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Trends in prevalence from 1990 to 2007 of patients hospitalized with heart failure in Sweden

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Abstract

Aims To investigate trends in absolute numbers and prevalence from 1990 to 2007 of patients hospitalized with heart failure (HF) in Sweden.

Methods and results National inpatient and cause-specific death registers were used to calculate age- and sex-specific trends in absolute numbers and prevalence from 1990 to 2007 of patients hospitalized with HF in Sweden. Absolute numbers increased from 105,449 in 1990 to 144,925 in 2007, with a 77% increase in patients aged 85–99 years. The overall age-adjusted prevalence in 1990 was 1.73% and increased with an estimated annual percentage change (EAPC) of 4.3% (95% confidence interval (CI): 3.6% to 4.9 %) from 1990 to 1995, with no further significant change until 2002. The single year with highest prevalence was 1998 when it peaked with 2.13%. The prevalence then declined slowly from 2002 (EAPC: -1.1 (95% CI: -1.5% to -0.6%) to 1.99% in 2007. The decrease in prevalence was not found in persons <65 years, where, instead, an increase was found throughout the period.

Conclusion Fears of an impending HF ‘epidemic’ could not be confirmed in this analysis of trends in prevalence for the period 1990–2007 of patients hospitalized with HF in Sweden . An overall slight decrease in age-adjusted prevalence was observed from 2002. The prevalence in patients <65 years increased markedly. In absolute numbers, there was a substantial increase among the very old, consistent with demographic changes.

Keywords: Heart failure • Epidemiology • Gender • Age • Prevalence

Introduction

Heart failure (HF) is a major health problem worldwide with an estimated prevalence of about 2% in the Western world.^{1,2} Prognosis is poor with a 5-year survival rate of approximately 50%.³ HF requires substantial healthcare resources and, in Sweden, 75% of the costs of HF are related to hospitalizations.⁴

Many factors, including increased life expectancy, changes in the prevalence of risk factors and of underlying diseases for HF, improved diagnostic accuracy, and advances in medical care can all have a bearing on the prevalence and incidence of HF. Several studies have reported a trend of a decreasing incidence of HF and related mortality during the last few decades.⁵⁻⁷ The lower incidence of HF may be related to new pharmacological therapies and interventions that are increasingly being used in patients with cardiovascular disease,⁸ and the concomitant reduction in myocardial infarctions (MI) and their severity.⁹ A decreasing incidence of HF after acute MI in Sweden was recently reported by our group.¹⁰ Advances in the treatment of HF itself, in particular implementation of international guidelines,^{11,12} have also likely contributed to a reduction in mortality rates. However, there is an increase in the prevalence of risk factors for HF, which suggests that an HF ‘epidemic’ may be occurring.¹³ These include diabetes,¹⁴ obesity,¹⁵ atrial fibrillation,¹⁶ a sedentary lifestyle,¹⁷ and age-related sclerotic valvular heart disease.¹⁸ Additionally, as the incidence of HF increases steeply with age, increased life expectancy may have an impact on the prevalence of HF in the population.¹⁹ In a recent paper by Zarrinkoub et al, the estimated prevalence of HF in Sweden 2006 to 2010 was 2.2%,²⁰ but estimates prior to this, when most changes in the management of HF, acute MI and hypertension were implemented, were not provided. Given this background our aim was to determine time trends in HF prevalence from 1990 to 2007 for patients hospitalized with HF in Sweden.

Methods

Study subjects

All men and women in Sweden were eligible for inclusion in this study if they fulfilled two main criteria:

1. They were hospitalized in Sweden for any reason at least once during 1980-2007 with a principal or contributory diagnosis of HF.
2. They were aged between 19 and 99 years at any time during the period 1990–2007.

Sweden has a universal healthcare system that provides low-cost health care (including hospital care) to the Swedish population. Registration of principal and contributory discharge diagnoses for all patients is mandatory in the Swedish national inpatient register. Each patient is given a principal diagnosis and up to five secondary diagnoses. In Sweden, the number of secondary diagnoses per case in inpatient care increased during the 1990s after the introduction of DRG (diagnosis-related group)-based prospective payment systems. Most of this increase took place in the early 1990s. The national inpatient register has been in operation since the 1960s and on a nationwide basis since 1987. From 1984 to 1986, data were available from 19 of 24 Swedish counties, comprising about 85% of the Swedish population.

Diagnosis at discharge was coded using the International Classification of Diseases (ICD) system. ICD version 8 (ICD-8) was used until 1986, ICD-9 between 1987 and 1996, and ICD-10 from 1997 onwards. The discharge codes applied to HF in this analysis were 427.00, 427.10 (ICD-8), 428A, 428B, 428X (ICD-9), and I50 (ICD-10).

The Swedish mandatory cause-specific death register has been in operation since 1961 and include all deceased persons who by the time of death were registered in Sweden.

A person in this study is considered to have a diagnosis of HF during the period between the incident year when he, or she, for the first time was hospitalized with a first or contributory diagnosis of HF and the year of death. In order to estimate the prevalence for a specific age X on a specific year Y, to the actual incident cases year Y we added the 1-year survivors among the incident cases of age X-1 at year Y-1 and the 2-year survivors among incident cases of age X-2 at year Y-2 and so on. The counting method we used of the partition of the prevalent cases of a specific age and year into subsets of incident cases of younger ages and previous years was described more formally by Gail et al.²¹ In the present analysis, data from the national inpatient register and cause-specific death registers from 1980 to 2007 were linked through the personal identity number, which is unique for all Swedish citizens. The inpatient registry data from 1987 to 2007 was used for the estimation of age-specific incidences and the inpatient registry data from 1980 to 2007 for the estimation of age-specific survival. Survival with a range of maximally 28 years was then estimated. The exponential function was used to estimate survival through extrapolation for longer intervals. These age-specific incidences and survival distributions were applied to population data for the years before 1987. All survival estimates for the period before 1980 was adjusted with general mortality data from the Human Mortality Base.²² Estimations of the total accumulation of hospitalized patients with HF still alive in the interval from 1990 to 2007 provided the number of cases used in all analyses of absolute numbers and prevalence. Population data for the Swedish population for the corresponding age and/or sex-specified group and calendar year was used as reference populations in all prevalence estimates. The Swedish general population of 2000 was used as the reference for age-adjusted prevalence rates that were computed by using direct standardization. This data was provided by the Swedish governmental agency Statistics Sweden. The prevalence estimates (age and/or sex specified or total) for each year were the input to the statistical procedure of joinpoint regression²³. This procedure gave us the annual

percentage change (APC) including 95% confidence interval (CI) for the prevalence figures for the interval 1990-2007 and also an estimation for the years where the APC changed in magnitude and/or direction. As all data were coded, no patient consent was required. The study was approved by the Regional Ethical Review Board of Gothenburg University.

Statistical analysis

SAS software version 9.2 (SAS, Cary, NC, USA) and R software version 2 (R Development Core Team) were used for data analysis. Joinpoint Regression Program 4.0.4 – May 2013 (Statistical Methodology and Applications Branch, Surveillance Research Program, National Cancer Institute) was used for joinpoint analysis.

Results

Overall absolute numbers

The absolute number of patients aged 19-99 who have been hospitalized with HF in Sweden was estimated at 105,449 in 1990, rising to 145,417 patients in 2001, an increase of 38%.

From 2001 to 2007 only minor changes in absolute numbers were observed and the absolute number of HF patients in 2007 was roughly unchanged at 144,925 (e-Table 1).

Overall age-adjusted prevalence

The age-adjusted prevalence of patients aged 19-99 who have been hospitalized with HF in Sweden increased from 1.73% in 1990 to a maximum of 2.13% in 1998, with a subsequent slight decrease to 1.99% in 2007 (Table 1).

Absolute numbers by sex

There were 54,238 women and 51,212 men aged 19-99 who have been hospitalized with HF in Sweden in 1990. Women were in the majority until 2005, but from 2005 to 2007 the reverse was true. The absolute number of male patients with HF increased to 74,064 in 2006. The absolute numbers of female patients with HF peaked at 73,914 in 1998, followed by a decrease to 70,861 in 2007 (e-Table 1). Proportionally, increases were similar in both men and women until 1998 when the number of women showed a gradual decrease (Figure 1).

Age-adjusted prevalence by sex

In 1990, the age-adjusted prevalence of patients who have been hospitalized with HF in Sweden was 1.70% in men and 1.77% in women. The prevalence in both sexes then increased to 2.13% in men and 2.14% in women around 1998–2000. Subsequently, the prevalence decreased to 2.03% in men and 1.93% in women (Table 1).

Absolute numbers by age

Absolute numbers of patients who have been hospitalized with HF in Sweden increased by 60% in the age group 19–54 years and by 82% in the age group 55–64 years from 1990 to 2007 (Figure 3). In the age group 65–74 years numbers increased by 23% until 1996 but from 1997 onwards, numbers decreased. The age group 75–84 years was the largest throughout the study period with 43,782 patients in 1990 increasing to 58,676 in 1998, followed by a decrease to 51,679 in 2007 (e-Table 1). An increase of 77% from 27,592 to 48,761 was observed in patients aged 85–99 years (Figure 3). During the same period the underlying demographic figures for the total Swedish population aged 19–99 years increased by 9.2% from 1990 to 2007 (e-Table 1) with considerable increases in the age groups 55–64 years and 85–99 years of 46% and 61%, respectively (Figure 4).

Age-specific prevalence

The prevalence of patients who have been hospitalized with HF in Sweden increased steeply with age. In the age group 19–55 years, the prevalence increased throughout the study period, from 0.086% in 1990 to 0.133% in 2007, a proportional increase of 55% (Table 1, Figure 2). The prevalence in patients with HF aged 55–64 years increased from 0.85% in 1990 to 1.07% in 1995 followed by a minor decrease until 2004 when the prevalence once again increased until the end of the study, with a final figure in 2007 of 1.06%. Among older persons aged 65–74 years and 75–84 years, the prevalence was 2.80% and 8.11%, respectively, in 1990, increasing to 3.71% and 10.1%, respectively, in 1998, and then decreasing to 3.20% and 9.23%, respectively, in 2007. In the oldest age group, 85–99 years, prevalence peaked at 21.3% in 1998, with only a slight decrease to 20.4% in 2007.

Joinpoint analysis

Table 2 shows the results of the joinpoint analyses. Overall, there was a comparatively steep increase in the prevalence of patients who have been hospitalized with HF in Sweden, with an estimated annual percentage change (EAPC) of 4.3% (95% CI: 3.6% to 4.9%) during 1990 to 1995, after which rates remained stable during 1995 to 2002, and then declined slowly but significantly (EAPC: -1.1 (95% CI: -1.5% to -0.6%). Trends for men and women differed slightly in that rates in men decreased slowly but significantly from 1996 to 2007 (EAPC: -0.3(95% CI -0.5% to -0.1%), while women displayed a decrease at similar pace from 1996 to 2003 (EAPC: -0.4% (95% CI: -0.8% to -0.1%) followed by a steeper decrease from 2003 to 2007 (EAPC: -1.6 (95% CI -2.2 to -1.1). Age-specific analyses showed increasing rates throughout among patients aged 19–54 and 55–54, albeit at a slower rate from 1998 onwards. In the three oldest groups, all showed steeply increasing rates until the mid-1990s, then a flattening and thereafter decreasing rates. After 1996, there were no significant changes

among persons aged 85–99, until the early 2000s, when significant decreasing trends of 1.9% and 1.4% annually among those aged 65–74 and 75–84 years, respectively, were apparent

Discussion

Using data from all patients who have been hospitalized with HF in Sweden, we were unable to confirm an 'epidemic' of HF for the period from 1990 to 2007. There was an increase in age-adjusted prevalence until 1995 in the total population and a decrease from 2002 to 2007. However, changes in age-specific prevalence were divergent, with increasing prevalence among people aged less than 65 years, where absolute rates are very low, whereas rates in older persons, which included most HF cases, decreased.

Warnings of a HF 'epidemic' have been expressed.¹³ Therefore we set out to determine the prevalence in a whole country where all inhabitants are covered by public health care, thereby eliminating bias from geographical and health insurance factors. The prevalence of a diagnosis is the net effect of the rate of incidence of a diagnosis and the mortality for the patients with the diagnosis over time in a particular population. Earlier studies from our group have shown a decrease in both HF incidence from 1988 to 2000 and HF mortality from 1987 to 2003.⁹ In the present study, we included all hospitalizations with a HF diagnosis from the total Swedish population to estimate numbers for the period from 1990 to 2007 and found an initial increase in age-adjusted prevalence, levelling off after 1995 followed by a slight decrease from 2002. This is in contrast to two studies from USA that have shown a steady increase in the prevalence of HF, from 1994–2003²⁴ and from 2000–2005.²⁵ Different patient and/or reference populations may explain the divergent findings. The US studies included either patients 65 years or older covered by Medicare or medically insured patients in the south-eastern United States. In one of the studies²⁵ two-thirds were outpatients whereas in our

study only inpatients were included. Accordingly, given different methodologies, insurance systems and patient populations, direct comparisons between the US and Sweden are difficult.

Sex factors

The age-adjusted prevalence of patients hospitalized with HF in Sweden was slightly higher in women from 1990 to 1999, whereas the opposite was found thereafter in concordance with other reports from the same era.^{24, 25} and in Framingham estimates from 1993¹ but not in the US National Health and Nutrition Examination Survey from 1992² where similar prevalence of HF in men and women has been observed. The different prevalence found between our studies and earlier ones^{1, 2} may be explained by different time periods studied and/or different populations.

Our finding of a decreased age-adjusted prevalence in both men and women since 1996 is in contrast with data from the Kaiser Permanente report with medically insured patients, that also provide sex-specific data, where prevalence increased in both men and women from 2000 to 2005.²⁵ The incidence decreased in both men and women at similar rates in previous reports from both Sweden and Scotland which covered at least parts of our observational period.^{5, 6} The 1-year mortality decreased more in men than in women in Sweden from 1987 to 2003⁹ and in Medicare data, unadjusted 1-year mortality actually increased in women but declined in men between 1998 and 2008.²⁶ Thus, the differing prevalence trends in men and women from 2003 might be explained by differences in mortality trends. In addition, a Swedish study of the prevalence of HF, using data from the Stockholm region in 2006 to 2010, found a decreasing, however weak, temporal trend in women but not in men.²⁰

Age factors

In medically insured patients in south-eastern USA, HF prevalence increased in all age groups from 2000 to 2005 in both men and women, but at a slower pace at higher ages.²⁵

In our study of patients who have been hospitalized with HF, trends were more diversified. In the two youngest age groups, prevalence increased markedly through the whole study period in concordance with Kaiser Permanente data²⁵ and with an increasing incidence among the young²⁷ but since the absolute majority of patients was elderly, this affected the overall rates only marginally.

The birth rate varies over time, for reasons that are not entirely understood, but at least partly as a result of socioeconomic factors. One example is the “baby boom generation” that contributed to a temporary demographic peak and who will reach their 80s from 2023 onwards. In our study there was a more pronounced increase of patients aged 55–64 from 1998 onwards that coincided with the high birth rates in Sweden from 1943 to 1949. Thus, this particular generation will most likely contribute more to the absolute number of HF patients in the future.

In the age groups 65–74 and 75–84, prevalence of patients who have been hospitalized with HF decreased from a peak in 1998. As these age groups together include more HF cases than the other combined, the trend in the overall population paralleled the decreasing trend in the age groups 65–74 and 75–84.

Although the prevalence in the age group 85–99 years was roughly unchanged since 1996, there was an increase of 77% in the absolute numbers of patients with HF in this age group throughout the observation period, coinciding with improved general survival in the Swedish population. The age group 85–99 years may be even more quantitatively important in the future through the projected continuous demographic transitions to an even more aging population, particularly when, as mentioned, the ‘baby-boomers’ grow old. As prevalence of

most diseases increase with age, very old HF patients with multiple co-morbidities probably will become an increasing challenge for healthcare systems around the world.

Strengths and limitations

There are some limitations to our study but also several strengths. Strengths are that we were able to use data from an entire nation where practically all persons could be followed throughout the period. There are also a few limitations: first, we used administrative data which were not systematically validated, and second, we only studied patients who were hospitalized. However, a principal or contributory diagnosis of HF in the Swedish national inpatient register has been shown to have a reasonably high validity. Using the European Society of Cardiology (ESC) definition, 82% of the possible cases in the national inpatient register are classified as having definite HF. For patients treated at an internal medicine or cardiology clinic the validity of a HF diagnosis is 86% and 91%, respectively.²⁸ In contrast, a validation study of the HF diagnosis in primary care in Sweden found that the ESC diagnostic criteria were fulfilled in only about 30%.²⁹ In a recent report from the Stockholm region in Sweden that included both in- and outpatients, the prevalence of HF was estimated to be 2.2% in Sweden in 2010 after adjustment for the demographic composition. Of the HF patients in 2010, 32% in the Stockholm region had not been hospitalized during 1997–2010.²⁰

Conclusion

We demonstrated increased age-adjusted prevalence from 1990 to 2007 of patients who have been hospitalized with HF in Sweden but with a slight but statistically significant decreasing trend in prevalence since 2002. In contrast, the prevalence increased gradually in patients <65 years throughout the study period. In absolute numbers, HF patients older than 85 years

increased by 77% from 1990 to 2007, mainly for demographic reasons. A continuing trend of increasing numbers of very old HF patients will most likely strain healthcare resources further in the future.

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Conflict of Interest: none declared.

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Table 1 Prevalence of patients hospitalized with heart failure in the total population, by sex, age and calendar year.

%	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Prevalence, age-adjusted	1.73	1.76	1.82	1.95	2.02	2.09	2.11	2.10	2.13	2.12	2.10	2.11	2.10	2.08	2.06	2.04	2.02	1.99
Men	1.70	1.74	1.80	1.93	2.00	2.07	2.10	2.10	2.13	2.11	2.11	2.11	2.10	2.09	2.07	2.07	2.06	2.03
Women	1.77	1.79	1.86	1.98	2.05	2.11	2.14	2.12	2.14	2.12	2.10	2.10	2.09	2.06	2.04	2.00	1.97	1.93
Age group																		
19-54	0.09	0.09	0.09	0.10	0.10	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.12	0.13	0.13	0.13	0.13	0.13
55-64	0.85	0.87	0.91	0.97	1.01	1.06	1.05	1.05	1.07	1.04	1.04	1.03	1.03	1.02	1.02	1.03	1.05	1.06
65-74	2.80	2.89	3.09	3.35	3.52	3.60	3.68	3.65	3.71	3.68	3.64	3.61	3.56	3.48	3.40	3.36	3.29	3.20
75-84	8.11	8.31	8.69	9.37	9.77	10.0	10.1	10.0	10.1	10.0	10.0	10.0	9.92	9.79	9.68	9.53	9.42	9.23
85-99	18.6	18.5	18.5	19.5	19.9	20.6	20.9	20.8	21.3	21.1	20.9	21.2	21.2	21.2	21.2	21.0	20.8	20.4

Table 2 Joinpoint analysis: trends in prevalence of patients hospitalized with heart failure. Rates in the total population, sex-specific and age-specific.

	Period 1		Period 2		Period 3	
	Years	EAPC (95% CI)	Years	EAPC (95% CI)	Years	EAPC (95% CI)
Total population	1990-95	4.3* (3.6 to 4.9)	1995-2002	0.1 (-0.4 to 0.6)	2002-7	-1.1* (-1.5 to -0.6)
Gender						
Men	1990-96	4.4* (3.9 to 4.9)	1996-2007	-0.3* (-0.5 to -0.1)		
Women	1990-96	3.8* (3.4 to 4.3)	1996-2003	-0.4* (-0.8 to -0.1)	2003-7	-1.6* (-2.2 to -1.1)
Age						
19-54	1990-93	3.6* (2.7 to 4.6)	1993-97	5.7* (5.1 to 6.2)	1997-2007	1.3* (1.2 to 1.4)
55-64	1990-95	4.9* (4.2 to 5.6)	1995-2004	-0.5* (-0.8 to -0.2)	2004-7	1.3* (0.2 to 2.5)
65-74	1990-95	6.2* (5.5 to 6.9)	1995-2000	0.4 (-0.2 to 1.1)	2000-7	-1.9* (-2.2 to -1.5)
75-84	1990-95	5.2* (4.6 to 5.8)	1995-2002	0.0 (-0.3 to 0.3)	2002-7	-1.4* (-1.8 to -1.0)
85-99	1990-96	2.4* (1.7 to 3.1)	1996-2004	0.2 (-0.3 to 0.7)	2004-7	-1.3 (-2.9 to 0.4)

EAPC, estimated annual percentage change, *significantly different from 0

e-Table 1 Patients hospitalized with heart failure in absolute numbers by total population, sex, age and calendar year.

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Total population																			
	All	105449	108785	114345	123471	129924	136118	139692	140606	143841	143728	143862	145417	145110	144964	144919	145547	145872	144925
	All men	51212	52845	55432	59726	62815	65800	67522	68240	69927	70055	70501	71496	71649	71990	72308	73230	74064	74063
	All women	54238	55941	58913	63745	67109	70318	72171	72366	73914	73674	73361	73921	73461	72974	72611	72317	71808	70861
Age group																			
19-54	Total	3574	3735	3890	4174	4407	4702	4934	5049	5128	5190	5154	5241	5260	5296	5376	5480	5580	5726
	Men	2327	2428	2547	2705	2846	3045	3205	3286	3354	3384	3366	3401	3411	3458	3494	3588	3640	3742
	Women	1247	1308	1343	1469	1561	1657	1729	1763	1774	1806	1788	1840	1849	1838	1882	1893	1940	1984
55-64	Total	7091	7276	7609	8165	8582	9074	9205	9489	10056	10298	10744	11119	11514	11732	12016	12399	12732	12930
	Men	4758	4896	5136	5466	5698	6064	6193	6462	6863	7062	7357	7653	7985	8160	8352	8634	8903	9068
	Women	2333	2380	2473	2699	2884	3010	3013	3027	3193	3236	3386	3466	3529	3571	3665	3765	3828	3862
65-74	Total	23410	24106	25544	27602	28785	28734	28806	28181	28076	27498	26936	26634	26354	25997	25733	25730	25679	25828
	Men	13892	14318	15239	16407	17181	17196	17306	17122	17100	16840	16456	16421	16281	16245	16234	16396	16485	16670
	Women	9518	9789	10305	11195	11604	11539	11500	11059	10976	10659	10479	10213	10073	9752	9500	9334	9194	9158
75-84	Total	43782	45101	47463	51212	53522	56364	57811	57984	58676	58325	58362	58624	57815	57042	56181	54444	53103	51679
	Men	20977	21616	22575	24338	25473	26905	27643	27931	28496	28517	29001	29242	28870	28524	28218	27780	27547	26980
	Women	22805	23485	24887	26874	28048	29459	30168	30053	30181	29809	29360	29382	28945	28517	27963	26664	25556	24699
85-99	Total	27592	28567	29839	32318	34629	37244	38936	39902	41904	42417	42667	43799	44167	44898	45612	47494	48778	48761
	Men	9257	9587	9935	10811	11617	12591	13175	13438	14115	14253	14320	14780	15102	15602	16010	16834	17489	17603
	Women	18335	18980	19904	21507	23012	24653	25761	26464	27789	28164	28347	29019	29065	29295	29602	30660	31289	31158

Legends

Figure 1 Relative change in number of men and women hospitalized with heart failure from 1990 to 2007.

Figure 2 Relative change in prevalence in patients hospitalized with heart failure by age group from 1990 to 2007.

Figure 3 Relative change in number of patients hospitalized with HF by age group from 1990 to 2007.

Figure 4 Relative demographic changes in the Swedish population by age group from 1990 to 2007.

Figure 1

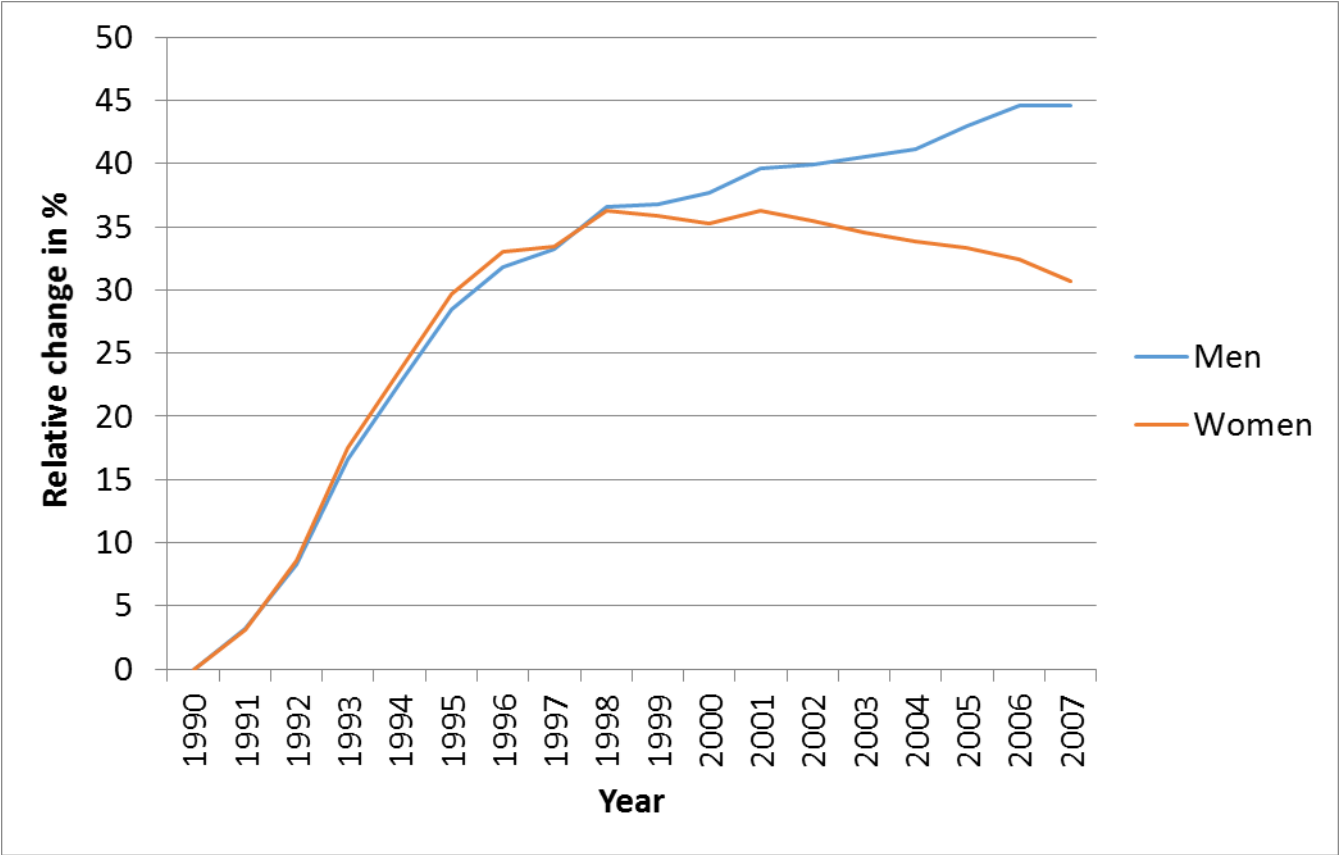


Figure 2

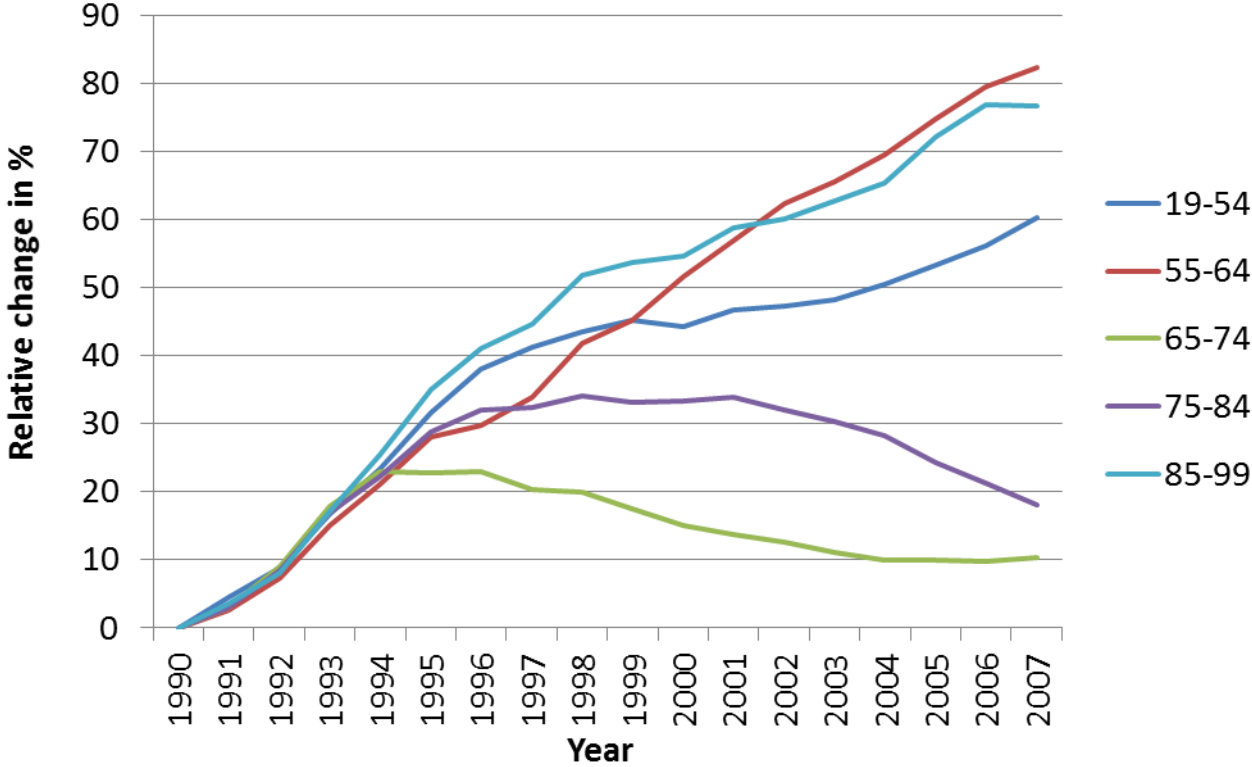


Figure 3

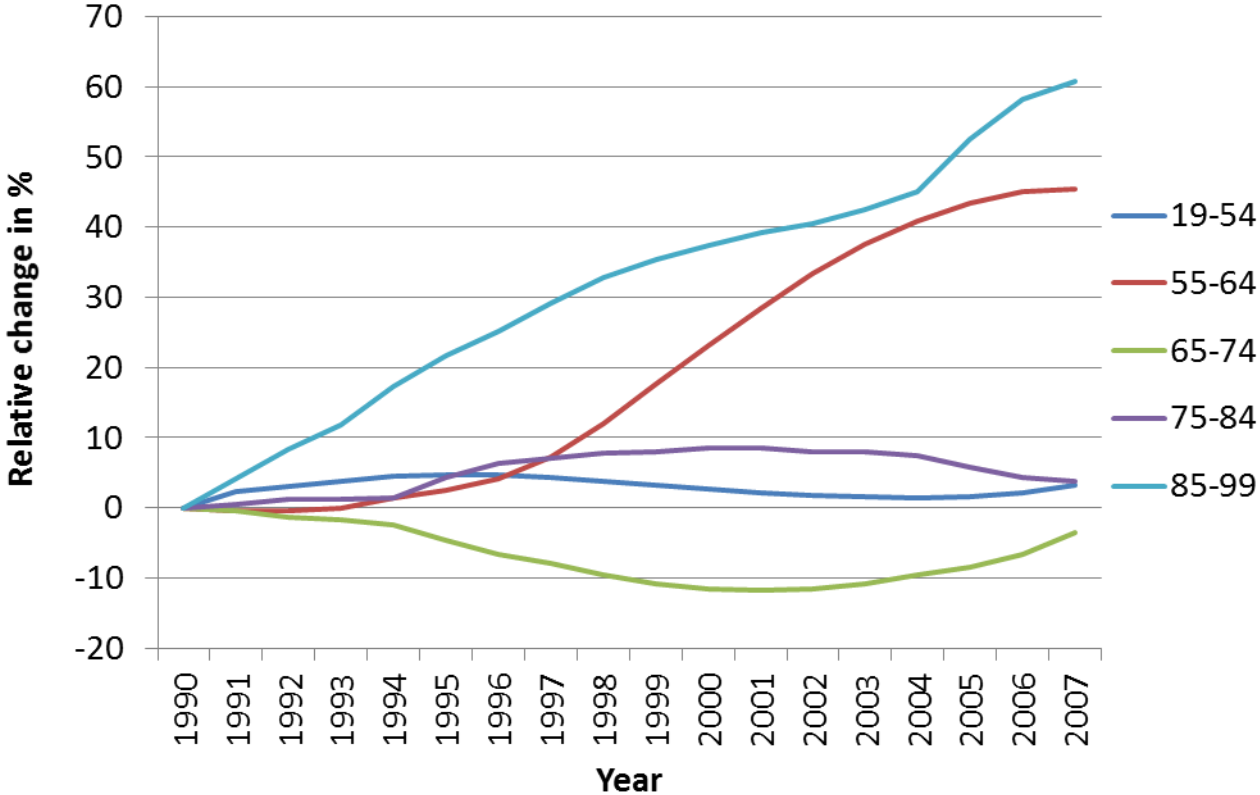


Figure 4

