Changing Risk Factors
An Analysis on Short Term Mortality

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October 24, 2023

Abstract

Ongoing medical advances and individual lifestyles have a lasting impact on mortality risk and life expectancy. Using data from the National Health Interview Survey (NHIS), we examine how the risk of dying from selected pre-existing conditions and individual behaviors changed between 1997 and 2014. In addition to cardiovascular disease, respiratory disease, and cancer, we examined tobacco and alcohol use, physical activity, and body mass index as indicators of medical progress. The results show significant reductions in the relative risk of death for cancer, diabetes, and hypertension, and for men also significant reductions for heart disease. On the other hand, there was an increased relative risk for current smokers and, for women, also for former smokers. In summary, medical progress has made a significant contribution to reducing relative mortality risks, while individual lifestyles have had a counteracting effect.

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1 Introduction

Medical achievements and breakthroughs such as the invention of beta-blockers, the first portable defibrillator, coronary artery bypass grafting, and the invention of insulin have ensured that life expectancy has continued to increase in recent decades. Infectious diseases, once a major cause of death, have become more manageable. Improvements in the diagnosis and treatment of diseases, including cardiovascular disease and cancer, have contributed to increased life expectancy (Howlader et al., 2020; O'Flaherty et al., 2013; Vincent et al., 2010). In addition, advances in preventive medicine, including vaccinations and health promotion programs, have helped reduce the spread of infectious diseases (Bonanni, 1999; Simonsen et al., 2005). Access to clean water, sanitation and immunization have also helped reduce mortality rates. For both men and women, in both high-income and poor countries, the risk of death has decreased and life expectancy has increased (Kinsella, 1992; Raleigh, 2019). While the mortality rate of children and infants initially declined due to better medical care and higher living standards, mortality of the elderly population in particular has declined substantially during the past 50 years (Chang et al., 2011; Hakobyan and Yepiskoposyan, 2010). Medical science is enabling people to live longer. At the same time, new challenges have emerged that affect mortality risk. Demographic change, particularly in countries with aging populations, has led to an increase in age-related diseases such as cardiovascular disease, cancer and neurodegenerative diseases. Lifestyle factors such as unhealthy diets, physical inactivity, tobacco and alcohol use, and the rise in mental illness also affect mortality. On the other hand, there is a paradox in that while medical breakthroughs continue to advance, the rate of increase in life expectancy has slowed in many countries (Cardona and Bishai, 2018; Ho and Hendi, 2018; Raleigh, 2019). In the United States, the trajectory of life expectancy has stagnated and began to decline already before the onset of the COVID-19 pandemic. How can we explain this trend?

One explanation could be that the influence of medicine on the one hand and that of personal lifestyle on the other have different effects on the development of life expectancy and possibly even counteract each other. But what influence do these two aspects have on the mortality risk in detail?

The aim of this study is to examine how mortality risk has changed over time in relation to pre-existing conditions and individual lifestyle. Special attention will be paid to medical progress, as measured by the mortality risk of selected diseases, on the one hand, and to the influence of individual lifestyle on the other.

Health status

Heart disease, cancer, cerebrovascular and respiratory diseases, and diabetes were among the leading causes of death in the United States in both 1997 and 2014 (Hoyert et al., 1999; Kochanek et al., 2016). Since 1998, hypertension has also been among the top 15 causes of death (Martin et al., 1999). Although there has been little change in the ranking of the leading causes of death, there has been a long-term downward trend in the two leading causes of death, heart disease and cancer (Kochanek et al., 2016). The same is true for hypertension and stroke (Kochanek et al., 2016). The declining mortality rates for ischaemic heart disease, stroke and cardiovascular disease are partly due to medical improvements, more effective and earlier treatment, more accurate diagnosis and better post-hospital care (Ezzati et al., 2005).

For example, the global decline in stroke mortality can at least partly be explained by increased consumption and fortification of folic acid (Bonita et al., 1990; Yang et al., 2006). The influence of medical progress is also evident in cancer mortality. According to Howlader et al. (2020), the significant decline between 2013 and 2016 can be attributed to improvements in treatment, for example through the approval and use of targeted therapies. The contrasting trends in prevalence and mortality are also a clear sign of improved prevention. While the prevalence of diabetes increased in both sexes and across all age groups between 1995 and 2005, the mortality rate decreased. (Lipscombe and Hux, 2007).

It is important to note, however, that the diseases do not develop independently of each other. For example, the duration of diabetes affects the risk of coronary heart disease (Fox et al., 2004). In addition, diabetes is an independent predictor of cancer (Coughlin et al., 2004). It is also associated with high blood pressure and the risk of stroke (Joffres et al., 2013).

Despite evidence that medical advances have significantly reduced the risk of dying, life expectancy at birth in the United States has remained almost stagnant by international standards. (Raleigh (2019)) Looking behind the facade, smoking remains the most common preventable cause of death, followed by obesity and physical inactivity. (Mokdad et al. (2004))

Individual Lifestyle

Smoking

Smoking is a major cause of premature and avoidable death and morbidity worldwide. (Ezzati et al., 2005; Lakier, 1992; Office on Smoking and Health (US), 2001). Smoking

is associated with increased mortality from cancer, particularly lung cancer, stroke and cardiovascular disease. (Kenfield et al., 2008; Lakier, 1992). In general, the risk increases with the daily consumption of smoked cigarettes. The higher the consumption, the higher the mortality, including all-cause mortality (Carter et al., 2015; Kenfield et al., 2008). Thun et al. (2013) found clear gender differences in their study. While the risk for male smokers has remained more or less stable since the 1980s, the risk for female smokers continues to increase. By the end of the 2000s, there were hardly any differences. In addition, Thun et al. (2013) found that quitting smoking has a greater positive effect on mortality than reducing tobacco consumption. Similarly, Doll et al. (2004) and Kenfield et al. (2008) found that quitting at the age of 30 had almost no negative effect on mortality in old age. Quitting at the age of 50 halves the relative risk of death. (Doll et al., 2004) It is therefore important to consider former smokers as well as smokers and non-smokers. It is also important to differentiate the daily tobacco consumption of smokers. For this study, the classification of Doll et al. (2004) was used.[1]

Alcohol consumption

The effect of alcohol on health and ultimately mortality is complex and influenced by a number of factors, including the amount of alcohol consumed, the type of alcohol consumed, the pattern of consumption and individual health. However, it is important to note that the relationship between alcohol consumption and mortality is not linear. While excessive alcohol consumption is associated with increased mortality, studies show that low to moderate alcohol consumption is associated with a reduced risk of certain types of heart disease. Heavy drinking, on the other hand, is associated with an increased risk of death, especially from breast cancer and cirrhosis of the liver. The relationship between alcohol consumption and mortality is therefore more like a J or U curve (Fuchs et al., 1995; Marmot and Brunner, 1991; Poikolainen, 1995; White et al., 2002). Epidemiological and biological evidence suggests that light drinking may reduce the risk of death from cardiovascular disease. In contrast, heavy drinking is associated with increased mortality from suicide, accidents and stroke (Poikolainen, 1995). In addition to consumption, age also plays a role in the mortality associated with alcohol consumption. According to (White et al., 2002), there is a U-shaped progression for women from the age of 55 and for men from the age of 34. This may be partly due to the fact that some people cannot or are not allowed to drink because of existing health problems. It is important to note that the exact shape of the curve and the exact thresholds for 'moderate' and

[1]Low consumption is defined as 1–14 cigarettes per day, 15–24 cigarettes describe moderate consumption, more than 25 cigarettes per day are defined as heavy consumption.

'heavy' consumption may vary from study to study. For this study, the classification of consumption according to Baker et al. (2002) was followed, as a detailed breakdown according to frequency of alcohol consumption was available.

Body-Mass-Index

Among high-income countries, the United States has the lowest life expectancy and the highest prevalence of obesity.(Preston and Stokes (2011)) Between 1980 and 2000, the prevalence of obesity among adults in the United States increased significantly. This upward trend continued through 2014. (Flegal et al. (2016)) The influence of body weight on mortality and the relative risk of death has been the subject of numerous studies (Flegal et al., 2016; Gruberg et al., 2002; Manson et al., 1995; Masters et al., 2013; Oreopoulos et al., 2008; Preston and Stokes, 2011; Wannamethee and Shaper, 1989) For example, according to Preston & Stokes (2011), obesity can reduce life expectancy from the age of 50 for women by more than 1. 5 years for women and almost 1.9 years for men. Thus, high levels of obesity are associated with low levels of longevity. However, previous research has shown a J- or U-shaped relationship between BMI and mortality (Manson et al., 1995; Oreopoulos et al., 2008; Wannamethee and Shaper, 1989). This means that underweight people have an increased relative risk of death, while the risk is lowest for normal and overweight people. For obese people, the risk of death increases significantly. There is currently no clear explanation for this paradox, but there are several possible explanations (Oreopoulos et al., 2008). In their research, Wannamethee and Shaper (1989) find that underweight people die mainly from cancer or respiratory diseases, for which mortality rates are higher per se, whereas for obese people cardiovascular diseases are major causes of death, for which the probability of survival is significantly higher. The causality remains unclear. Another possible explanation comes from Gruberg et al. (2002), who found that for coronary heart disease, underweight and normal weight people had the highest relative risk of death. Gruberg et al. (2002) They highlight age as an influencing factor. The mortality rate for normal weight people is lowest among those under 50, and increases with age. Overweight people aged 50-69 have the lowest mortality rate, while overweight people aged 70 and over have the lowest mortality rate. All-cause mortality also shows that the relative risk of being overweight decreases with age. (Stevens et al. (1998); Bender et al. (1999); Corrada et al. (2006))

Physical activity

Physical activity is closely related to body mass index. Sedentary behaviour in particular has a negative impact on people's health. In addition to an increased risk of death from

cardiovascular disease and cancer, the risk of developing diabetes or heart disease also increases with frequent sedentary behaviour. The World Health Organization (WHO) therefore recommends that adults get at least 150 to 300 minutes of moderate activity, such as dancing or jogging, or 75 to 150 minutes of vigorous activity, such as strength training, every week. In general, the more often and for longer, the better for your health. However, it is also emphasised that a little activity is better than no activity at all. For people over 65, it is also recommended that activity be adapted to physical ability (WHO, 2020).[2]

2 Data

The analysis is based on data from the National Health Interview Survey (NHIS) from 1997 to 2014. The data cover a wide range of health indicators, including information on chronic conditions, access to health care, individual behaviours related to tobacco and alcohol use, and daily physical activity. These data were collected through face-to-face interviews with thousands of households across the US.

It is important to note that NHIS data are self-reported, meaning that they are based on respondents' answers and not on medical records or clinical examinations. Therefore, they may differ from the actual health status of the respondents.

The analysis is based upon a sample includes all persons aged 30 to 84, of whom 194,845 are women and 159,781 are men. All persons for whom no information was available on previous diseases, physical activity or body mass index were excluded (see Table 1).

As can be seen from the Table 1, the proportion of people who died within a survival time of 3 years after the interview remains the same for all time periods.[3] For women the proportion is between 2.0% and 2.2% - for men between 2.8% and 3.1%.

3 Method

We analyzed the change in mortality risk using a Cox Proportional Harzard model. By linking the NHIS data to the National Death Index (NDI), it is possible to combine individual mortality data with information from the survey to determine an accurate survival period.

We examined short-term mortality with a survival time of 3 years. The methodological

[2]This recommendation was used to guide the classification of physical activity in this study.

[3]For more detailed information on survival time, see the methods section

Table 1: Descriptive Statistic - Female and Male

	Female			**Male**		
	Alive	Dead	N	Alive	Dead	N
1997–1999	30,173	681	30,854	23,819	741	24,560
	97.8%	*2.2%*		*97.0%*	*3.0%*	
2000–2002	34,742	706	35,448	27,687	874	28,561
	98.0%	*2.0%*		*96.9%*	*3.1%*	
2003–2005	32,753	675	33,428	26,737	817	27,554
	98.0%	*2.0%*		*97.0%*	*3.0%*	
2006–2008	23,625	518	24,143	19,421	588	20,009
	97.9%	*2.1%*		*97.1%*	*2.9%*	
2009–2011	31,559	653	32,212	26,034	753	26,787
	98.0%	*2.0%*		*97.2%*	*2.8%*	
2012–2014	37,953	807	38,760	31,332	978	32,310
	97.9%	*2.1%*		*97.0%*	*3.0%*	
N	190,805	4040	194,845	155,030	4751	159,781
	97.9%	*2.1%*		*97.0%*	*3.0%*	

reason for this is that it creates the same basis for interpretation for each person - each person has the same period of time in which the event (in this case death) can occur. On the other hand, the fixed determination of survival time counteracts the distortion caused by changing behaviour over time (e.g. in terms of alcohol consumption or BMI). As described in the data section, people are interviewed once, which means that the reported lifestyle behaviors may change during the follow-up period. For example, a person may declare to be a non-smoker, but in the following years starts smoking. However, the person is still included in the analysis as a non-smoker. This can distort the results. Due to the gender-specific mortality risks, the development of relative mortality risks was carried out separately for men and women, in each case at 3-year intervals.

Overall, the analysis covers three areas that influence mortality. First, aspects of socio-economic status are included; second are pre-existing conditions, and the health status of individuals. Finally we also looked individual lifestyle factors (alcohol, tobacco consumption, physical activity and body mass index).

Surface Plots

To get a first impression of the general trend in relative mortality risks, the survival analysis was preceded by a logistic regression analysis to calculate odds ratios. The dependent variable in this regression was also survival or death within the 3-year survival period. To calculate the odds ratios, all missing values were removed from the data and dichotomous variables were created from the categorical variables tobacco and alcohol use and cancer. The results, presented in surface plots, clearly show whether there has

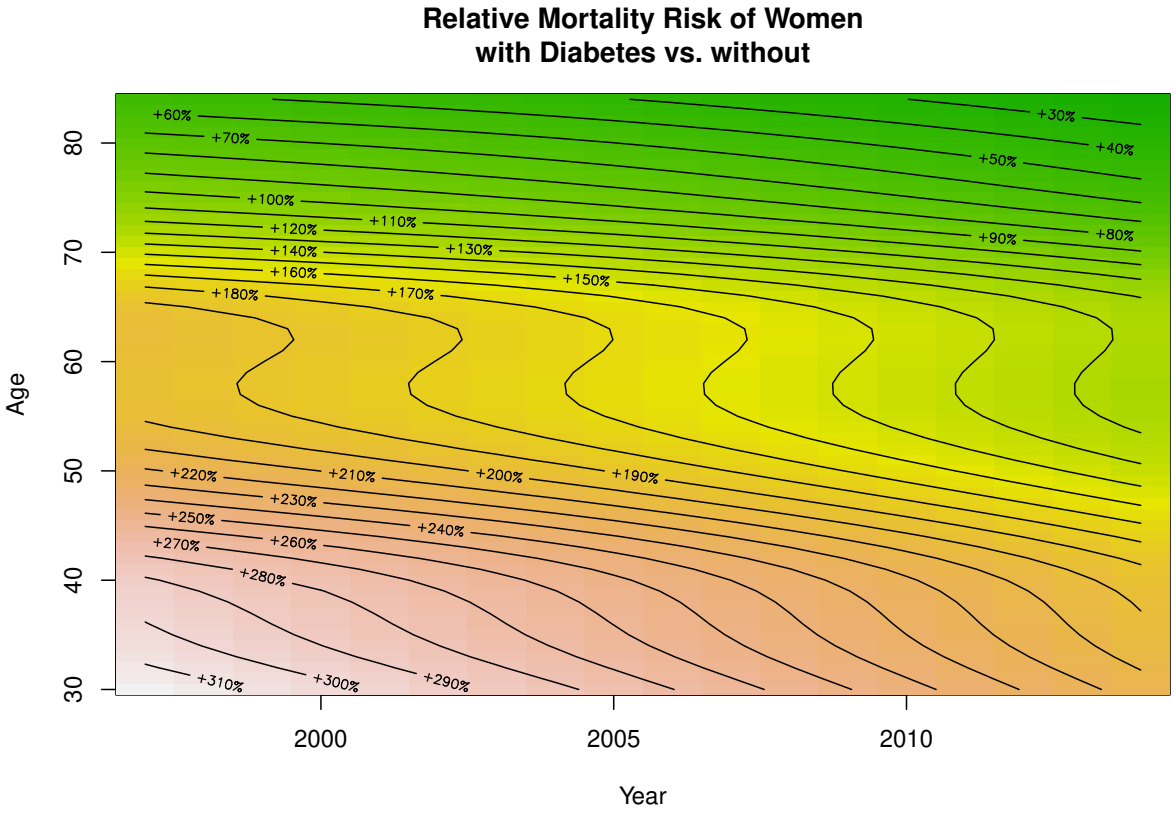
been a change in relative risks over time and how strong this change is. It should be noted that the influence is isolated in each case; further variables have not been taken into account.

4 Results

Surface Plots

Selected surface plots are shown below as examples.

Figure 1 shows the odds ratios for female and male diabetes patients. For women (upper panel), the excess mortality risk of being diagnosed with diabetes decreases with age. The changes seem to be most pronounced for those under 50. The picture is similar for men. Although the relative risk of dying reached its peak in the 2000s, it decreases as the years go by. For men, too, the changes are most marked for the under-60s and under-50s (see Figure 1).



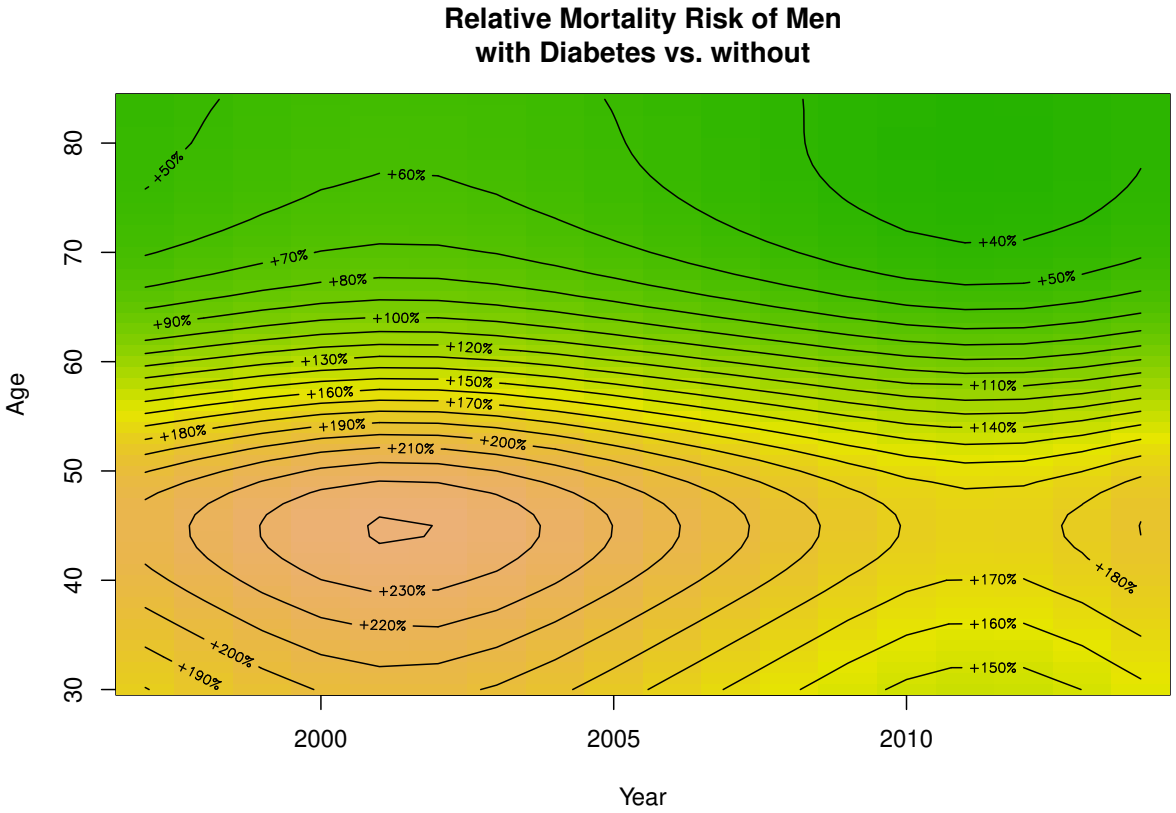
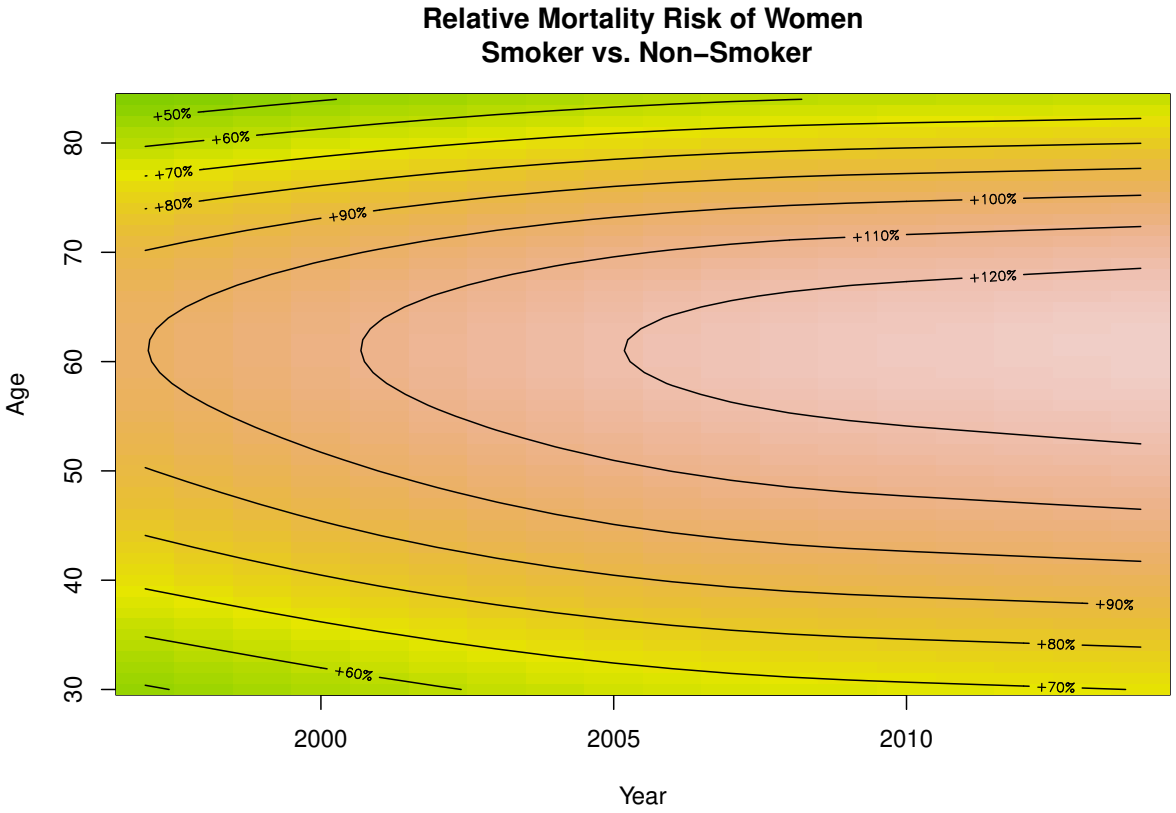


Figure 1: Surface Plots 9 Odds Ratios - Diabetes

On the other hand, smoking behavior shows the opposite trend. There is an increase over time for both sexes. For women, the relative mortality risk of smokers is particularly high between the ages of 40 and 75. However, increases can also be observed for the other age groups. A similar pattern can be described for men, with the largest changes occurring between the ages of 30 and 60. The changes from the 2000s onwards are particularly striking, especially after 2010 (see Figure 2).



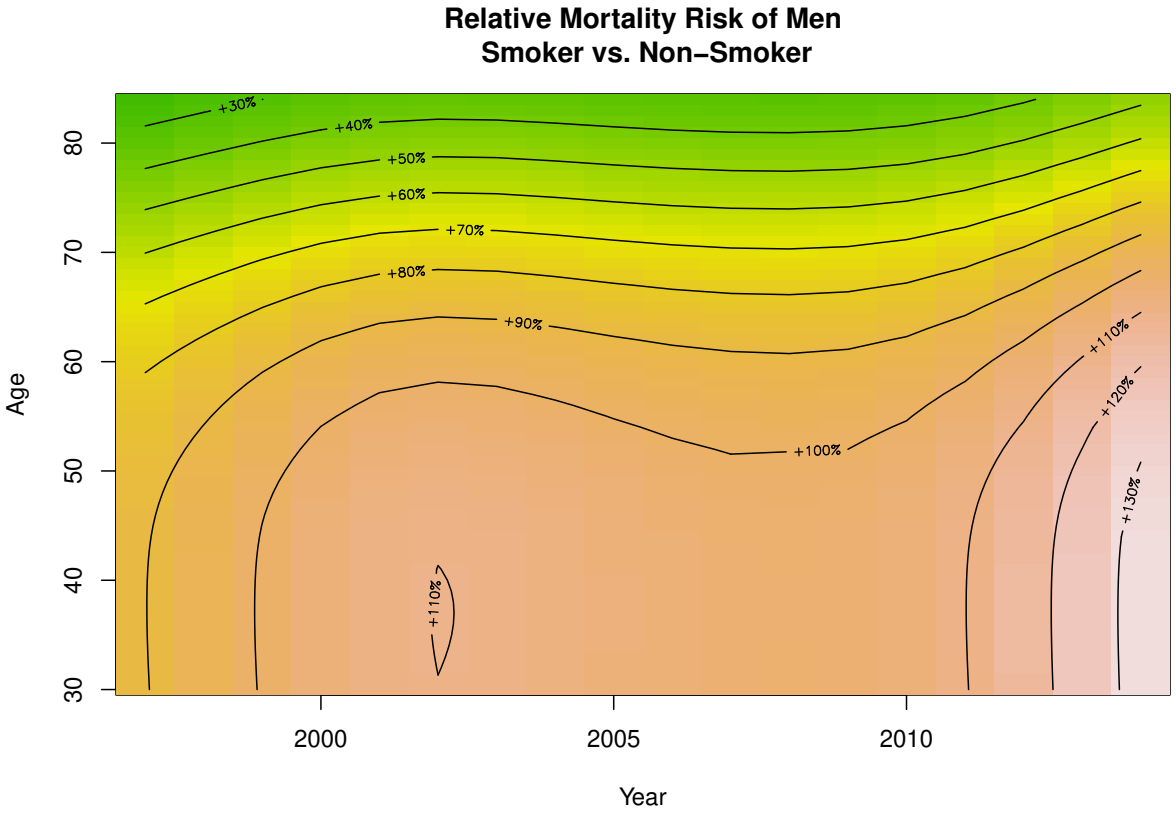


Figure 2: Surface Plots - Odds Ratios - Smoking behaviour

Descriptive Statistics - Prevalence

Tables 4 & 5 provide an overview of the descriptive statistics.
People with medium education are the largest group in all years for both sexes - although it should be noted that the share of people with medium and low education decreases over time, while the share of people with high education increases. The prevalence of heart disease does not change much for women, but increases by almost 2 percentage points for men. For diabetes, there is an increase for both sexes (4.6 percentage points for women; 5.7 percentage points for men). The proportion of people who have suffered a stroke is also increasing for both women and men. For women, it is slightly higher than for men, 0.8 to 0.6. In contrast, the prevalence of chronic bronchitis has decreased for both sexes. There was a significant increase in the proportion of people suffering from hypertension - 7.6 pp for women and 11 pp for men. The prevalence of cancer also increased. For both sexes, the proportion of current and cured cancer patients has increased.

Regarding smoking behavior, the proportion of women who have never smoked has increased since 1997 (56.6% to 61.1%). It should also be noted that women are much less likely to smoke (11.8% to 5.9%). A similar pattern emerges for men, although the proportions of non-smokers are lower than for women, but the proportion of heavy smokers is more pronounced for men. It is striking that the proportion of former smokers among men exceeds that of women by about 10 percentage points in all years.
With regard to alcohol consumption, for both sexes the proportion of non-drinkers decreases slightly over time, while the proportion of current drinkers increases slightly. There are no clear patterns. The topic of sport seems to have become increasingly important for the population over the years. In 1997–1999, 41.7% of women and 36.5% of men said they never exercised, but in 2012–2014 only 31.8% of women and 29.3% of men did so. In addition, the percentage of people exercising more than the WHO recommendation (source) is increasing.
Paradoxically, the average body mass index for both women and men increased during the observation period. While it was 25.5 for women in 1997-1999, it increased to 26.6 within 18 years. For men, it also increased, from 26.5 in 1997-1999 to 27.5 in 2012-2014. (see Tables 4 & 5).

Trends in prevalence may reflect an aging or sicker population, or they may reflect improved prevention. Diseases are being detected earlier and more often, in part because of better medical care. That this does not necessarily mean a sicker population is shown by the increasing proportion of cured cancer patients. Trends in individual lifestyles, on the other hand, are less clear, suggesting both increased health awareness and unhealthier lifestyles (see Tables 4 & 5).

Results: Females

The results for women are presented first. They are presented in Table 2.

Socioeconomic status

The analysis shows strong fluctuations for education and the income ratio. While no clear trend can be observed for the influence of income on relative mortality risk, a convergence of the different levels can be observed for education. Compared to persons with a high level of education, the relative mortality risk for persons with a low level of education has decreased since 1997–1999. While the relative risk was 85% at the beginning of the observation period, it decreased to 34% by 2012–2014. There are also fluctuations in the relative risk for those with a medium level of education — from 47% to 20%. (see Table 2).

Health status

The incidence of preexisting conditions also varies widely from year to year. There is no clear trend for heart disease. For stroke, there is a clear increase in the relative risk of death from 2000 to 2005, which decreases sharply in the following years and falls to a level of 49% in 2012–2014.

In contrast, there is a clear negative trend in the relative risk of death for patients with diabetes. In 1997–1999, the relative risk was about 2.2 times higher for diabetics than for non-diabetics. The relative risk then decreased to 42% by 2012–2014. Thus, the excess risk of death for people with diabetes decreased by almost 80 percentage points during the observation period.

The relative risk of death for hypertensive patients has also decreased significantly. While it was 95% in 1997–1999 compared to non-hypertensives, it decreased by 45 percentage points to 50% in 2012–2014. Although there was an increase of 13 percentage points in 2006-2008.

The trend in the relative risk of death for people with chronic bronchitis also shows a decreasing trend - but it should be noted that there are significant fluctuations between 2000 and 2011.

The most significant decrease in the relative risk of death is for cancer. Whereas in 1997–1999 cancer patients had a relative risk almost 4 times higher than non-cancer patients, the risk decreased by more than 130 percentage points during the observation period. The largest changes occurred between 2009 and 2014.

Even among those considered cancer-free [4], the relative risk decreased by a maximum of 37 percentage points (2006–2008). However, the analysis shows a slight increase from 2006–2008 to 2012–2014.

Overall, most of the selected pre-existing conditions show a decreasing relative risk of death for women. (see Table 2)

Lifestyle Factors

The picture is different for individual lifestyle factors.

Compared to nonsmokers, current smokers with light and heavy tobacco use in particular show a significant increase in relative mortality risk. Overall, the risk increases by 80 percentage points for light smokers, although there is a brief dip in 2003–2005. For heavy smokers, the relative risk increased by 81 percentage points and was more than double that of non-smokers who were interviews in 2012–2014. There was also an increase for former smokers. Over the entire observation period, the risk increased by almost 20 percentage points. Strikingly, there was a short-lived spike in 2006-2008 to nearly 2.4 times the risk compared with never-smokers.

In the case of alcohol consumption, the paradox described in the literature is evident - non-drinkers and former drinkers have a higher real risk than current drinkers. In particular, the risk of former drinkers has changed over the observation period. While the risk decreased from 1997–1999 to 2006–2008, it has increased again to the baseline level since 2009.

Physical activity, regardless of duration (measured according to WHO recommendations(source)), has a preventive effect on relative mortality risk. This effect remains approximately constant throughout the observation period. (See Table 2).

No clear conclusion can be drawn for the change in the effect of BMI on relative mortality risk. It can be stated that a BMI of less than 25 is associated with an increased relative risk of mortality - a slight attenuation of this negative effect can also be assumed. With regard to overweight or obesity, only the periods 1997–1997, 2003–2005 and 2009–2011 show an increased risk. (see Figure 6)

[4] It is assumed that individuals whose cancer diagnosis was more than 10 years ago are considered cancer-free

Table 2: Results Survival Analysis Female

Variable		1997-1999	2000-2002	2003-2005	2006-2008	2009-2011	2012-2014
Education							
	Low	1.85	1.13	1.65	1.42	1.88	1.34
	Medium	1.47	0.98	1.31	1.08	1.69	1.20
	High (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	NA	0.49	0.61	1.64	3.58	1.20	1.33
Poverty threshold							
	Under	1.17	1.05	1.19	1.05	1.36	1.11
	Over (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	NA	1.17	1.10	1.16	1.28	1.28	0.95
Heart Diseases							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	1.74	1.86	2.05	1.54	1.84	1.79
	NA	294.16	NA	0.41	0.00	NA	NA
Diabetes							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	2.21	1.86	1.87	1.66	1.70	1.42
	NA	3.62	2.56	NA	0.00	NA	NA
Stroke							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	1.73	2.35	2.57	2.31	1.51	1.49
	NA	0.00	1.24	6.35	3.28	1.05	1.94
Chronic Bronchitis							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	1.33	1.08	0.98	1.04	1.21	0.95
	NA	2.40	2.74	0.66	0.90	NA	NA
Hypertension							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	1.95	1.78	1.49	1.62	1.31	1.50
	NA	3.86	NA	6.49	2.88	6.91	4.94
Cancer (any type)							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	3.77	3.45	3.82	3.64	2.99	2.46
	Healed	1.78	1.88	1.86	1.41	1.58	1.60
	NA	0.61	3.78	6.39	3.07	0.64	1.47
Smoking							
	Never smoking (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Current smoker – weak	1.60	1.87	1.46	2.51	2.38	2.40
	Current smoker – moderate	1.52	0.95	1.17	2.15	1.68	1.67
	Current smoker – strong	1.28	1.42	1.46	1.83	1.35	2.09
	Former smoker	1.53	1.76	1.59	2.38	1.59	1.77
	NA	2.02	1.29	0.97	1.79	1.11	1.68
Alcohol consumption							
	Lifetime abstainer (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Current drinker – weak	0.67	0.64	0.64	0.56	0.72	0.69
	Current drinker – moderate	0.93	0.75	0.64	0.46	0.85	0.61
	Current drinker – heavy	1.05	0.60	0.88	0.57	1.35	0.99
	Former drinker	1.25	1.13	1.05	1.03	1.24	1.30
	NA	1.34	1.77	1.30	1.46	0.78	1.45
Physical Activity (Compare to WHO recommadation							
	Never (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Less than recommadation	0.53	0.48	0.68	0.43	0.73	0.66
	Equal to recommadation	0.29	0.30	0.38	0.40	0.56	0.41
	More than recommadation	0.31	0.23	0.30	0.34	0.45	0.35
	Unable dor activity	2.20	1.70	1.61	1.64	1.48	1.73
	NA	0.16	0.33	0.91	0.44	0.71	1.05

Reference: NHIS 2023 (own estimations)

Results for Males

The results for male are discussed below and shown in Table 3.

Socioeconomic status

Since 1997, the influence of educational level has developed positively for men - the different levels have converged. It should be noted that in 2012–2014 the differences have increased again. At least in 2009–2011, the differences are 11% for the low educated and 9% for the medium educated compared to the high educated.

The influence of income level is, similar to women, highly variable and does not show a clear trend (see Table 3).

Health status

The trend for stroke patients is similar to that for women, but to a lesser extent. There is a significant increase between 2000 and 2008, after which the initial level is reached again by 2014.

In contrast to women, male heart patients show a clearly positive trend in the relative risk of death. While the relative risk was 2.3 times higher in 1997–1999 compared to those without heart disease, the risk decreased to 44%. Thus, the relative risk decreased by almost 90 percentage points in 17 years.

For diabetics, the relative risk of death also showed a positive trend - in 2012–2014 it was only 27%. In 1997–1999, diabetics had an 80% higher relative risk than nondiabetics.

Persons with chronic bronchitis had an almost 60% higher relative risk of death in 1997–1999 compared with those without the disease. This relative risk decreased to 35% during the observation period, a decrease of more than 20 percentage points. The decrease was most pronounced between 2000–2002 and 2003–2005.

The development of the relative risk of death among hypertensive patients is also positive. At the beginning of the observation period, patients with hypertension had a relative risk that was almost 70% higher than that of those without the disease. In 2012–2014, this was only 39%, although there was a slight increase between 2009–2011 and 2012–2014.

The mortality risk of cancer patients showed a similar positive trend, but to a much greater extent. During the observation period, the relative risk fell from 216% to 90%, a decrease of almost 130 percentage points. As was already the case for women, the largest decrease was also observed for men in 2009. (see Table 3).

Lifestyle Factors

Smoking behavior shows a clear downward trend for men. While no clear trend emerges for former smokers, current smokers, regardless of tobacco use, show an increase in relative risk of smoking. The increase is greatest for light tobacco use - in 1997-1999, the relative risk was 18% higher than for never smokers; in 2012-2014, the relative risk was 2.4 times higher than for never smokers. For moderate use, the relative risk increased by almost 80 percentage points over the observation period, and for heavy use by 25 percentage points.

For the observation period up to 2008, the risk paradox already described for women can be observed for alcohol consumption (source?). Overall, however, the relative risk of death due to alcohol consumption decreases over time and reaches a minimum in 2012-2014, with the exception of heavy consumption. Physical activity, as already observed for women, has a positive effect on relative mortality risk - individuals who participate in physical activity (regardless of the amount) have a lower relative mortality risk than men who do not participate in physical activity. There is little change over time.

Similar to women, for BMI we see that underweight has a negative effect on the relative risk of death. There is no clear trend, but the lowest relative risk for underweight is observed for 2009-2011, while 1997-1999 shows a significantly higher relative risk. For overweight and obesity, an increased relative risk is observed only for 2012-2014, and there is no trend. (see Table 3 & Figure 7)

Table 3: Results Survival Analysis Male

Variable		1997-1999	2000-2002	2003-2005	2006-2008	2009-2011	2012-2014
Education							
	Low	1.83	1.46	1.48	1.41	1.11	1.60
	Medium	1.37	1.26	1.24	1.12	1.09	1.37
	High (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	NA	1.69	1.19	0.26	0.52	1.36	3.15
Poverty threshold							
	Under	1.00	1.21	1.49	1.33	1.13	1.07
	Over (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	NA	1.14	1.05	1.27	1.33	1.26	1.15
Heart Diseases							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	2.30	1.96	1.75	1.88	1.78	1.44
	NA	11.22	1.51	0.00	NA	NA	NA
Diabetes							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	1.80	2.09	1.85	1.94	1.56	1.27
	NA	0.00	0.71	3.00	1.62	1.27	NA
Stroke							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	1.74	2.10	2.16	2.01	1.89	1.75
	NA	2.56	1.47	4.69	1.46	NA	NA
Chronic Bronchitis							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	1.58	1.63	1.25	1.35	1.39	1.35
	NA	1.42	2.40	0.51	2.49	NA	6.51
Hypertension							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	1.68	1.32	1.73	1.26	1.26	1.39
	NA	2.43	0.92	1.45	0.00	3.09	2.00
Cancer (any type)							
	No (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Yes	3.16	2.94	3.04	2.51	2.07	1.90
	Healed	1.50	2.57	2.78	2.03	1.38	2.13
	NA	4.19	1.93	1.10	2.95	1.05	1.97
Smoking							
	Never smoking (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Current smoker – weak	1.18	1.76	1.58	1.88	1.20	2.42
	Current smoker – moderate	1.34	1.71	2.00	1.98	1.74	2.12
	Current smoker – strong	1.57	1.78	1.82	1.74	1.62	1.82
	Former smoker	1.50	1.83	1.39	1.46	1.68	1.59
	NA	0.81	1.23	1.01	3.39	2.13	2.03
Alcohol consumption							
	Lifetime abstainer (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Current drinker – weak	0.90	0.73	0.85	0.83	0.67	0.73
	Current drinker – moderate	0.91	0.97	1.15	1.11	0.60	0.68
	Current drinker – heavy	0.82	1.00	0.83	1.10	0.82	0.95
	Former drinker	1.46	1.15	1.23	1.09	1.02	0.96
	NA	0.63	1.26	1.25	0.79	0.80	0.67
Physical Activity (Compare to WHO recommadation							
	Never (Ref.)	***1***	***1***	***1***	***1***	***1***	***1***
	Less than recommadation	0.60	0.64	0.62	0.56	0.52	0.55
	Equal to recommadation	0.46	0.44	0.49	0.49	0.33	0.51
	More than recommadation	0.30	0.35	0.36	0.38	0.40	0.39
	Unable dor activity	1.48	1.88	1.64	1.82	1.55	1.91
	NA	0.46	0.63	0.59	0.49	0.47	0.38

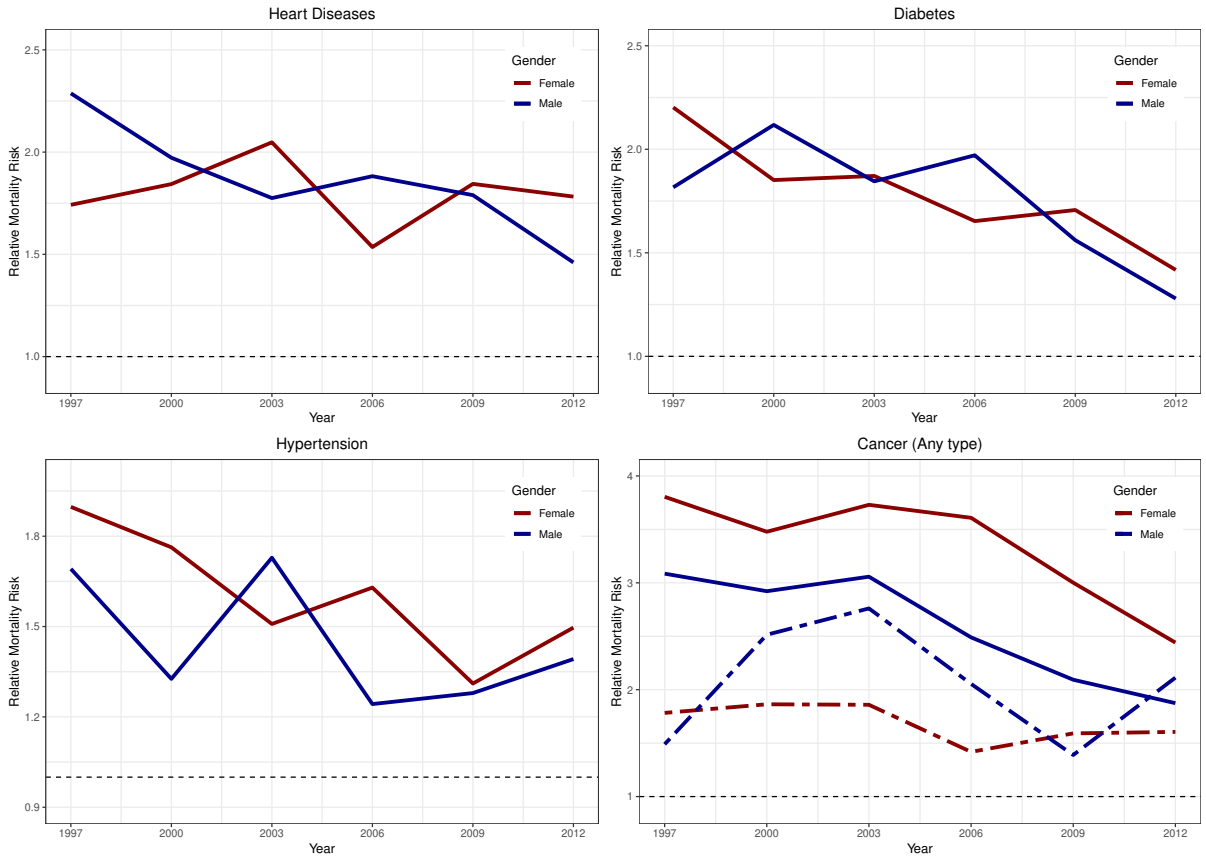


Figure 3: Relative Mortality Risk - Health variables

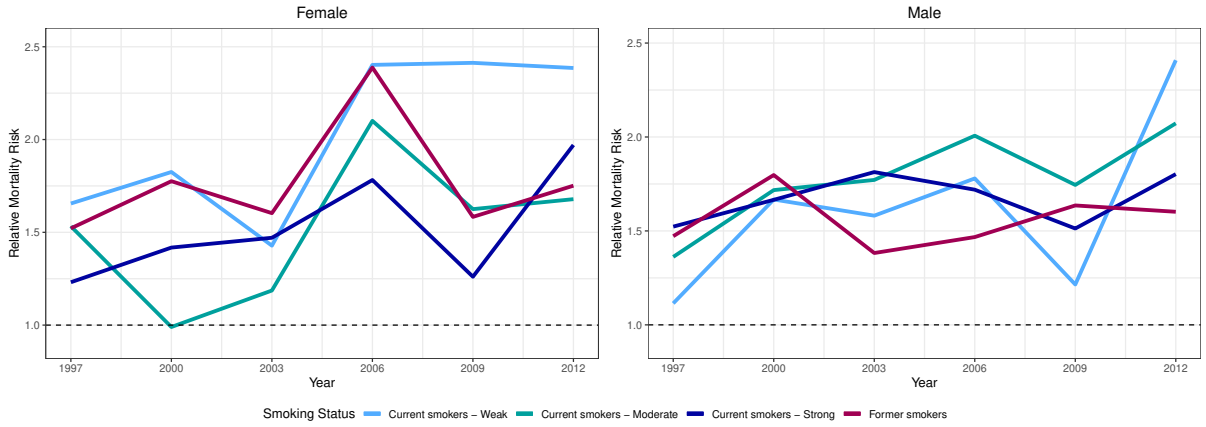


Figure 4: Relative Mortality Risk - Smoking consumption

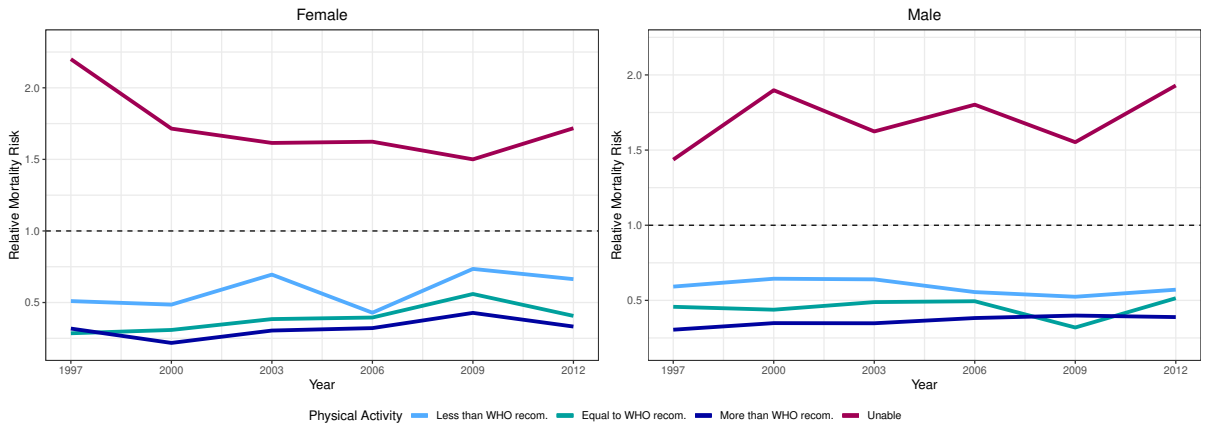


Figure 5: Relative Mortality Risk - Physical activity

5 Discussion

The development of short-term relative mortality risks is characterized by many fluctuations - and there are also clear differences between men and women. In general, there are positive developments, especially in the area of pre-existing conditions. Men benefit significantly more from medical advances than women. On the other hand, there is a worsening of the relative mortality risk for both sexes in the area of individual lifestyle, in particular tobacco and alcohol consumption. It should be noted that BMI does not fully reflect the effect as expected from the literature. Although underweight people have a higher relative risk, as expected, there are only isolated adverse effects for very overweight people. The beneficial effects of physical activity persist over time, but at a constant level. The differences between men and women are relatively small.

It was observed that socio-economic influences seem to play a minor role in the overall construct of mortality. The effect of income does not seem to change overall for either sex — if anything, there is a slight increase. Although the evolution of the influence of education is subject to strong fluctuations, a positive balance can be drawn. Positive in the sense that relative differences in mortality by education are converging. This contradicts studies that point to a widening of social inequalities. (Singh and Siahpush (2006))

Medical progress is a major contributor to changes in the relative risk of death. Cancer research in particular shows significant improvements for both sexes from 2009 onwards. Progress in the field of diabetes is also clearly positive.

The development of the relative risk of death for stroke patients shows an increasing trend for both men and women until 2003-2005 and then a decreasing trend. Although the relative risk for women has decreased by about 24 percentage points since 1997–1999, the results contradict studies showing a decrease in stroke mortality (Cooper et al.,

1990; Yang et al., 2006)). Although this decline has slowed in recent decades due to demographic and geographical influences (Yang et al., 2017). One explanation for the results of this study could be an increase in prevalence due to early detection. Strokes could be diagnosed earlier due to better medical facilities. This paper also looked at all-cause mortality in relation to various pre-existing conditions. Yang (2006) and Cooper (1990) looked specifically at deaths from stroke. It is therefore not illogical that the results differ.

The unexpected results on BMI and its influence on relative risk of death raise questions. The fact that being severely to very severely overweight does not have a negative effect on the relative risk of death contradicts previous findings. One possible explanation could be the selected survival time. Much of the literature refers to long-term survival. [5]. It is likely that being severely overweight or obese has a long-term negative effect on relative mortality risk rather than a short-term effect. The fact that even in the short term underweight has a negative effect on relative mortality risk over all years may be due to the interaction between pre-existing conditions and BMI. For example, cancer patients may lose a lot of weight as a result of their disease and treatment. It can also be assumed that people who are already underweight because of their illness do not gain as much weight and therefore have an increased relative risk. Surface plots of each BMI category were generated to assess the issue in more detail (see section *Surface Plots* for a description of surface plots). In each case, using the nomarl weights (BMI > 18.5 & ≤ 25.0) as reference, three plots were calculated - underweight (BMI ≤ 18.5), overweight (BMI > 25.0 & ≤ 30.0) and obese (BMI > 30.0). For women, underweight is particularly detrimental in older age groups (50 to 75 years), although younger age groups are also negatively affected by underweight. There is also a decrease in the severity of the disadvantage of being underweight over time. The picture is different for men. Here, in addition to significantly higher relative mortality risks, the results also show a concentration of the disadvantage at younger ages, which increases significantly by 2014 (see Figure 8). Overweight shows a protective effect for both sexes, which remains approximately stable for men at all ages and over all years. For women, the relative risk of death decreases with increasing age and continues to do so until 2014. (see figure 9) For obesity, women show an increased relative risk, especially for those under 50, but paradoxically this decreases over time. Furthermore, the older the woman, the lower the relative risk of death. For men, however, there are no significant changes in the relative risk of death over time. Again, the relative risk decreases with increasing age. (see figure 10) It can therefore be seen that the paradoxical results of the survival analysis also persist in the

[5] or survival time is not defined more precisely

individual analysis. However, it should be noted that there are significant gender and age differences.

The inclusion of recent data would be interesting for subsequent analyses. The current data situation of the NHIS allows a linkage of the NDI until 2018. [6] As the data are updated, it would also be possible and useful to carry out a further analysis of the research design in order to assess how it is progressing. Under the assumption that the selected survival time has an influence on the research results (e.g. on the influence of BMI), it would be interesting to analyse an adaptation of the research design against the background of different survival times.

Limitations

The NHIS data provide a wealth of information about people's health and lifestyles, as well as their mortality. The problem, as noted in the data section, is that the information is collected only once. This means that there can be a long period of time between the interview and the death of a person, during which time circumstances can change. Lifestyle factors, tobacco and alcohol consumption, physical activity and BMI are particularly affected. Also, pre-existing conditions that are discovered after the interview are not recorded retrospectively.

[6] Month of birth data needed for survival analysis are only available until 2014

6 Appendix

Table 4: Prevalence Female

	1997-1999		2000-2002		2003-2005		2006-2008		2009-2011		2012-2014	
Education												
Low	6,644	**21.5**	7,034	**19.8**	6,078	**18.2**	4,310	**17.9**	5,350	**16.6**	5,843	**15.1**
Medium	17,452	**56.6**	20,485	**57.8**	19,158	**57.3**	13,670	**56.6**	18,054	**56.0**	21,603	**55.7**
High	6,641	**21.5**	7,768	**21.9**	8,022	**24.0**	6,061	**25.1**	8,710	**27.0**	11,215	**28.9**
NA	117	**0.4**	161	**0.5**	170	**0.5**	102	**0.4**	98	**0.3**	99	**0.3**
Poverty threshold												
Under	3,828	**12.4**	4,054	**11.4**	3,732	**11.2**	3,107	**12.9**	5,081	**15.8**	6,362	**16.4**
Over	20,886	**67.7**	23,810	**67.2**	22,481	**67.3**	17,574	**72.8**	24,628	**76.5**	30,001	**77.4**
NA	6,140	**19.9**	7,584	**21.4**	7,215	**21.6**	3,462	**14.3**	2,503	**7.8**	2,397	**6.2**
Heart diseases												
Yes	3,829	**12.4**	4,279	**12.1**	4,246	**12.7**	3,013	**12.5**	3,955	**12.3**	4,707	**12.1**
No	27,002	**87.5**	31,158	**87.9**	29,172	**87.3**	21,122	**87.5**	28,253	**87.7**	34,049	**87.8**
NA	23	**0.1**	11	**0.0**	10	**0.0**	8	**0.0**	4	**0.0**	4	**0.0**
Diabetes												
Yes	2,204	**7.1**	2,713	**7.7**	2,935	**8.8**	2,505	**10.4**	3,613	**11.2**	4,550	**11.7**
No	28,616	**92.7**	32,706	**92.3**	30,481	**91.2**	21,624	**89.6**	28,595	**88.8**	34,198	**88.2**
NA	34	**0.1**	29	**0.1**	12	**0.0**	14	**0.1**	4	**0.0**	12	**0.0**
Stroke												
Yes	850	**2.8**	1,011	**2.9**	1,069	**3.2**	895	**3.7**	1,172	**3.6**	1,382	**3.6**
No	29,959	**97.1**	34,409	**97.1**	32,325	**96.7**	23,230	**96.2**	31,013	**96.0**	37,359	**96.4**
NA	45	**0.1**	28	**0.1**	34	**0.1**	18	**0.1**	114	**0.4**	19	**0.0**
Chronic Bronchitis												
Yes	2,027	**6.6**	2,447	**6.9**	2,072	**6.2**	1,420	**5.9**	2,075	**6.4**	2,200	**5.7**
No	28,787	**93.3**	32,969	**93.0**	31,326	**93.7**	22,710	**94.1**	30,123	**93.5**	36,544	**94.3**
NA	40	**0.1**	32	**0.1**	30	**0.1**	16	**0.1**	14	**0.0**	16	**0.0**
Hyptertension												
Yes	9,177	**29.7**	10,652	**30.0**	10,907	**32.6**	8,576	**35.5**	11,822	**36.7**	14,443	**37.3**
No	21,631	**70.1**	24,772	**69.9**	22,493	**67.3**	15,550	**64.4**	20,376	**63.3**	24,294	**62.7**
NA	46	**0.1**	24	**0.1**	28	**0.1**	17	**0.1**	14	**0.0**	23	**0.1**
Cancer (any type)												
Yes	1,635	**5.3**	1,976	**5.6**	1,897	**5.7**	1,442	**6.0**	1,980	**6.1**	2,583	**6.7**
Yes, but healed	1,010	**3.3**	1,181	**3.3**	1,207	**3.6**	952	**3.9**	1,424	**4.4**	1,800	**4.6**
No	28,135	**91.2**	32,221	**90.9**	30,244	**90.5**	21,696	**89.9**	28,756	**89.3**	34,303	**88.5**
NA	66	**0.2**	57	**0.2**	64	**0.2**	44	**0.2**	37	**0.1**	58	**0.1**
Smoking												
Never smoker	17,466	**56.6**	20,574	**58.0**	19,920	**59.6**	14,762	**61.1**	19,657	**61.0**	23,709	**61.2**
Current smoker – weak	1,527	**4.9**	1,674	**4.7**	1,594	**4.8**	1,222	**5.1**	1,729	**5.4**	2,112	**5.4**
Current smoker – moderate	1,499	**4.9**	1,794	**5.1**	1,587	**4.7**	1,149	**4.8**	1,657	**5.1**	1,949	**5.0**
Current smoker – heavy	3,631	**11.8**	3,827	**10.8**	3,076	**9.2**	1,967	**8.1**	2,296	**7.1**	2,306	**5.9**
Former smoker	6,571	**21.3**	7,400	**20.9**	7,055	**21.1**	4,933	**20.4**	6,765	**21.0**	8,565	**22.1**
NA	160	**0.5**	179	**0.5**	196	**0.6**	110	**0.5**	108	**0.3**	119	**0.3**
Alcohol consumption												
Lifetime abstainer	8,727	**28.3**	10,198	**28.8**	9,791	**29.3**	6,894	**28.6**	8,218	**25.5**	9,621	**24.8**
Current drinker – weak	13,155	**42.6**	15,213	**42.9**	14,031	**42.0**	10,193	**42.2**	14,353	**44.6**	17,310	**44.7**
Current drinker – moderate	2,822	**9.1**	3,355	**9.5**	3,372	**10.1**	2,479	**10.3**	3,539	**11.0**	4,611	**11.9**
Current drinker – heavy	463	**1.5**	469	**1.3**	453	**1.4**	360	**1.5**	530	**1.6**	570	**1.5**
Former drinker	5,320	**17.2**	5,760	**16.2**	5,360	**16.0**	3,961	**16.4**	5,359	**16.6**	6,390	**16.5**
NA	367	**1.2**	453	**1.3**	421	**1.3**	256	**1.1**	213	**0.7**	258	**0.7**
Physical Activity												
Never	12,880	**41.7**	14,066	**39.7**	12,992	**38.9**	9,318	**38.6**	11,238	**34.9**	12,337	**31.8**
Less than recommendation	7,289	**23.6**	8,068	**22.8**	7,532	**22.5**	5,755	**23.8**	7,917	**24.6**	9,504	**24.5**
Equal to recommendation	4,672	**15.1**	5,258	**14.8**	5,428	**16.2**	3,765	**15.6**	5,275	**16.4**	6,837	**17.6**
More than recommendation	4,865	**15.8**	6,064	**17.1**	5,667	**17.0**	4,117	**17.1**	6,435	**20.0**	8,581	**22.1**
Unable	780	**2.5**	1,296	**3.7**	1,219	**3.6**	775	**3.2**	861	**2.7**	894	**2.3**
NA	368	**1.2**	696	**2.0**	590	**1.8**	413	**1.7**	486	**1.5**	607	**1.6**
Body-Mass-Index												
Minimum	14.3		14.6		15.2		14.9		14.8		14.3	
1^{st} Quantil	22.3		22.6		22.8		23.0		23.2		23.3	
Median	25.5		25.7		25.8		26.5		26.6		26.6	
Mean	26.3		26.7		27.0		27.5		27.7		27.8	
3^{rd} Quantil	29.3		29.9		30.2		30.9		31.1		31.3	
Maximum	50.2		50.5		51.7		54.7		54.5		55.3	

Table 5: Prevalence Male

	1997-1999		2000-2002		2003-2005		2006-2008		2009-2011		2012-2014	
Education												
Low	4,806	**19.6**	5,356	**18.8**	4,922	**17.9**	3,534	**17.7**	4,475	**16.7**	4,939	**15.3**
Medium	13,340	**54.3**	15,404	**53.9**	14,855	**53.9**	10,635	**53.2**	14,393	**53.7**	17,502	**54.2**
High	6,290	**25.6**	7,636	**26.7**	7,629	**27.7**	5,732	**28.6**	7,823	**29.2**	9,745	**30.2**
NA	124	**0.5**	165	**0.6**	148	**0.5**	108	**0.5**	96	**0.4**	124	**0.4**
Poverty threshold												
Under	1,800	**7.3**	2,062	**7.2**	2,005	**7.3**	1,762	**8.8**	3,004	**11.2**	3,778	**11.7**
Over	18,466	**75.2**	20,925	**73.3**	20,069	**72.8**	15,754	**78.7**	21,971	**82.0**	26,684	**82.6**
NA	4,294	**17.5**	5,574	**19.5**	5,480	**19.9**	2,493	**12.5**	1,812	**6.8**	1,848	**5.7**
Heart diseases												
Yes	3,159	**12.9**	3,799	**13.3**	3,806	**13.8**	2,772	**13.9**	3,927	**14.7**	4,742	**14.7**
No	21,389	**87.1**	24,747	**86.6**	23,736	**86.1**	17,233	**86.1**	22,850	**85.3**	27,562	**85.3**
NA	12	**0.0**	15	**0.1**	12	**0.0**	4	**0.0**	10	**0.0**	6	**0.0**
Diabetes												
Yes	1,656	**6.7**	2,347	**8.2**	2,594	**9.4**	2,134	**10.7**	3,222	**12.0**	4,003	**12.4**
No	22,877	**93.1**	26,189	**91.7**	24,946	**90.5**	17,858	**89.2**	23,549	**87.9**	28,294	**87.6**
NA	27	**0.1**	25	**0.1**	14	**0.1**	17	**0.1**	16	**0.1**	13	**0.0**
Stroke												
Yes	733	**3.0**	836	**2.9**	841	**3.1**	651	**3.3**	899	**3.4**	1,153	**3.6**
No	23,801	**96.9**	27,691	**97.0**	26,688	**96.9**	19,345	**96.7**	25,872	**96.6**	31,141	**96.4**
NA	26	**0.1**	34	**0.1**	25	**0.1**	13	**0.1**	16	**0.1**	16	**0.0**
Chronic Bronchitis												
Yes	814	**3.3**	1,017	**3.6**	858	**3.1**	616	**3.1**	913	**3.4**	975	**3.0**
No	23,726	**96.6**	27,508	**96.3**	26,669	**96.8**	19,372	**96.8**	25,863	**96.6**	31,315	**96.9**
NA	20	**0.1**	36	**0.1**	27	**0.1**	21	**0.1**	11	**0.0**	20	**0.1**
Hyptertension												
Yes	6,766	**27.5**	8,179	**28.6**	8,495	**30.8**	7,034	**35.2**	10,018	**37.4**	12,454	**38.5**
No	17,760	**72.3**	20,329	**71.2**	19,011	**69.0**	12,955	**64.7**	16,727	**62.4**	19,827	**61.4**
NA	34	**0.1**	53	**0.2**	48	**0.2**	20	**0.1**	42	**0.2**	29	**0.1**
Cancer (any type)												
Yes	1,293	**5.3**	1,605	**5.6**	1,547	**5.6**	1,176	**5.9**	1,664	**6.2**	2,129	**6.6**
Yes, but healed	384	**1.6**	529	**1.9**	586	**2.1**	434	**2.2**	742	**2.8**	905	**2.8**
No	22,838	**93.0**	26,368	**92.3**	25,362	**92.1**	18,362	**91.8**	24,337	**90.9**	29,233	**90.5**
NA	33	**0.1**	57	**0.2**	45	**0.2**	30	**0.1**	37	**0.1**	31	**0.1**
Smoking												
Never smoker	9,897	**40.3**	12,252	**42.9**	12,554	**32.6**	9,338	**46.7**	12,731	**47.5**	15,633	**48.4**
Current smoker – weak	1,183	**4.8**	1,475	**5.2**	1,418	**3.6**	1,079	**5.4**	1,628	**6.1**	1,886	**5.8**
Current smoker – moderate	966	**3.9**	1,218	**4.3**	1,232	**8.1**	910	**4.5**	1,267	**4.7**	1,602	**5.0**
Current smoker – heavy	4,307	**17.5**	4,591	**16.1**	3,957	**20.7**	2,498	**12.5**	2,989	**11.2**	3,245	**10.0**
Former smoker	8,029	**32.7**	8,833	**30.9**	8,184	**55.3**	6,038	**30.2**	8,058	**30.1**	9,773	**30.2**
NA	178	**0.7**	192	**0.7**	209	**1.5**	146	**0.7**	114	**0.4**	171	**0.5**
Alcohol consumption												
Lifetime abstainer	2,818	**11.5**	3,616	**12.7**	3,820	**23.6**	2,595	**13.0**	2,973	**11.1**	3,947	**12.2**
Current drinker – weak	9,581	**39.0**	11,125	**39.0**	10,641	**46.6**	7,858	**39.3**	11,041	**41.2**	12,952	**40.1**
Current drinker – moderate	5,153	**21.0**	5,791	**20.3**	5,566	**27.5**	4,066	**20.3**	5,572	**20.8**	6,796	**21.0**
Current drinker – heavy	1,922	**7.8**	2,406	**8.4**	2,130	**9.6**	1,536	**7.7**	2,042	**7.6**	2,434	**7.5**
Former drinker	4,629	**18.8**	5,092	**17.8**	4,884	**21.0**	3,634	**18.2**	4,884	**18.2**	5,850	**18.1**
NA	457	**1.9**	531	**1.9**	513	**3.9**	320	**1.6**	275	**1.0**	331	**1.0**
Physical Activity												
Never	8,975	**36.5**	10,064	**35.2**	9,997	**57.0**	7,104	**35.5**	8,154	**30.4**	9,452	**29.3**
Less than recommendation	4,857	**19.8**	5,493	**19.2**	5,451	**26.2**	4,163	**20.8**	5,915	**22.1**	6,906	**21.4**
Equal to recommendation	3,633	**14.8**	4,294	**15.0**	4,220	**20.9**	3,000	**15.0**	4,406	**16.4**	5,323	**16.5**
More than recommendation	6,139	**25.0**	7,205	**25.2**	6,476	**24.8**	4,790	**23.9**	7,257	**27.1**	9,430	**29.2**
Unable	476	**1.9**	775	**2.7**	775	**4.6**	509	**2.5**	549	**2.0**	597	**1.8**
NA	480	**2.0**	730	**2.6**	635	**5.2**	443	**2.2**	506	**1.9**	602	**1.9**
Body-Mass-Index												
Minimum	16.4		17.1		16.2		16.7		15.8		16.2	
1^{st} Quantil	24.3		24.4		24.4		24.4		25.0		25.0	
Median	26.5		26.6		27.0		27.3		27.4		27.5	
Mean	27.1		27.3		27.6		27.8		28.1		28.2	
3^{rd} Quantil	29.4		29.7		30.0		30.4		30.7		30.8	
Maximum	48.1		48.1		49.8		52.3		51.4		51.2	

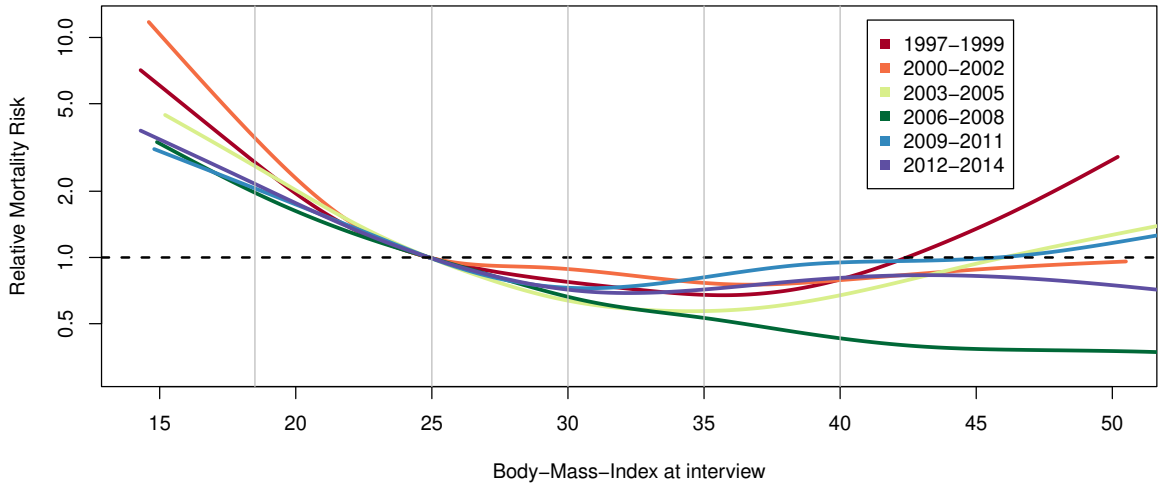


Figure 6: Body-Mass-Index Splines - Female

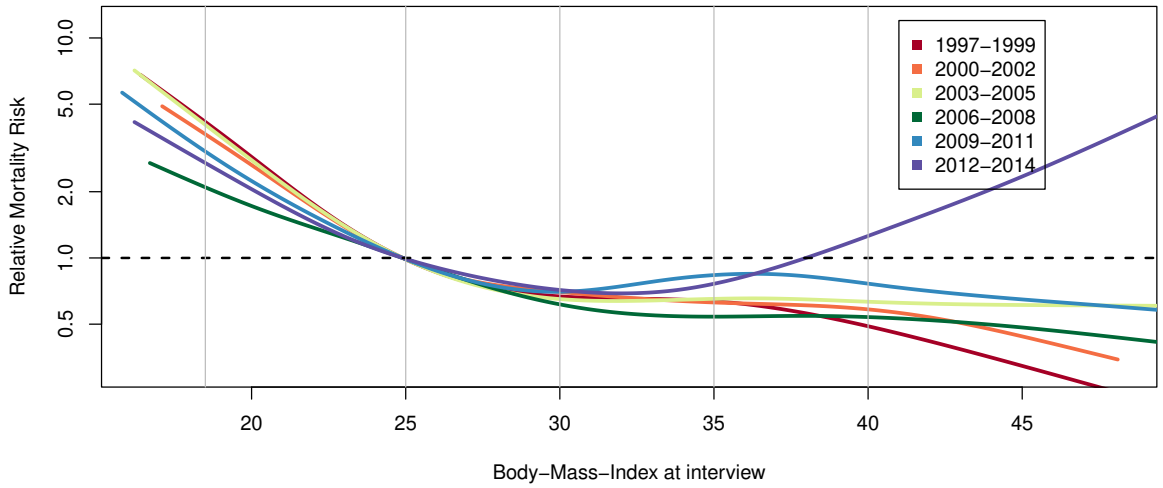


Figure 7: Body-Mass-Index Splines - Male

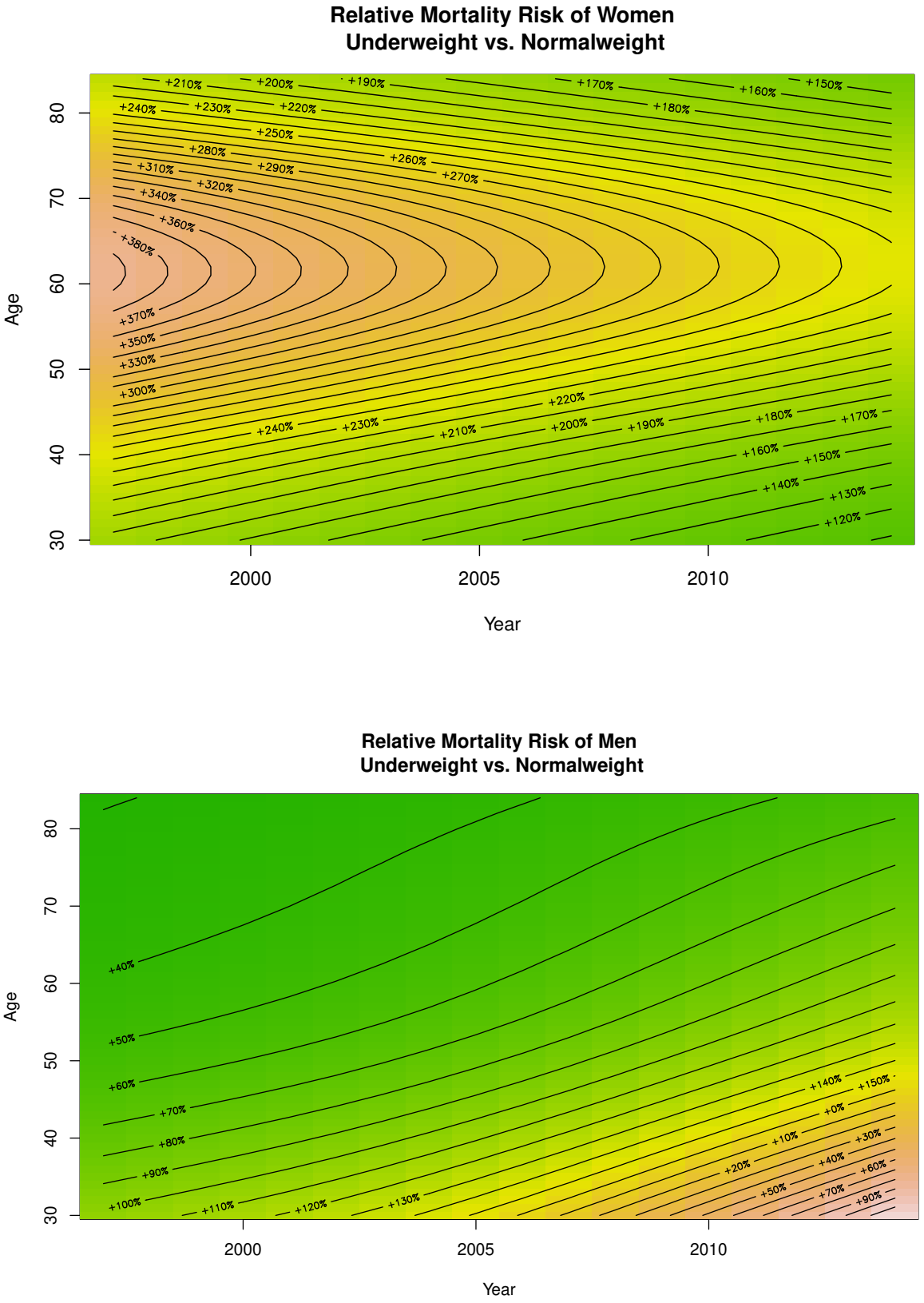
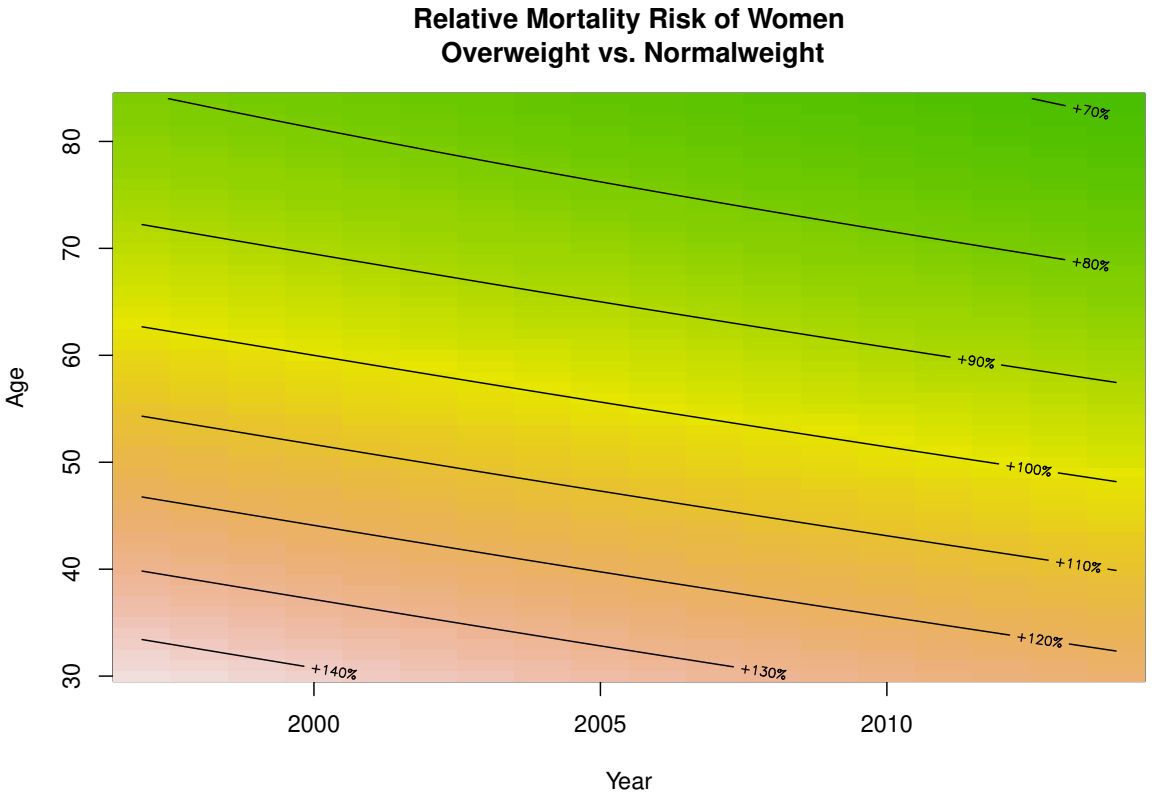


Figure 8: Surface Plots - Odds Ratios - Underweight



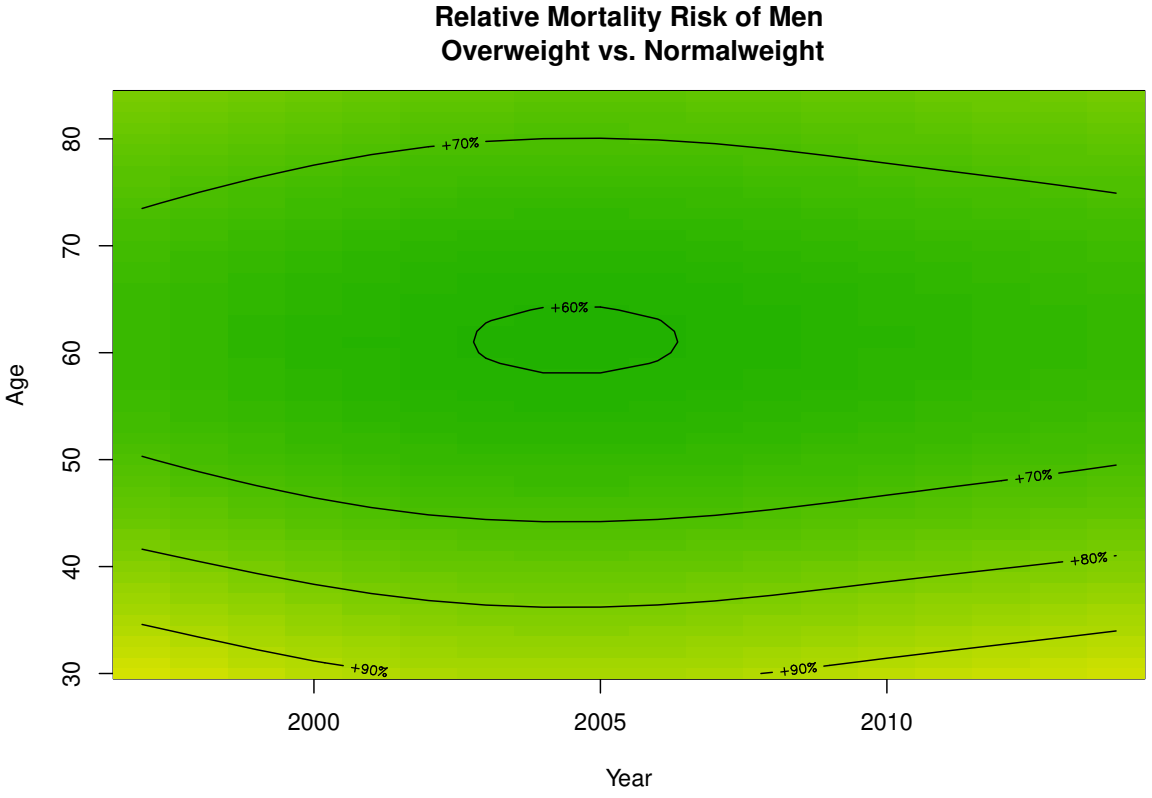
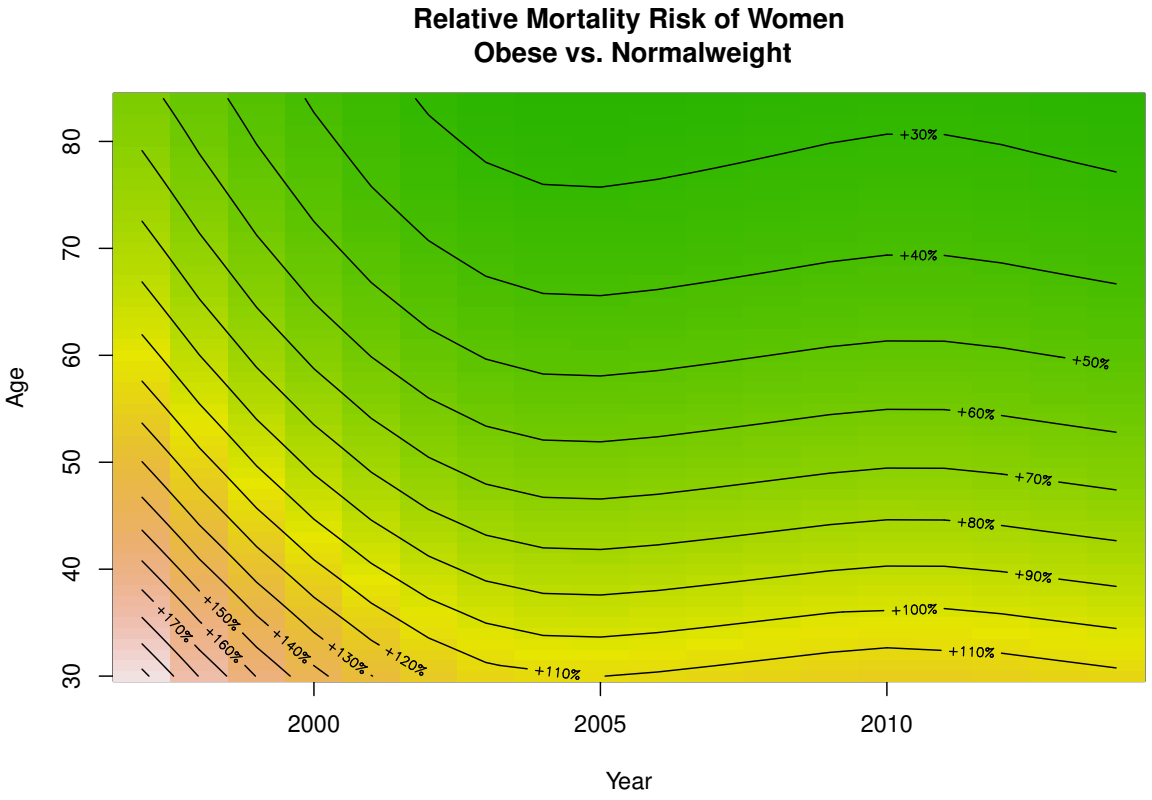


Figure 9: Surface Plots - Odds Ratios - Overweight



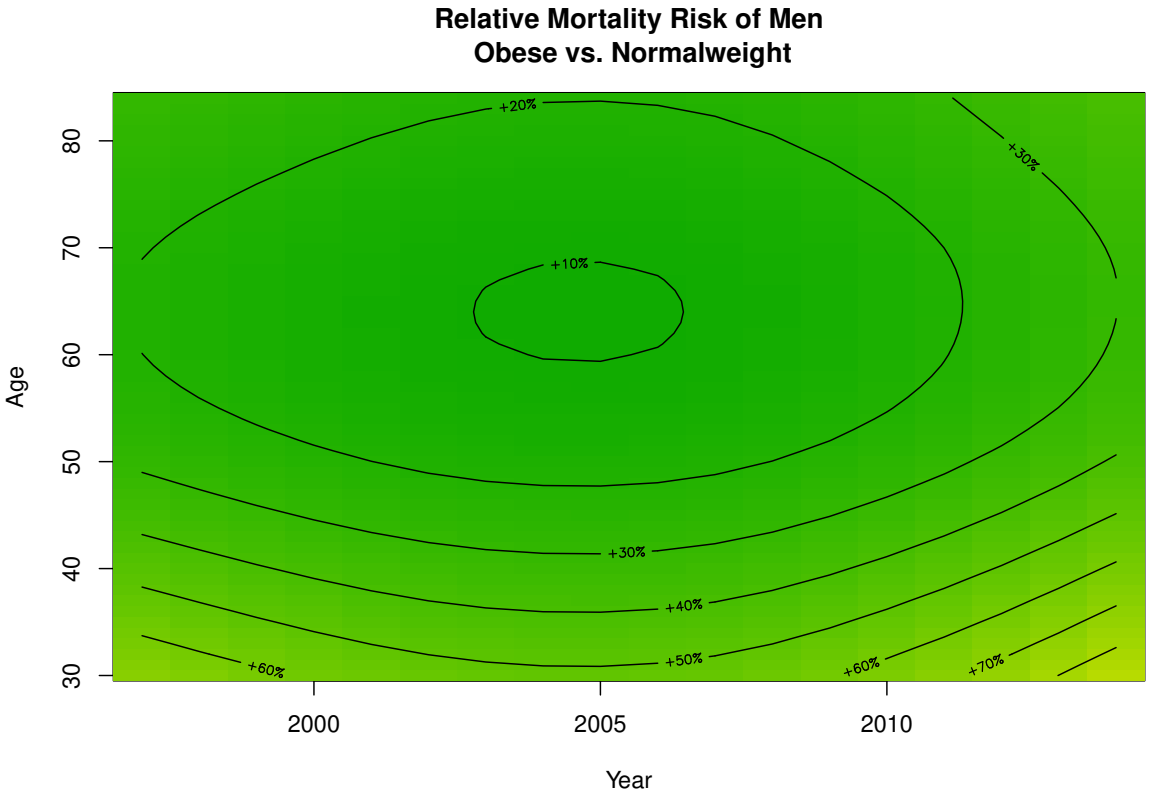


Figure 10: Surface Plots - Odds Ratios - Obese

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