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Trends in disability-free life expectancy

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Abstract

Purpose: To assess trends in Disability-Free Life Expectancy, in life expectancy with disabilities according to levels of severity and in Disability-Adjusted Life Expectancy in the Netherlands between 1989 and 2000.
Method: The disability-free life expectancy, a composite population health status measure, was calculated with data on long-term disability. Weights reflecting the impact of disability on personal functioning were assigned to different levels of severity of disability, in order to calculate a Disability-Adjusted Life Expectancy and to define cut-off points, in order to distinguish between levels of severity.
Results: At an aggregated level, for both males and females at the ages of 16 and of 65 years, an increase in years with disabilities and a decline in disability-free life expectancy were observed. These trends were mainly caused by a rise in the number of years with mild disabilities, with the number of years with moderate and severe disabilities decreasing. The combined changes have resulted in an increase in the Disability-Adjusted Life Expectancy.
Conclusion: Trends in disability-free life expectancy and in years with disabilities provide support for a scenario of dynamic equilibrium. The number of years with moderate and severe disabilities has reduced, resulting in an increase in the number of years with minor disabilities. Further research should focus on the underlying causes of the increase of years with minor disabilities.

Introduction

The demographic ageing of Western populations and the concomitant increase of chronic conditions will lead to a continuous increase in the prevalence of physical disabilities.[1] Physical disabilities have a major impact on both individuals and on populations, resulting in restrictions in social participation, and growing health care needs. In sustaining health policy, data on the prevalence of disabilities are used more and more as indicators to monitor and describe the health status of the population and to allow comparison over time.[1,2]

To monitor public health on the basis of disabilities, several approaches are possible. The first approach is measuring prevalence. Manton *et al.* found a significant decline in prevalence of chronic disability between 1982 and 1994 in the USA.[3] Picavet and Hoeymans observed a fairly stable prevalence of disability in the Netherlands over the last 10 years (standardised to the 1995 population). They even noticed a slight decrease in recent years, especially in mobility disabilities.[2] These findings contradict the expectations, which might be related to different definitions of disabilities (e.g. including only severe disabilities in the prevalence rates).

A more comprehensive approach to the analysis of changes in disabilities consists of combining prevalence with mortality, resulting in disability-free life expectancy (DFLE).[4–6] Disability-free life expectancy is defined as the number of years an average person is expected to live without disabilities. In the crude approach, a distinction is made only between years with and without disabilities. Crimmins *et al.* analysed trends in DFLE in the USA over a period of two decades (1970–1990). They observed an increase in disability-free years both for males and females.[7] In the last decades of the 20th century in the Netherlands, the United Kingdom and Denmark, a clear increase among males in years without disabilities was observed. The trend was less clear for females.[8] So, looking at trends in DFLE at an aggre-

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gated level—in terms of years with disabilities vs. years without disabilities—no evidence was observed of an increase in disabilities.

One of the main drawbacks of the crude approach is its considerable dependence on the definition of disability.[9] In the Netherlands, for instance, prevalence of disability varies between 4% and 25%, depending on the definition of disability and the measurement instruments.[10] In addition, this approach does not provide information about the changes that occur in the years with disabilities. The introduction of levels of severity in the calculation of DFLE—the third approach—contributes to a more detailed understanding of the trends. Definitions of levels of severity are based on the response categories used in the surveys. Severe disability is frequently defined as 'confined to bed', 'institutionalisation' or 'not being able to do at least one activity'. In analysing chronological series of DFLE data for several countries, Robine *et al.* concluded that life expectancy free of severe, or very severe, disabilities increased at about the same rate as total life expectancy. The same study also found an increase in years with less severe disabilities.[11–13] These data deliver supportive evidence for a public health scenario of a dynamic equilibrium, the gist of which is that the increase in prevalence of disability is mainly due to an increase in the prevalence of mild disabilities.[14]

A fourth approach could be distinguished, in which a more elaborate procedure is used to assign utilities (weights) to the different levels of severity. These utilities reflect the impact of disabilities on personal functioning, ranging from 0 (the worst possible state of health or functioning) to 1 (the best possible state of health or functioning), and reflect the preferences of individuals vis-à-vis the various health (or functional) states. Each year with a certain level of severity is then weighted with this utility.[15–17] This approach results in a Disability-Adjusted Life Expectancy (DALE). Disability Adjusted Life Expectancies is a general term for health expectancies which estimate the expectation of equivalent years of good health. DALE is calculated for an exhaustive set of health states defined in terms of disability severity. DALEs give a weight of 1 to years of good health, and non-zero weights to at least some other states less than good health.[18] This approach (also known as Health-Adjusted Life Expectancy (HALE)) was only used in Canada in the early 1990s. Preferences—as a basis for deriving utilities—were collected using a standard gamble procedure.[19]

Our study aimed to assess trends in DFLE and DALE by combining the advances of the fourth approach with those of the third approach. A Person Trade-Off approach was used to assign utilities to different levels of severity that reflect the impact of severity on six dimensions of personal functioning.[20] On the basis of these utilities or weights, we have introduced more objective cut-off points to observe the dynamics in the years with disabilities, for which several scenarios have been described: expansion, compression or dynamic equilibrium.[14, 21–23]

The aims of this paper are:

(a) to assess the trends in the Netherlands between 1989 and 2000 for DFLE, for life expectancy with disability according to levels of severity and for DALE;
(b) to discuss possible explanations for the observed trends.

Data and methods

DFLE and DALE are calculated using the Sullivan method.[4–6] Using age-specific mortality figures for a particular year, total life expectancy is calculated for a synthetic, period life-table cohort. The number of person years that the synthetic cohort will live in that interval is calculated for each age interval. The number of person years is then divided into disability-free years and years with different levels of disability severity on the basis of the prevalence of disabilities in that particular year and age group. By analysing DFLE as a proportion of the total life expectancy, the Disability Free Life Percentage (DFLP) is calculated, using the following formulas:

$$DFLE \text{ at age } a0 = \frac{1}{l_{a0}} \sum_{a=a_0}^{a=a_n} L_a(1 - p_{a.})$$

$$DALE \text{ at age } a0 = \frac{1}{l_{a0}} \sum_{a=a_0}^{a=a_n} L_a(1 - \sum_{i} w_i p_{ai})$$

$$DFLP \text{ at age } a0 = DFLE_{a0}/LE_{a0}$$

$$DALP \text{ at age } a0 = DALE_{a0}/LE_{a0}$$

where:

L_a = the years lived in age interval starting with age a
a_n = lower age of highest age interval
p_{ai} = prevalence of disability state i in the age interval starting with age a
$p_{a.}$ = prevalence of disability (all states together)
w_i = weight given to disability state i
l_{a0} = number of persons still alive at age $_{a0}$
LE_a = total life expectancy at age a

Because of the standard life table approach, the results are independent of the composition of the population and allow comparison to other populations or over time.[6, 24]

Data on the prevalence of long-term disabilities was obtained from the health interview surveys conducted by Statistics Netherlands between 1989 and 2000. In 1989 almost 10 000 non-institutionalised respondents (58.5%) completed the health interview survey. In 2000, almost 10 000 respondents (55%) again completed the survey. In between these years, the number of respondents fluctuated between 7000 (1990) and 11 000 (1997) and the response rate fluctuated between 55% (in 1993 and 2000) and 60% (in 1997). To be representative for the Dutch non-institutionalised living population, the data is weighted to take socio-demographic characteristics of the Dutch population into account.[25]

The health interview surveys have measured long-term disability since 1989 using ten items of the instrument developed by the Organization for Economic Co-operation and Development (OECD) (table 1).[26, 27]

Factor analysis showed the 10 items to cluster into three different types of disabilities: vision problems, hearing problems and problems with mobility and activities of daily life (ADL). Over the years, the measurement instrument has remained the same in terms of wording, response categories and the way data are collected. However, the sampling procedure for the health interview survey changed in 1997 from household sampling to individual sampling.

Until 1997, the health interview survey did not cover long-term disability in persons below the age of 16 years. Starting in 1997, information about long-term disability was also collected for the 12-to-15 age group. To allow for the calculation of the trends for the same age groups, disability-free life expectancy is calculated from the age of 16 years onwards. Because long-term disabilities are mainly a problem for older age groups, we also present the results at the age of 65 years.

In order to differentiate between levels of severity, weights for different disabilities were obtained from the Dutch project on 'Disability weights for diseases'.[28, 29] The weights were assigned in a Person Trade-Off procedure in which a panel of 38 medical professionals assigned disability weights to stages of 52 diseases and to four levels of severity for each of three

Table 1 Type of disability, OECD items as included in the Netherlands Health Interview Survey and used for the calculation of disability-free life expectancy, levels of severity, weights assigned to different levels of severity and crude prevalence in 1989 and 2000 (in %)

Type of disability	*Items*	*Levels of severity**	*Weights (0 = perfect health, 1 = death)*	*Crude prevalence*	
				1989	*2000*
Vision	– ability to read small print in newspapers	Mild	0.02	5.8	8.8
	– ability to recognize another person's face	Moderate	0.17	3.8	4.4
		Severe	0.43	3.5	2.7
Hearing	– ability to follow a conversation in a group	Mild	0.04	7.4	10.7
	– ability to hold a conversation with one other person	Moderate	0.12	2.4	2.4
		Severe	0.37	0.4	0.3
Mobility Activities of Daily Life	– ability to carry a 5 kg object 10 metres	Mild	0.01	18.5	15.0
	– ability to bend and pick something up from the floor	Moderate	0.11	6.1	3.2
	– ability to walk 400 metres in one go	Severe	0.65	22.9	4.7
	– ability to dress and undress oneself				
	– ability to get in and out of bed				
	– ability to move from one room to another (on the same floor)				

Levels of severity:
Vision:
Mild: minor problems reading small print, no problems recognizing a face at 4 m distance.
Moderate: major problems reading small print, minor problems recognizing a face at 4 m distance.
Severe: not able to read small print, major problems recognizing a face at 4 m distance.
Hearing:
Mild: minor problems following a conversation with one or more persons.
Moderate: major problems following a conversation with three or more persons, minor or no problems to have a conversation with one person.
Severe: major problems or unable to have a conversation with one person.
Mobility/ADL:
Mild: minor problems with ADL-activities.
Moderate: major problems with ADL.
Severe: Unable to perform ADL.

types of disability (vision, hearing and ADL mobility). This panel judged the impact of this disability on the five dimensions of functioning using the EuroQol system (mobility, self-care, daily activities, pain, and anxiety/depression), to which one extra dimension (cognition) was added. Table 1 shows the weights assigned to the different levels of severity for each single type of disability. To simplify calculation, the scale is reversed: from 0 (good health) to 1 (death). Over the years between 1989 and 2000, about 40% of disabled persons suffered from more than one type of disability (co-disability). As co-disability was not considered in the weight procedure, weights were assigned in our study to co-disability using to the algorithm $1 - ((1 - X) \times (1 - Y) \times (1 - Z))$, where X, Y and Z are the weights for the three different types of disabilities.[30] So the weight factor for co-disability involving severe disability in vision, severe hearing disability and severe disabilities in mobility and ADL is $1 - ((1 - 0.65) \times (1 - 0.43) \times (1 - 0.37)) = 0.87$. In total, after rounding off the figures, 21 different weight factors ranging from 0 to 0.87 were included in the calculation of DALE.

To differentiate between distinct severity levels (minor, moderate and severe disability), cut-off points were introduced in the range of disability weights. Persons with a disability weight between 0.01 and 0.09 were considered to have a minor disability (equal to mild mobility and ADL problems, mild vision and/or mild hearing disabilities). Persons with a disability weight between 0.10 and 0.59 were classified as moderately-disabled persons. Persons with a disability weight over 0.60 were considered to be severely-disabled (equal to at least severe mobility and ADL problems or at least the combination of severe vision and severe hearing problems).

The Health Interview Surveys do not include the institutionalised population (in residences for the elderly and nursing homes). Other data sources for the institutionalised population do not measure disability to the extent necessary for the assignment of weights. For our calculations, we assumed the population in residences for the elderly to have a disability severity equal to the average severity of the disabled people living independently (weight = 0.41). People living in nursing homes were considered to have the severest level of disabilities, with a weight of 0.87.

To estimate the influence of these assumptions, we performed two sensitivity analyses. First, we assumed that the age- and gender-specific prevalence of disabilities in the entire institutionalised population was equal to the population living independently (best case). In the second analysis, we classified the entire institutionalised population as having the severest level of disability and therefore assigned them a weight of 0.87 (worst case).

To assess changes over time in total life expectancy, in DFLE, in different levels of severity and in the DALE, the trends were analysed using linear regression, with the life expectancies—weighted using the inverse of the squared standard errors—as the dependent variables and calendar years as the independent variables.

Results

AT AGE 16

At the aggregated level, we observed a significant increase in total life expectancy between 1989 and 2000 for males aged 16 years (from 58.5 to 60.1 years, represented by the upper trend line in figure 1) (table 2). DFLE fluctuated between 37.6 years (in 1992) and 39.8 (in 1989). Over the years, there was a slight non-significant decrease in DFLE from 39.8 to 38.5 years (represented in figure 1 by the lowest trend line). Life expectancy with disabilities also fluctuated, but there was a significant increase from 18.7 to 21.7 years ($p < 0.05$), suggesting an expansion of disability.

Taking into account levels of severity, the number of years with mild disabilities for males aged 16 increased from 9.9 to 13.9 years ($p < 0.01$). An insignificant reduction in years with moderate and severe disabilities from 8.8 years to 7.8 years was observed. These results supported evidence for the theory of dynamic equilibrium with an increasing number of years with mild disabilities and a decreasing number of years in moderate and severe disabilities.

For females aged 16, total life expectancy increased slightly from 64.6 to 65.1 between 1989 and 2000 ($p < 0.01$). DFLE decreased from 37.4 to 34.7 years ($p < 0.01$) and life expectancy with disabilities increased from 27.2 to 30.4 years ($p < 0.01$). So, at the aggregated level, the trend in DFLE for females at the age of 16 supports the theory of expansion of disability. Between 1989 and 2000, the number of years with mild disabilities increased from 10.6 to 14.8 ($p < 0.01$). An insignificant downward trend was observed in the number of years with moderate and severe disabilities. As observed for males, these results supported evidence for the scenario of dynamic equilibrium.

For both males and females at the age of 16, the combination of the increasing total life expectancy, the decreasing numbers of years with moderate and severe disabilities, the increasing numbers of years with mild disabilities and the decrease in DFLE resulted in an increase in DALE This increase was significant for both

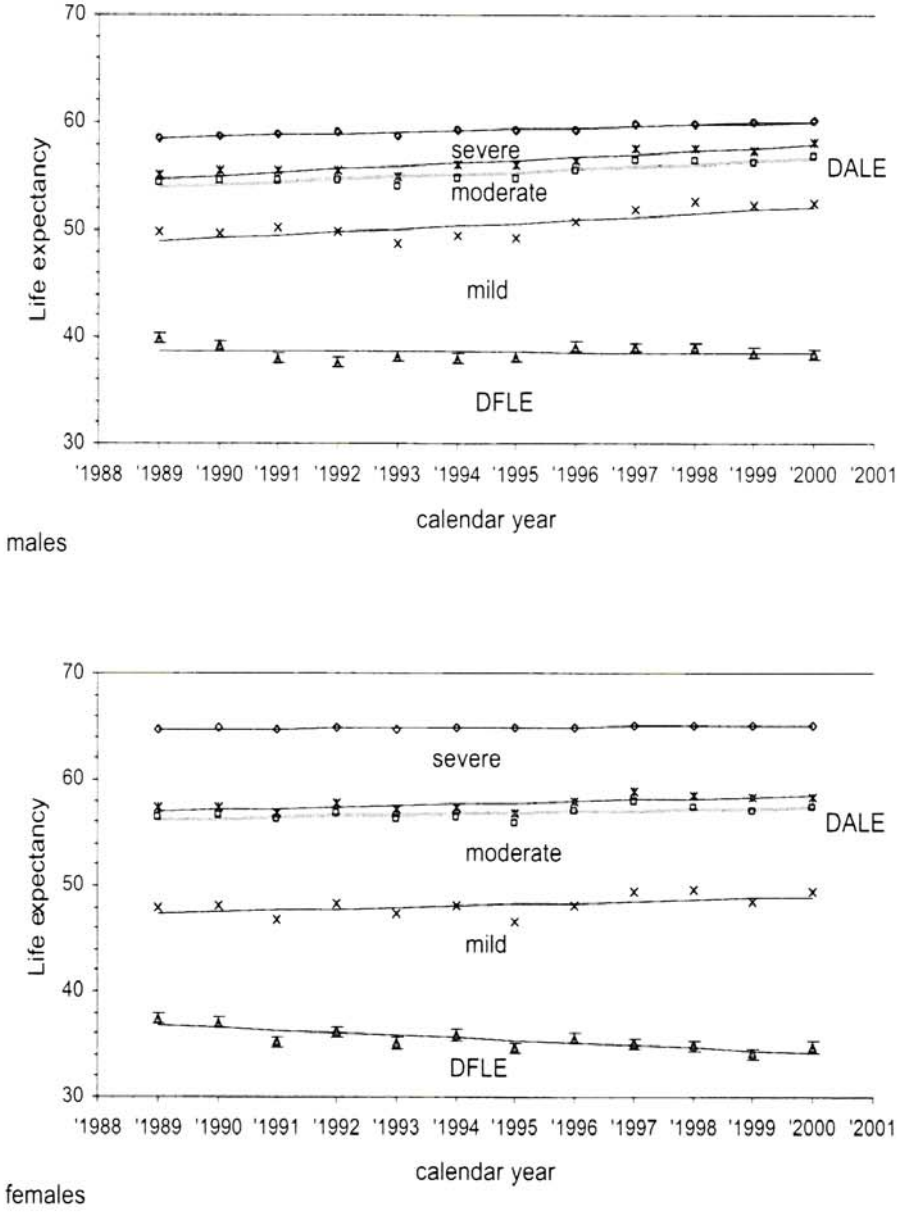

Figure 1 Trends in disability-free life expectancy, life expectancy in different levels of disability severity and in DALE, for males (above), and females (below) aged 16, between 1989–2000.

males and females: for males at the age of 16 from 54.3 to 56.8 adjusted years ($p < 0.01$), and for females at the age of 16 from 56.4 to 57.4 adjusted years ($p < 0.05$).

Analysing DFLE as a proportion of total life expectancy, we observed for males an insignificant decrease from 68.1% to 64.0%. For females, the decrease was significant: from 57.9% to 53.2% ($p < 0.01$). The total proportion of life with disabilities increased both for males (non-significant) and for females ($p < 0.05$). In relative terms, the results at the aggregated level also showed an increase in disability. At a differentiated level for both males and females, analyses showed an increase in the proportion with mild disabilities and a reduction in the proportion with moderate and severe disabilities, supporting evidence for the theory of dynamic equilibrium.

AT AGE 65

For males aged 65, total life expectancy increased significantly from 14.3 years to 15.3 years between 1989 and 2000 ($p < 0.01$). DFLE decreased from 5.5 years to 4.6 years (not significant) and life expectancy with disabilities increased from 8.8 to 10.7 years

Table 2 Total Life Expectancy, Disability-Free Life Expectancy (DFLE), Life Expectancy with Disabilities (according to level of severity), Disability-Free Life Percentage (DFLP) and Disability-Adjusted Life Expectancy (DALE) for males and females, age 16 years (1989 to 2000)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Males												
Total life expectancy	58.5	58.7	58.9	59.1	58.8	59.3	59.3	59.3	59.8	59.8	60.0	60.1
DFLE	39.8	39.2	38.0	37.6	38.2	38.0	38.2	39.1	39.1	39.0	38.6	38.5
With disabilities	18.7	19.6	20.8	21.5	20.6	21.3	21.1	20.1	20.7	20.9	21.4	21.7
Of which with												
Mild disabilities	*9.9*	*10.4*	*12.1*	*12.2*	*10.5*	*11.5*	*11.0*	*11.6*	*12.8*	*13.7*	*13.6*	*13.9*
Moderate disabilities	*5.3*	*5.8*	*5.4*	*5.6*	*6.2*	*6.6*	*6.9*	*5.8*	*5.6*	*4.9*	*5.3*	*5.8*
Severe disabilities	*3.5*	*3.3*	*3.3*	*3.6*	*3.9*	*3.2*	*3.2*	*2.8*	*2.3*	*2.3*	*2.5*	*2.0*
DFLP	68.1	66.7	64.6	63.7	65.0	64.1	64.4	66.0	65.3	65.1	64.3	64.0
DALE	54.3	54.5	54.6	54.5	54.0	54.7	54.8	55.5	56.3	56.4	56.3	56.8
Females												
Total life expectancy	64.6	64.8	64.8	64.9	64.6	64.9	64.9	64.9	65.1	65.2	65.0	65.1
DFLE	37.4	37.1	35.2	36.2	35.1	35.9	34.6	35.5	35.0	34.8	34.1	34.7
With disabilities	27.2	27.8	29.6	28.8	29.5	29.0	30.3	29.4	30.0	30.3	31.0	30.4
Of which with												
Mild disabilities	*10.6*	*11.0*	*11.7*	*12.2*	*12.3*	*12.2*	*11.9*	*12.7*	*14.3*	*14.7*	*14.4*	*14.8*
Moderate disabilities	*9.4*	*9.3*	*10.0*	*9.3*	*9.8*	*9.2*	*10.2*	*9.8*	*9.5*	*8.9*	*9.9*	*8.9*
Severe disabilities	*7.2*	*7.6*	*7.9*	*7.2*	*7.4*	*7.5*	*8.1*	*6.9*	*6.1*	*6.7*	*6.7*	*6.8*
DFLP	57.9	57.1	54.3	55.7	54.3	55.3	53.4	54.7	53.8	53.4	52.4	53.2
DALE	56.4	56.6	56.2	56.7	56.3	56.5	55.9	57.0	57.8	57.4	57.1	57.4

N.B. figures rounded off

($p < 0.05$) (figure 2, table 3). So, at this aggregated level, trends in DFLE suggest an expansion of disability. The number of years with mild disabilities increased from 3.7 to 6.2 years ($p < 0.01$), while the combined number of years with moderate and severe disabilities showed a insignificant decrease from 5.1 to 4.5 years, indicating supportive evidence for the dynamic equilibrium theory.

For females aged 65 a very small increase in total life expectancy was observed (from 18.9 to 19.2 years, $p < 0.01$). No change in DFLE (4.3 years) was observed. The analyses showed a small but significant increase in life expectancy with disabilities from 14.7 to 14.9 years ($p < 0.05$), delivering supportive evidence for the expansion of disability theory.

Considering levels of severity, the number of years with mild disabilities increased from 3.6 to 5.0 years ($p < 0.01$). On the other hand, a significant decrease was observed in the years with moderate and severe disabilities (from 11.1 to 9.9 years ($p < 0.01$)). These results suggest supportive evidence for the theory of dynamic equilibrium.

The results are reflected in the DALE. For males, DALE increased from 11.7 adjusted years to 13.4 adjusted years ($p < 0.01$), while for females an increase was found from 13.0 to 13.7 adjusted years ($p < 0.01$).

Due to the fluctuations, an insignificant decrease in DFLE for males as a proportion of total life expectancy from 38.3 to 30.3% was observed (table 3). For females, the proportion of DFLE showed no change. At the differentiated level, for both males and females, the proportion of life expectancy with mild disabilities increased. On the other hand, a reduction in the proportion of years spent with moderate or severe disability was observed, supporting the scenario of a relative equilibrium.

Because the necessary data of disabilities for the institutionalised population are not available, two assumptions on the prevalence of disabilities in this group were made. To estimate the impact of the assumptions, a sensitivity analysis was carried out. First—as a best-case scenario—we assumed that the age- and gender-specific prevalence of disabilities in the entire institutionalised population was the same as the prevalence in the same age and gender groups in the non-institutionalised population. This assumption resulted in a DFLE that is, for males and females, about 0.2 (at age 16) to 0.1 (at age 65) years higher over the years. The time trends for the different levels of severity remained the same, in direction and with respect to significance. Secondly—as a worst-case scenario—we assumed that the entire institutionalised population had the severest level of disabilities possible. This assumption resulted in a DFLE about 0.1 years lower for males and 0.3 years lower for females (with a shift from mild and moderate disabilities towards severe disabilities). The trends

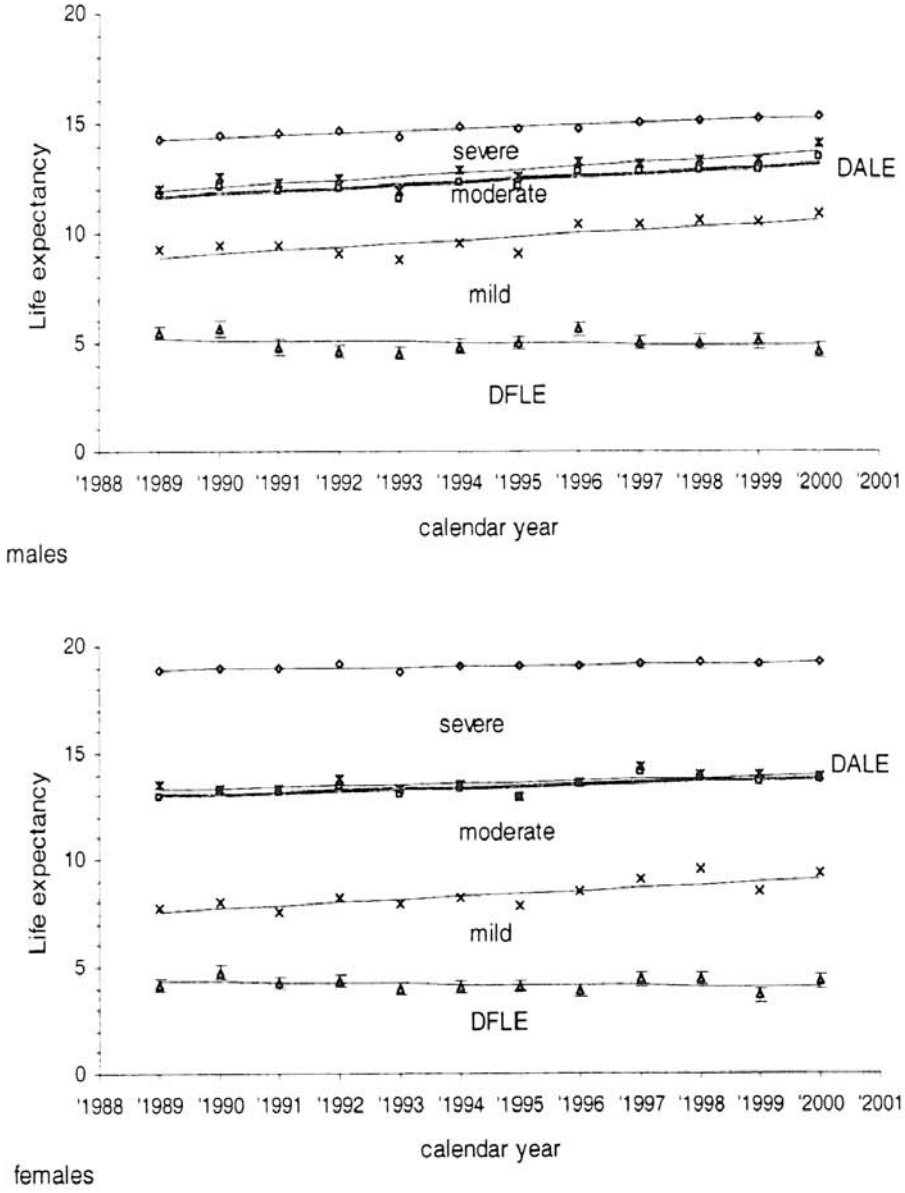

Figure 2 Trends in disability-free life expectancy, life expectancy in different levels of severity and in DALE, for males (above), and females (below) at age 65, between 1989–2000.

remained the same with respect to direction and significance.

Discussion and conclusions

This paper presented the results of trend analyses of Disability-Free Life Expectancy (DFLE) according to level of severity, and of Disability-Adjusted Life Expectancy (DALE). To distinguish between levels of severity, we used weights that reflected the impact of disabilities on functioning. On an aggregated level, in other words, distinguishing only between years with disability and disability-free years, the results tend towards an increase in years with disabilities, both in absolute numbers of years and as a proportion of total life expectancy. Introducing levels of severity, this increase appeared mainly to be caused by an increase in years with minor disabilities, with the number of years with moderate or severe disabilities decreasing. This result supports the theory of a dynamic equilibrium. In the trends in the DALE, we observed a significant increase for both males and females at the age of 16 and at the age of 65. Our trend results are well in line with the trends found in other countries (USA, UK, Finland, Australia, France, New Zealand, Canada). The observed trends indicate at least a

Table 3 Total Life Expectancy, Disability-Free Life Expectancy (DFLE), Life Expectancy with Disabilities (according to level of severity), Disability-Free Life Percentage (DFLP), Disability-Adjusted Life Expectancy (DALE) for males and females, age 65 years (1989 to 2000)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Males												
Total life expectancy	14.3	14.4	14.5	14.7	14.4	14.8	14.7	14.7	15.0	15.1	15.2	15.3
DFLE	5.5	5.6	4.8	4.6	4.5	4.8	5.0	5.6	5.0	5.0	5.1	4.6
With disabilities	8.8	8.7	9.7	10.0	9.9	10.0	9.7	9.1	10.0	10.1	10.1	10.7
Of which with												
Mild disabilities	*3.7*	*3.8*	*4.7*	*4.5*	*4.2*	*4.7*	*4.1*	*4.7*	*5.3*	*5.5*	*5.4*	*6.2*
Moderate disabilities	*2.8*	*3.1*	*2.8*	*3.3*	*3.1*	*3.3*	*3.5*	*2.9*	*2.8*	*2.7*	*2.9*	*3.2*
Severe disabilities	*2.3*	*1.8*	*2.3*	*2.2*	*2.5*	*1.9*	*2.2*	*1.5*	*1.9*	*1.8*	*1.8*	*1.3*
DFLP	38.3	39.3	33.1	31.5	31.5	32.7	34.0	38.3	33.4	33.3	33.3	30.3
DALE	11.7	12.1	11.9	12.0	11.5	12.2	12.1	12.7	12.7	12.8	12.8	13.4
Females												
Total life expectancy	18.9	19.0	19.0	19.1	18.8	19.1	19.1	19.0	19.2	19.2	19.1	19.2
DFLE	4.2	4.8	4.3	4.4	4.0	4.1	4.1	3.9	4.4	4.4	3.6	4.3
With disabilities	14.7	14.2	14.7	14.7	14.8	15.0	15.0	15.1	14.8	14.8	15.5	14.9
Of which with												
Mild disabilities	*3.6*	*3.2*	*3.3*	*3.8*	*3.9*	*4.1*	*3.7*	*4.6*	*4.6*	*5.1*	*4.9*	*5.0*
Moderate disabilities	*5.7*	*5.3*	*5.7*	*5.6*	*5.4*	*5.3*	*5.2*	*5.2*	*5.3*	*4.5*	*5.4*	*4.5*
Severe disabilities	*5.4*	*5.7*	*5.7*	*5.4*	*5.5*	*5.5*	*6.1*	*5.4*	*4.8*	*5.3*	*5.2*	*5.4*
DFLP	22.1	25.1	22.5	22.9	21.2	21.3	21.5	20.4	22.9	23.0	19.0	22.5
DALE	13.0	13.2	13.1	13.4	13.0	13.3	13.0	13.5	14.1	13.8	13.6	13.7

N.B. figures rounded off

dynamic equilibrium (13). Due to different definitions and operationalizations of the concept of disability, comparison of the absolute results of DFLE between countries cannot be considered.[24, 31]

The increase in years with disabilities in this study (all levels of severity included) exceeded the increase in total life expectancy. The increase appeared to be the result of an increase in the incidence of disabilities and not only demographic changes (the increase in the average age of the population). Disabilities were considered to be the consequence of diseases. It is worthwhile therefore to take a look at trends in diseases and disease-free life expectancy. As reported elsewhere for males and females aged 65, life expectancy without chronic diseases decreased and the number of years with chronic diseases increased between 1989 and 2000.[32–34] The increased prevalence of disability could well be the epidemiological consequence of the increasing incidence of chronic disease. The increase in years with chronic disease has not resulted in an increase in years with moderate and severe disability. The overall trend in these levels of severity remained stable or declines. It is possible that this decline is the result of health care interventions such as rehabilitation, and compensating mechanisms, such as the use of technical aids for the handicapped and the elderly. The introduction of new regulations on the availability of technical aids in 1996 in the Netherlands might support this explanation.

As stated above, how disabilities are defined has a major impact on results in terms of increases or decreases. In another Dutch study of trends in DFLE, the minor disabilities were included in the category 'without disabilities', resulting in the conclusion that disability in the Netherlands was decreasing.[33, 34]

In this study, levels of severity were distinguished by assigning weights or values to three levels of severity for three types of disabilities and combining these weights for co-disability. The results of the valuation procedure deserve some discussion, because the results and conclusions are closely connected to the disability weights assigned to the different levels of severity. Mild disabilities in mobility and ADL were not weighted as heavily as mild vision or mild hearing disabilities.[28, 29] The weight assigned to mild ADL mobility comes close to almost perfect health. This might be due to the weighting procedure and the type of judges on the weighting panel. The aim of the procedure was to have medical experts assign weights to different states of 52 diseases. Weighting disabilities may require another kind of expertise than weighting diseases. It is possible that experts in the field of disabilities or disabled people themselves would have assigned other weights to these levels. De Wit *et al.*, for instance, found that patients assigned lower weights to mild health status—defined in a Euroqol 5D profile as only having some mobility problems—than a general population.[35] The valuation procedure included a control procedure in which lay

persons (not medical professionals) performed the assignment on a smaller scale.[36] The results from this part of the project were close to the values that the medical professionals assigned to the levels of disability. Valuing the level of severity of mild ADL mobility too close to perfect health results in an overestimation of the Disability-Adjusted Life Expectancy. The consequences for the years in different levels of severity depend on the weight that should be assigned to these minor ADL mobility disabilities. If this weight does not exceed 0.10, it has no consequences.

A second point to be discussed here is the assumption about the prevalence of disabilities in the institutionalised population. We classified people living in residences for the elderly as moderately disabled, with a weight of 0.41, and people in nursing homes and institutions for disabled persons as severely disabled, with a weight of 0.87. We performed two sensitivity analyses: one best-case scenario, using the same prevalence of disabilities as in the population living independently, and a worst-case scenario, assuming that the entire institutionalised population has severe disabilities. We did not assume that the entire institutionalised population has no or only mild disabilities because, in the Netherlands, people have to be in poor health to be admitted to these types of institutions. In 2000, this population consisted of 4% of the male population of 60 years and older and 9% of the female population of 60 years and older. Our sensitivity analyses showed that, although the absolute number of years in the different levels of severity was influenced by the assumptions we made about the disability of the institutionalised population, the influence on the trend results was only marginal.

In summary, we observed a decrease in years with severe and moderate disabilities. This trend suggest an improvement in public health status. However, in the same period, a decrease in Disability-Free Life Expectancy was observed, due to an increase in years with minor disabilities. The increase in minor disabilities is caused primarily by a shift from severe and moderate disabilities towards minor disabilities. But also a substitution of the non-disabled years by years with minor disabilities was observed. Further research should look into the causes of the substitution of healthy years by years with minor disabilities.

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