Is a rise in the prevalence of chronic conditions an inevitable consequence of better survival? Exploring variations in the prevalence of renal replacement therapy, and life expectancy in Europe, 2001-2011

Ronny Westerman[1], Frederik Peters[2], Roland Rau[2]

Last modified June 22, 2016

Abstract

The progress in human survival throughout the past centuries marks a remarkable improvement in the average lifespan accompanied by a fundamental change in the composition of deaths. The aim of this paper is to explore the question whether higher life expectancy will ultimately lead to an expansion of the prevalence of chronic conditions. For this purpose we contrast changes in lifeexpectancy with the prevalence and incidence of Renal Replacement therapy. Using data from the human mortality database, the ERA-EDTA registry and the WHO causes of death database, the prevalence of renal-replacement therapy (RRT) as proxy for ESRD, and partial life expectancy was computed for the age groups 0-74 and 75+. Our sample comprised males and females in Austria, Denmark, Finland, Greece, Netherlands, Norway, Sweden and Scotland in 2001-2011. Although the life expectancy has increased, the prevalence of RRT decreases in all countries both for males and females. However, larger changes in life expectancy were not necessarily linked to larger changes in the prevalence/incidence of RRT.

1 Introduction

Human mortality underwent major changes throughout the past centuries, extending the life expectancy considerably without a looming limit (Riley, 2001; Vaupel, 2010). This progress was initially enabled by eradicating infectious diseases, and thereby lowering infant mortality, and later by a dramatic decline in deaths from cardiovascular conditions, decreasing old-age mortality (Rau et al., 2008; Vallin and Mesl´e,2009). Up until today, the risk of dying continues to decrease across the whole age-structure, suggesting an ever-increasing degree of control of humans over their environment and biological condition (Fogeland Costa, 1997).

Further progress in survival conditions is increasingly dependent on advances in medical technology to treat the complex mixture of comorbidites at higher ages causing death in modern societies (Bunker, 2001). Thereby, it was argued that the succesful treatment of the major killers cardiovascular diseases and cancer will lead to an expansion of people suffering chronic conditions (Rosen and Haglund, 2005).
In the longer run, this will change the cause-of-death profile of a population from deaths that are directly related to a single lethal disease to deaths that occur due to an interplay of multiple chronic conditions.

If this hypothesis would be valid, the spread of the occurrence of serious chronic conditions and related mortality calls for identifying modifiable causal factors. Therefore, it is important to search and control for different types of epidemiological forces, which cause these diseases. If the new challenges are indeed a side effect of the success in treating cardiovascular diseases and cancer, we need to develop prevention strategies to enable a healthy lifespan extension (Gruenberg, 1977).

We utilized renal replacement therapy as proxy for end-stage-renal disease (ESRD) as a prime example of a clearly defined incurable fatal disease where survival is only preserved by means of expensive medical treatment. To document the prevalence of chronic conditions we applied an indicator with a sharp and clearcut endpoint, which is incurable and fatal if untreated by expensive medical treatment, namely end-stage renal disease (ESRD). Unlike softer indicators of chronic conditions, such as hypertension, the prevalence of RRT is less affected by changes in detection because it represents the terminal loss of is less affected by changes in detection because it represents the terminal loss of the function of a vital organ. At the same time, the diagnosis is not related to self-perceived symptoms as for instances in the the case of chronic pain.

An increase in the prevalence of multiple chronic conditions, whereby renal diseases are just one example, likely results in an increase of infectious diseases and infectious mortality. To measure such a re-emergence of infectious deaths, we used sepsis mortality - a cause of death directly related to the presence of severe underlying chronic conditions typically occurring among people with impaired immune systems, e.g. cancer survivors treated by chemotherapy.

Current studies indicate a rising prevalence of ESRD and sepsis mortality along with increases in life expectancy. However, the time trends in of RRT and life expectancy and their interrelation have not been studied so far systematically. Our study is the first exploration of the trends in these indicators by using harmonized data for a group of European countries sharing the same broad cultural and geographical environment but exhibiting variations in healthcare systems, economic power and living conditions.

2 Data, Methods and Preliminary Results

For measuring the RRT prevalence/incidence we used data from the ERA-EDTA registry (Pippias et al., 2015). Population counts and sepsis deaths were extracted from the WHO causes of death database and data on life expectancy from the human mortality database (World Health Organization, 2015; Human Mortality Database, 2015). We selected those European countries that contained data between 2001 and 2011, leaving the countries Austria, Denmark, Finland, Greece, Netherlands, Norway, Sweden and Scotland in our sample.

We computed the prevalence of renal-replacement therapy (RRT), and partial as well as remaining life expectancy for the age groups 0-74 and 75+ separately for males and females. Based on the magnitude of the change of each of these indicators, the countries were ranked and the correlation among the ranks was

estimated using Spearman's Rho. Thereby, the top rank indicates the highest change in a value on the country level, while the lowest rank indicates the lowest change.

We found that the values for all three indicators increased for all combinations of sex, age and country between 2001 and 2011 (see Table 2 to Table 5). Countries with a larger change in life expectancy tend to exhibit also larger changes in the prevalence of RRT and in the proportion of sepsis deaths of all deaths, except for females at age 75+, where a negative association was measured (see table 1).

However, none of the correlations was statistically significant. In fact, the country-specific results reveal a great variety of trajectories to higher life expectancy. For example, the Netherlands achieved top ranks in the changes of life expectancy and the prevalence of RRT accompanied by a comparatively small increase in the proportion of sepsis deaths. Finland represents an interesting case, where large improvements in life expectancy coincided with small changes in the prevalence/incidence of RRT and at age 75+.

3 Concluding Remarks

This study documents that increases in life expectancy were accompanied by decreases in the prevalence/incidence of chronic conditions and infectious diseases measured by the key indicators, prevalence of RRT and the share of sepsis deaths of all deaths. This was valid in all eight European countries, both for males and females, and at younger and older age groups. However, we could not confirm the hypothesis that countries with higher improvements in life expectancy faced also a higher burden of changes in the RRT. By contrast, it seems to be the case that higher life expectancy could be achieved also with only small changes in the prevalence/incidence of RRT.

The trends and associations presented in our paper are a first indication but not enough to prove a causal relationships as it is usually the case in observational studies using aggregated data at the country level. For this reason, our results could be extended in further studies by analyzing the relation between survival, chronic diseases and the risk to die on infectious causes at the individual level.

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4 Tables

Table 1. Rank correlation between the ranks for changes in life expectancy, the change in the share of sepsis deaths of all deaths (sepsis), and the change in the prevalence of renal-replacement therapy (RRT)

agegroup	**sex**	**sepsis**	p-value	**RRT**	p-value
0-74	males	0.52	0.18	0.02	0.96
0-74	females	0.12	0.78	0.55	0.16
75+	males	0.12	0.78	0.43	0.29
75+	females	-0.48	0.23	-0.02	0.96

Table 2. Life expectancy (A), the share of sepsis deaths of all deaths (B), and the prevalence of renal-replacement therapy (C), age 0-74, males

A

agegroup	country	2001	2011	change	rank
0-74	Austria	69.57196	70.65	1.08	5
0-74	Denmark	69.42895	70.75	1.32	3
0-74	Finland	69.10842	70.16	1.05	6
0-74	Greece	69.73872	70.41	0.67	8
0-74	Netherlands	70.19456	71.52	1.33	2
0-74	Norway	70.13852	71.26	1.12	4
0-74	Scotland	70.82231	71.7	0.88	7
0-74	Sweden	68.47443	69.86	1.39	1

B

agegroup	country	2001	2011	change	rank
0-74	Austria	0.0012	0.0012	0.00002	8
0-74	Denmark	0.0008	0.0033	0.00254	2
0-74	Finland	0.0016	0.0023	0.00065	7
0-74	Greece	0.0021	0.0036	0.0015	6
0-74	Netherlands	0.0047	0.0063	0.00163	5
0-74	Norway	0.0036	0.0057	0.00208	4
0-74	Scotland	0.0037	0.0061	0.00236	3
0-74	Sweden	0.0031	0.0069	0.0038	1

B

agegroup	country	2001	2011	change	rank
0-74	Austria	0.0009	0.0012	0.00025	4
0-74	Denmark	0.0008	0.001	0.00015	8
0-74	Finland	0.0007	0.001	0.00023	5
0-74	Greece	0.0009	0.0012	0.00026	3
0-74	Netherlands	0.0007	0.001	0.0003	1
0-74	Norway	0.0007	0.001	0.00029	2
0-74	Scotland	0.0008	0.0009	0.00019	7
0-74	Sweden	0.0009	0.0011	0.0002	6

Table 3. Life expectancy (A), the share of sepsis deaths of all deaths (B), and the prevalence of renal-replacement therapy (C), age 0-74, females

A

agegroup	country	2001	2011	change	rank
0-74	Austria	72.18273	72.65754	0.47	6
0-74	Denmark	71.24376	72.2426	1	1
0-74	Finland	72.28249	72.6605	0.38	7
0-74	Greece	72.50156	72.82277	0.32	8
0-74	Netherlands	71.84091	72.46725	0.63	2
0-74	Norway	72.15329	72.70895	0.56	4
0-74	Scotland	72.38594	72.87444	0.49	5
0-74	Sweden	71.09574	71.71025	0.61	3

B

agegroup	country	2001	2011	change	rank
0-74	Austria	0.0014	0.0014	-0.00001	8
0-74	Denmark	0.0014	0.0022	0.00077	6
0-74	Finland	0.002	0.0026	0.00062	7
0-74	Greece	0.0032	0.006	0.00281	3
0-74	Netherlands	0.0066	0.0076	0.00103	5
0-74	Norway	0.0014	0.0081	0.00678	1
0-74	Scotland	0.0053	0.008	0.0027	4
0-74	Sweden	0.0041	0.0071	0.00298	2

B

agegroup	country	2001	2011	change	rank
0-74	Austria	0.0005	0.0007	0.00013	2
0-74	Denmark	0.0005	0.0006	0.00013	4
0-74	Finland	0.0005	0.0006	0.00007	8
0-74	Greece	0.0006	0.0006	0.00008	7
0-74	Netherlands	0.0005	0.0007	0.00017	1
0-74	Norway	0.0004	0.0006	0.00013	3
0-74	Scotland	0.0005	0.0006	0.00011	5
0-74	Sweden	0.0005	0.0006	0.00011	6

Table 4. Life expectancy (A), the share of sepsis deaths of all deaths (B), and the prevalence of renal-replacement therapy (C), age 75+, males

A

agegroup	country	2001	2011	change	rank
75+	Austria	9.78	10.88	1.1	6
75+	Denmark	9.05	10.37	1.32	5
75+	Finland	9.25	10.67	1.42	2
75+	Greece	10.01	11.04	1.03	7
75+	Netherlands	9.09	10.68	1.59	1
75+	Norway	9.42	10.8	1.38	3
75+	Scotland	9.97	11	1.03	7
75+	Sweden	9.04	10.41	1.37	4

B

agegroup	country	2001	2011	change	rank
75+	Austria	0.0009	0.0013	0.00041	8
75+	Denmark	0.0019	0.0065	0.00457	3
75+	Finland	0.0025	0.0036	0.00111	7
75+	Greece	0.0039	0.0072	0.00336	4
75+	Netherlands	0.0051	0.0081	0.00306	5
75+	Norway	0.0056	0.0122	0.00653	2
75+	Scotland	0.0062	0.0089	0.00271	6
75+	Sweden	0.0052	0.0124	0.00729	1

C

agegroup	country	2001	2011	change	rank
75+	Austria	0.0018	0.0032	0.00144	3
75+	Denmark	0.0017	0.0028	0.0011	5
75+	Finland	0.0011	0.0022	0.00108	6
75+	Greece	0.0029	0.0043	0.00132	4
75+	Netherlands	0.0016	0.0037	0.00216	1
75+	Norway	0.0017	0.0034	0.00177	2
75+	Scotland	0.0015	0.0021	0.00061	8
75+	Sweden	0.0002	0.0029	0.00094	7

Table 5. Life expectancy (A), the share of sepsis deaths of all deaths (B), and the prevalence c
renal-replacement therapy (C), age 75+, females

A

agegroup	country	2001	2011	change	rank
75+	Austria	11.91	13.11	1.2	3
75+	Denmark	11.39	12.39	1	7
75+	Finland	11.69	13.2	1.51	1
75+	Greece	11.5	12.57	1.07	6
75+	Netherlands	11.65	12.95	1.3	2
75+	Norway	11.99	13.07	1.08	5
75+	Scotland	12.23	13.1	0.87	8
75+	Sweden	11.08	12.18	1.1	4

B

agegroup	country	2001	2011	change	rank
75+	Austria	0.0009	0.0011	0.00029	8
75+	Denmark	0.0021	0.0053	0.00316	5
75+	Finland	0.0025	0.0034	0.00093	7
75+	Greece	0.005	0.0084	0.00343	3
75+	Netherlands	0.0054	0.0087	0.00325	4
75+	Norway	0.0059	0.009	0.00305	6
75+	Scotland	0.0061	0.0104	0.00422	2
75+	Sweden	0.0042	0.0099	0.00568	1

C

agegroup	country	2001	2011	change	rank
75+	Austria	0.0009	0.0014	0.00052	3
75+	Denmark	0.0007	0.0011	0.00043	6
75+	Finland	0.0005	0.0007	0.00028	8
75+	Greece	0.0014	0.0022	0.00073	2
75+	Netherlands	0.0006	0.0016	0.00096	1
75+	Norway	0.0005	0.001	0.0005	4
75+	Scotland	0.0006	0.001	0.00048	5
75+	Sweden	0.0006	0.001	0.00038	7