'. Changes over time were separated into the mortality and morbidity components in order to identify how increasing life expectancy affects the number of years with morbidity and, at the same time, how morbidity rates have changed over time. The morbidity effect was then disentangled into single diseases and co-morbidity and into the diseases contained within these two categories. England was selected for the study since the Health Survey for England (HSE) includes detailed information on morbidity. The study was carried out on the period 1991-2005.



## Key Findings

- Between 1992 and 2004 life expectancy increased for both sexes, with the increase being more pronounced for males.
- The life expectancy increase was greater during the second half of the period when males gained 1.8 years and females 1.2 years.
- For males:
  - of the 1.8 years of increased life expectancy, 1.7 years were disability free and 0.1 years were with disability;
  - of the 1.8 years of increased life expectancy, 0.2 years were spent without disease and 1.6 years with disease; and
  - of the extra 1.6 years spent with disease, 0.2 years were due to a change in morbidity. This change resulted from a 1.6 years increase from multiple diseases and 1.4 years decline from single diseases.
- For females:
  - of the 1.2 years of increased life expectancy, 0.9 years were disability free and 0.3 years were with disability;
  - of the 1.2 years of increased life expectancy, 0.3 years were without disease and 0.9 years with disease; and
  - the extra 0.9 years spent with disease were due entirely to increased life expectancy. The morbidity component as a whole did not contribute because there was a 1.5 years increase from co-morbidity and a 1.5 years decline from single diseases.
- Increasing life expectancy triggered increasing life expectancy with morbidity.
- Morbidity rates changed due to a decline of single diseases and an expansion of multiple diseases.

## Data

In order for the Sullivan method (1971) to be applied, mortality rates and prevalence morbidity rates are required. Hence, the data needed to comprise death, population and morbidity counts by sex and age. Mortality and population counts were provided by the Office for National Statistics (ONS) whilst morbidity counts were drawn from the HSE.

The HSE includes questions on the occurrence of long-term illness limiting or not, and on the occurrence of conditions that require medicine to be taken regularly. The counts from these questions were used to obtain the wider measure of morbidity, 'disease life expectancy'. Respondents with a long-term illness (limiting or not) could list up to six illnesses; in addition, for each prescribed medicine, the survey provided an additional variable specifying the diseases under treatment. This information enabled respondents to be allocated across the morbidity groups and the information was used afterwards to explore the morbidity conditions contributing the most to disease and disability life expectancy.

Morbidity conditions were aggregated in five broad categories that reflect a combination of trauma, chronic and long-term conditions, as well as infectious diseases and acute episodes. The categories were infections, neoplasm, cardiovascular diseases, respiratory or other chronic diseases (i.e. digestive, musculoskeletal, and mental diseases) and other acute diseases (e.g. endocrine, blood, genitourinary, nervous system diseases). Multiple morbidities were obtained by combining the five disease categories and, for the decomposition analysis, the co-morbidities having the greatest effect on the two morbidity life expectancies were kept.

## Methods

In line with the official figures released by the Government Actuary's Department and the ONS, life expectancies were computed using three-year data periods (i.e. 1991-1993, 1994-1996,....., 2003-2005). Disease and disability rates were similarly obtained using three-year survey periods. Based on the survey data availability, disease and disability life expectancies covered the periods 1991-2005 and 1997-2005 respectively.

The decomposition method of Nussleder and Looman (2004) was applied to decouple the changes to the disease and disability life expectancies. The method originates from the Sullivan method, which computes a morbidity life expectancy through the product of total person-years and morbidity prevalence rates. These two components were separated using the following formula:

$$\delta L_{morb} = \delta L \left( \frac{\pi_t + \pi_{t+n}}{2} \right) + \delta \pi \left( \frac{L_t + L_{t+n}}{2} \right) \quad (1)$$

where  $L_{morb}$  represents the person-years with morbidity,  $L$  represents the total number of person-years,  $\pi$  is the prevalence morbidity rate,  $\delta$  denotes a change over time,  $t$  and  $t+n$  refer to the time points under comparison. It is important to note that, in all of the analysis which follows, the first component of the morbidity life expectancy shown in equation (1) is the 'mortality component' and the second is the 'morbidity component'.

The decomposition was applied to explain the changes in disease life expectancy between 1992 and 2004, 1992 and 1998, and 1998 and 2004, and in disability life expectancy between 1998 and 2004.

## Total, disease and disability life expectancies

Between 1992 and 2004, the total life expectancy increased 3.1 years for males and 2.0 years for females. For both sexes the change was greater between 1998 and 2004 when males gained 1.8 years and females 1.2 years. Life expectancy with diseases increased more rapidly than total life expectancy and this pattern was more evident for males than females. The greatest change occurred in the earlier period (1992-1998) when males gained 3.6 years and females 1.7 years.



These findings suggest that total and disease life expectancies did not increase at the same rate and the majority of the increase occurred in different time periods from one another (i.e. 1992-1998 for disease life expectancy and 1998-2004 for total life expectancy).

Between 1998 and 2004, the number of years with disability increased by 0.1 years for males and 0.3 years for females compared to a change of 1.6 and 0.9 years in disease life expectancy. Hence, if the additional measure of disease life expectancy had not been computed, morbidity in England would have been underestimated by 1.5 years for males and 0.6 years for females.

### Decomposition of changes to disease life expectancy

Changes in the decomposition of disease life expectancy over time are shown in Table 1. A negative sign for the morbidity component is actually a positive feature: it suggests individuals are spending less time with disease than at the earlier time point.

For males, the disease life expectancy increased by 5.3 years between 1992 and 2004; 2.9 years of this change were due to increased morbidity and 2.4 to increased life expectancy.

For females, the disease life expectancy increased by 2.6 years between 1992 and 2004; about 1.0 years of this change was due to the increase in disease prevalence rates and 1.6 years were attributable to increases in life expectancy. For both sexes, most of the change in the disease rates occurred during the first period of investigation (1992-1998).

The results for single and co-occurring diseases for females are presented in Figure 1. Most single diseases had a downward trend between 1992 and 2004 and the largest part of this decline was caused by the decrease of 'other acute diseases'.

Unlike single diseases, the life expectancy with multiple diseases had an upward trend from the beginning of the investigation. However, some co-morbidity categories became more prominent than others over time. Life

expectancy with both 'cardiovascular' and 'respiratory or other chronic diseases' was higher in the earliest years of the investigation (i.e. 1992-1998) than in the following years (i.e. 1998-2004). By contrast, the life spent with both 'cardiovascular' and 'other acute diseases' increased more in the latest years.

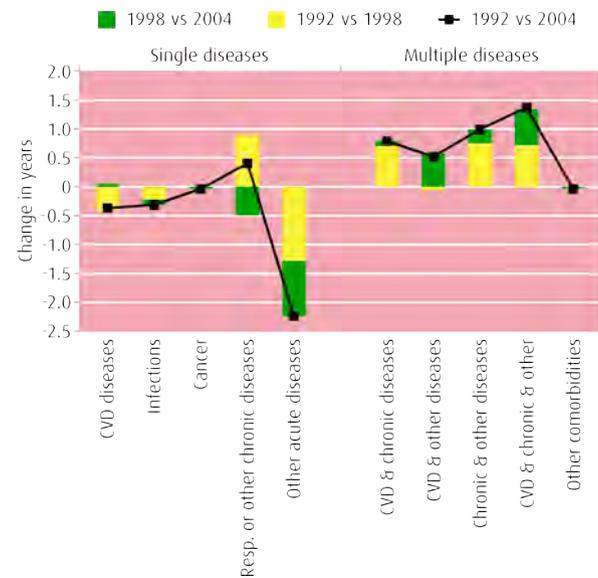


FIGURE 1. DECOMPOSITION OF THE MORBIDITY EFFECT ACCOUNTING FOR CHANGES IN DISEASE LIFE EXPECTANCY, ENGLAND, FEMALES AT AGE 16 Source: Own analysis on ONS and HSE data

### Decomposition of changes to disability life expectancy

Between 1998 and 2004, disability life expectancy gained about 0.1 years for males and 0.3 years for females (Table 2); these changes resulted from the counterbalancing values of mortality and disability components. For males, the mortality component increased by 0.8 years whilst the disability component decreased by 0.7 years causing a total change of 0.1 years in disability life expectancy. Similar comments can be made about females. Therefore, for both sexes most of the increase in life expectancy was spent without disabilities.

Changes over time	Males			Females		
	1992 vs 2004	1992 vs 1998	1998 vs 2004	1992 vs 2004	1992 vs 1998	1998 vs 2004
Total	5.26	3.62	1.64	2.65	1.72	0.93
Mortality	2.40	0.98	1.42	1.59	0.62	0.97
Morbidity	2.86	2.64	0.22	1.06	1.10	-0.04
Change due to single and multiple diseases						
Single diseases	-0.39	1.04	-1.43	-2.57	-1.04	-1.53
Multiple diseases	3.25	1.60	1.65	3.63	2.14	1.49

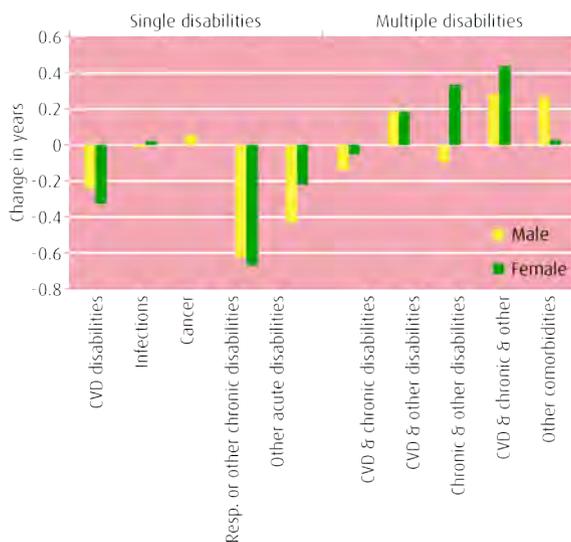
TABLE 1. DECOMPOSITION OF CHANGES IN DISEASE LIFE EXPECTANCY OVER TIME, ENGLAND, MORTALITY AND MORBIDITY EFFECTS BY SEX AT AGE 16 Source: Own analysis on ONS and HSE data

Changes over time	Males	Females
Total	0.07	0.32
Mortality	0.83	0.62
Disability	-0.76	-0.30
	Change due to single and multiple disabilities	
Single disabilities	-1.25	-1.20
Multiple disabilities	0.49	0.90

**TABLE 2: DECOMPOSITION OF CHANGES IN DISABILITY LIFE EXPECTANCY OVER TIME. MORTALITY AND DISABILITY EFFECTS. ENGLAND, MALES AND FEMALES AT AGE 16, 1998-2004**  
 Source: Own analysis on ONS and HSE data

Analysing the decomposition of morbidity into their single and co-occurring disability components, the morbidity component was negative overall because the decrease from the single disability component more than offset the increase from the co-morbidity component. Between 1998 and 2004, the life spent with multiple disabilities increased by 0.5 years for males and 0.9 years for females. However, because of a larger decline of life spent with single disabilities, there was an overall improvement in the quality of survival.

The co-morbidity category 'cardiovascular, respiratory or other chronic diseases, and other acute diseases' contributed the most to the increase in disability life expectancy for both sexes (Figure 2).



**FIGURE 2: DECOMPOSITION OF THE DISABILITY EFFECT ACCOUNTING FOR CHANGES IN DISABILITY LIFE EXPECTANCY. ENGLAND, MALES AND FEMALES AT AGE 16, 1998-2004**  
 Source: Own analysis on ONS and HSE data

## Policy implications

The fact that increasing life expectancy is accompanied by an increase in time spent with morbidity has significant implications for health policy in England since disease prevalence in the population increases result in additional health costs. This is because increasing co-morbidity leads to more doctor visits, outpatient appointments, prescriptions and hospital admissions. For older people with more than one long term condition (i.e. co-morbidity) it may also translate into greater social care needs with accompanying cost implications.

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## Contact details of the authors

Domenica Rasulo, Office for National Statistics  
 1 Myddelton Street, London EC1R 1UW  
 Email: [domenica.rasulo@ons.gsi.gov.uk](mailto:domenica.rasulo@ons.gsi.gov.uk)

Les Mayhew, Cass Business School, City University  
 106 Bunhill Row, London EC1Y 8TZ, UK  
 Email: [lesmayhew@googlegmail.com](mailto:lesmayhew@googlegmail.com)

Ben Rickayzen, Cass Business School, City University  
 106 Bunhill Row, London EC1Y 8TZ, UK  
 Email: [B.D.Rickayzen@city.ac.uk](mailto:B.D.Rickayzen@city.ac.uk)