Longevity and the aging Swedish population[1]

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Abstract

This paper is focusing, first, on the very concept of aging, what does it mean for a population, and what does it mean to an individual. Second, on the individual level, is longevity clustered within certain families (family trees)?

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1 Introduction

The questions about population aging and individual aging in a population are the core of a project within the research environment *Ageing and Living Conditions*, which is funded by The Swedish Research Council with a Linnaeus grant for ten years, hosted by the Centre for Population Studies at The Demographic Data Base, Umeå, Sweden.

What is the age of a population, and what does it mean to say that a population is *aging* (growing older)? One simple measure is mean (or median) age of its members, as a function of time. If this function is increasing, we could say that the population is aging. This is however too simplistic; closer to the heart of the question of aging is *changing age distribution.* If the proportion of, say, people above 65 years of age is increasing over time, we could talk of an aging population. There is however a piece of arbitrariness over the choice of the age 65. Implicit in the discussion of the aging population is the assumption that it causes all kinds of *problems* to society. It is important to identify these, and relate them to the concept of an aging population.

The question "what is individual aging" is on the surface simple to understand and answer. Deeper lie the relation between individual and population aging, and the dependence structures that may be present between groups of individuals (e.g., biological families) in the population.

2 Population aging

In Figure 1, changes of age distribution are illustrated for Sweden between the years 1860 and 2050. The six panels show the development of the whole population over time (the last one is a prediction).

[Figure 1 about here.]

It is evident that the shape of the distribution changes over time, from a triangular type to an almost rectangular. This is a typical change in pattern for a population that goes from high fertility and high mortality to low fertiity and mortality.

This transition towards a larger proprortion "elderly" is given much attention in Sweden, as well as in other western countries, today. It is seen as a threat to the welfare that the "support burden" will increase too much. The general, formal, retirement age in Sweden is 65 years of age, and the prediction of population development shows that the fraction of people above 65 will almost double in the next 50 years. One way to reduce the support burden, or at least keep it constant, would be to slowly(?) raise the retirement age.

Figure 2 shows the part of the population aged 65 and above. It is clear that the age distribution moves from triangular to rectangular in shape.

[Figure 2 about here.]

This constitutes another threat to welfare; the proportion very old (say above 80) will increase unproportionately much, putting severe stress on the health care system.

My personal view on these matters is that the first, the increasing support burden, is given too big proportions. First, the support burden should not only include the retired as “non-productive”, it should also include the young, say the fraction below 20 years of age.

The upper panel in Figure 3 shows the relation in size between three age groups, below 20, between 20 and 65, and above 65. The lower panel is the ratio between the number of supported (below 20 and above 65) and the supporting (between 20 and 65), a crude measure of the support burden in society.

[Figure 3 about here.]

It is obvious that the support burden threat is not very frightening, at least not at a time horizon of fifty years. We note that the support burden around the turn of the nineteenth century was much higher than today. It can of course be argued that young people at that time started working far below the age of 20, but we can also use that argument in the predicting of the future, saying that young people will enter the labor force at higher and higher ages, and that the retirement age will be higher and higher.

Second, a more valid question than how much the fraction above 65 will increase is how much do we need to raise the retirement age in order to keep the fraction retired constant, for instance on today’s level. This is best illustrated by the *population percentiles* and their development over time.

Figure 4 shows the change in the percentiles of the age distribution over time.

[Figure 4 about here.]

The two panels in Figure 5 are predictions, with and without migration, based on age-specific mortality and fertility 2006.

[Figure 5 about here.]

We see from Figures 4 and 5 that the fraction retired 2006 is about

Figure 6 illustrates the relation in sizes of the young and old working force. The prediction in the rectangle (made in the mid-eighties) caused a intense debate in Sweden at that time (“the age shock”). This illustrates the usefulness of a long time perspective.

[Figure 6 about here.]

The idea was that it is a bad situation with few young workers and many young in a company. Normal career roads will be closed for both the young and most of the older employees.

3 Is longevity clustered?

This section has three subsections, a methodological, where mathematical and statistical models for interactions within family trees will be studied and developed, and an applied, where the models are used in the analyses of inheritance questions around the concept of aging. But the first subsection describes the region and data under study.

3.1 Data

Data are taken from the Skellefteå region in northern Sweden, see Figure 7, and covers the time period 1831–1900.

[Figure 7 about here.]

The analysis is based on information found in the Swedish church book records, that is, birth, death, migration, and catechetical registers. In the catechetical registers the clergy kept a continuous record of all demographic events for all individuals residing in a parish, making it possible to follow individuals over time and to identify their relatives. Furthermore, information on literacy and occupation was recorded, including any changes in status. A selected number of parishes are digitalized by the Demographic Data Base at Umeå University (http://www.ddb.umu.se/). The entries in the catechetical registers have been linked for each individual making possible longitudinal analyses. The area under study is the Skellefteå region on the Gulf of Bothnia. The analyses of the Skellefteå region cover the period 1831–1900.

The Skellefteå region consists of the parish of Skellefteå and the parish of Byske. Byske was a part of Skellefteå parish until 1875. For the remaining part of the century it was an independent parish. Two other parishes which became independent in the early nineteenth century, Jörn and Norsjö, were incorporated into the parish of Skellefteå for a number of years at the beginning of the century and are included in the analyses for these years. The region is situated in the province of Västerbotten in the northern part of Sweden on the Gulf of Bothnia. The parish was one of the largest parishes in Sweden both in area and in population during the nineteenth century. The population began to increase slowly during the seventeenth and eighteenth centuries. By the turn of the nineteenth century, about 6 900 inhabitants lived in the parish. The population of the parish increased rapidly during the first half of the century, reaching approximately 14 000 by 1850. By 1900 the two parishes had nearly 30 000 inhabitants (Alm Stenflo 1994). The increase in population was mainly the result of a high natural growth. Mortality was comparatively low. Fertility was high, not only by Swedish standards, but also in an international comparison and there are no indications of family planning. Total fertility fluctuated around five children per woman and, although fertility did decline during the nineteenth century, the actual fertility transition occurred late in the district (Alm Stenflo 1994). The rate of illegitimacy was low in comparison with many other parts of Northern Sweden where frequent pre-nuptial conceptions and illegitimate births were common. The illegitimacy rate fluctuated between three and six per cent during the nineteenth century (Alm Stenflo 1994). As the population increased new land was cultivated and, although some villages became quite large, population density, on the whole, was low.

During most of the nineteenth century industrialisation had little impact on the local economy. Some small sawmills were established early in the century. The majority of the population (in 1835 approximately 85 per cent) made their living from farming, mainly animal husbandry. The farmers were mainly freeholders and there were no large estates in the region. The distribution of economic resources among this group was comparatively equal.

3.2 Model

The methodological part addresses the important question of how to model the interaction between demographic processes (in this project, mortality) in different generations. The simplest possibility, and the one used in this paper, is to use conditions in one generation as explanatory variables in a Cox regression, where longevity in the next generation is the response. Formally,

$$\lambda(t; \mathbf{x}, \mathbf{z}) = \lambda_0(t) \exp(\mathbf{x}\boldsymbol{\beta} + \mathbf{z}\boldsymbol{\alpha}), \quad t > 0,$$

where `x` are covariates related to the parent generation and `z` covariates related to the individual herself.

3.3 Analysis

The applied part deals with the question whether longevity is clustered or not. In previous research (Bengtsson & Broström 2005), we found that there was a strong link between mothers and daughters. In studies of infant mortality we found a stong clustering effect within families (Edvinsson, Brändström, Rogers & Broström 2005), and a strong inheritance factor between mothers and daughters (Lindkvist & Broström 2006).

The effect of parent's longevity is studied simultaneously for mother's and father's effects. In Table 1 the results are shown.

[Table 1 about here.]

As can be seen, there is a strong interaction effect between `parity` and `sex`, which motivates separate analyses for females and males. In Table 2 the effect on daughters is shown.

[Table 2 about here.]

It is evident that the effect of parent's longevity on daughters old age survival is very strong. More surprisingly, high birth `parity` seems to be beneficial for a long life. However, this is not the case for sons, as can be seen in Table 3.

[Table 3 about here.]

For men, mother's longevity is still very beneficial, almost as evident as for females, but thre is no effect of `parity`.

In Figure 8 the results concerning parent's effect on longevity for daughters and sons are summarized. The effect is very consistent, but slightly larger for females compared to males.

[Figure 8 about here.]

4 Conclusion

The Swedish population is ageing, but the consequences in a fifty-years-horizon do not seeem to be too severe. Retirement ages need to e raised a couple of years, but hopefully people are not only getting older but also healthier.

The concept of inheritance is difficult to study, because from data alone it may be impossible to distinguish genetic from social inheritance in the first place, and inheritance from pure association in the second.

Hovever, we have shown that longevity is a property that follows family, and that the effects of father and mother are almost identical.

References

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Bengtsson, T. & Broström, G. (2005), 'Parental effects on children's mortality in older ages, southern Sweden, 1829–1894'. Paper presented at the Menorca meeting "Inherited Characteristics of Human Populations in the Past", May 2005.

Edvinsson, S., Brändström, A., Rogers, J. & Broström, G. (2005), 'High-risk families: The unequal distribution of infant mortality in nineteenth-century Sweden', *Population Studies* **59**, 321–337.

Lindkvist, M. & Broström, G. (2006), 'Clustered infant mortality in an intergenerational perspective, Skellefteå, 1831–1890'. Paper presented at the SSHA Conference in Minneapolis, November 2006.

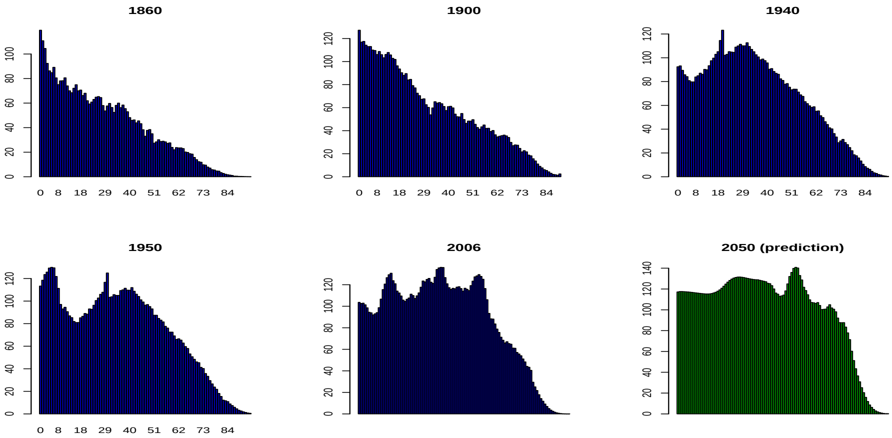

Figure 1: Changes of age distribution in the Swedish population.

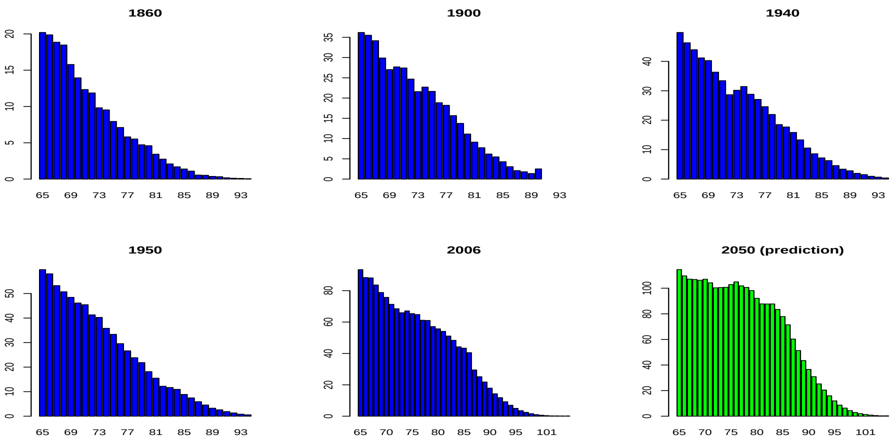

Figure 2: Changes of age distribution in the Swedish population in ages above 65.

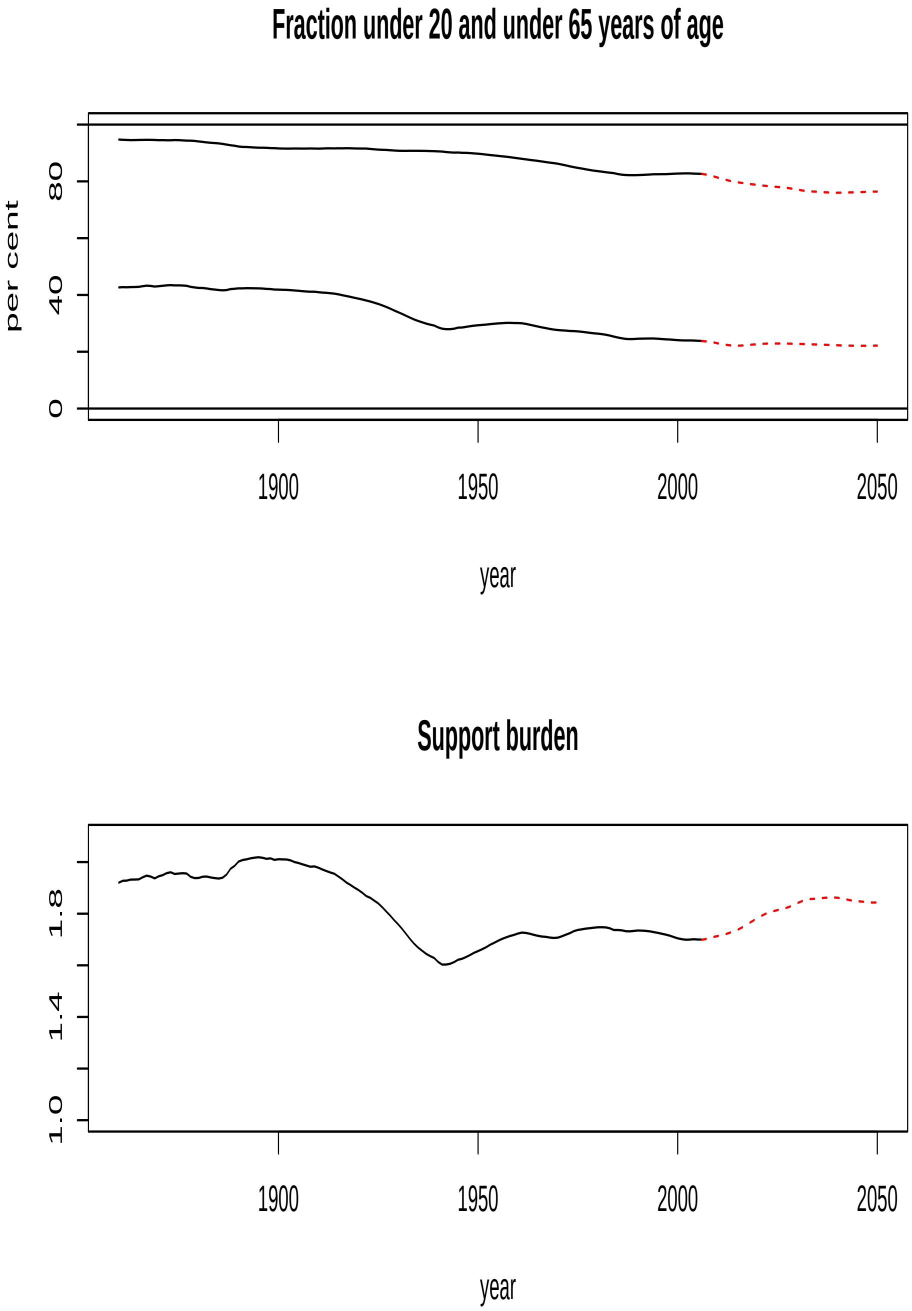

Figure 3: Support burden, Sweden 1860–2050.

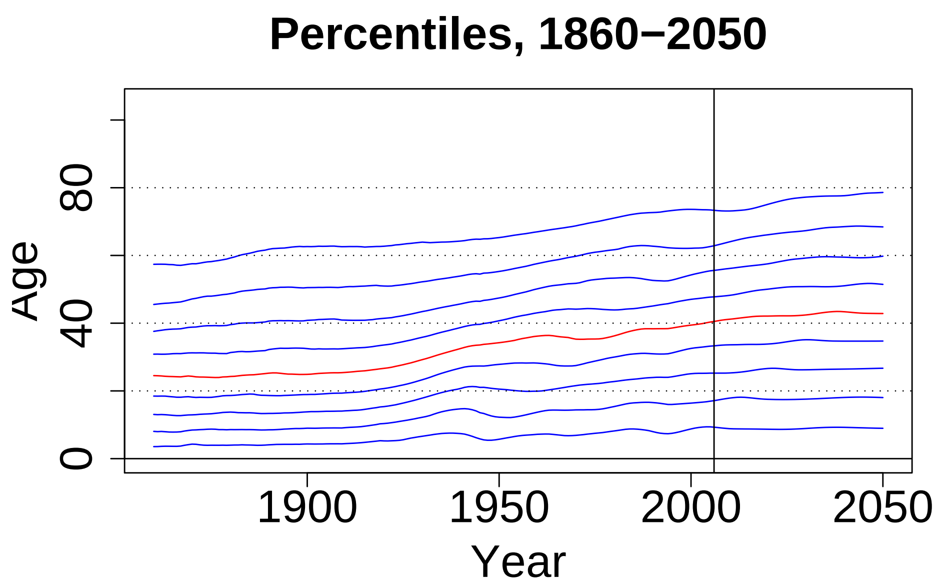

Figure 4: Changes of percentiles over time in the age distribution of the Swedish population.

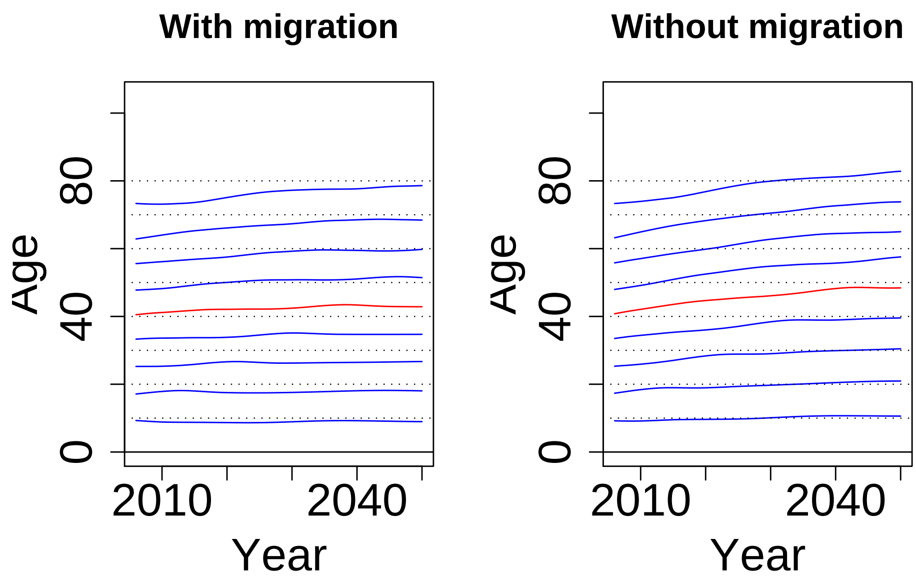

Figure 5: Changes of percentiles over time in the age distribution of the Swedish population. Predictions with and without migration.

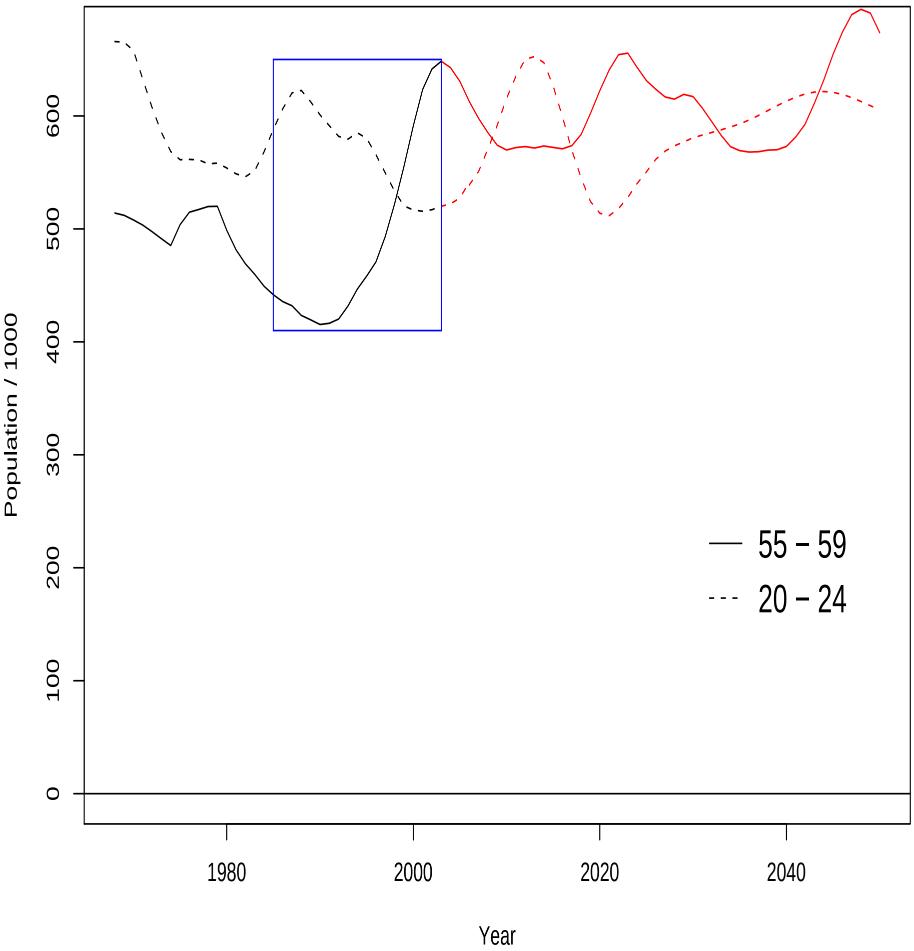

Figure 6: Age competition at the labor market, Sweden 1860–2050.

Figure 7: Map of Sweden with the study area, the Skellefteå region.

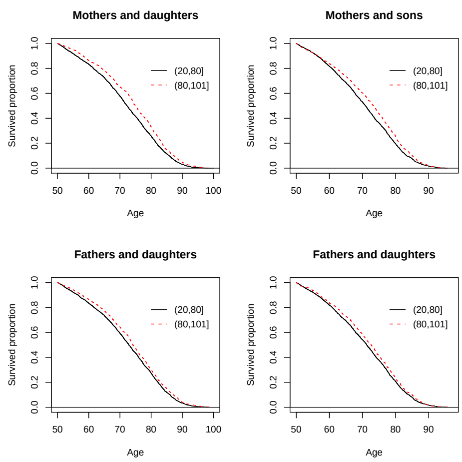

Figure 8: Longevity as a function of death age of parents. Mothers and daughters, mothers and sons, top panels. Fathers and daughters, fathers and sons, bottom panels. Survivor functions.

Table 1: Males and females.

Covariate		Mean	Coef	Rel.Risk	S.E.	Wald p
birthdate		1810.426	0.003	1.003	0.001	0.000
bthpar						
	no	0.084	0	1 (reference)		
	yes	0.916	0.133	1.143	0.052	0.011
parity		4.217	0.005	1.005	0.007	0.441
sex						
	male	0.474	0	1 (reference)		
	female	0.526	-0.079	0.924	0.047	0.092
m.death.age		70.549	-0.004	0.996	0.001	0.000
f.death.age		69.473	-0.004	0.996	0.001	0.000
m.dead		0.934	0.110	1.117	0.087	0.206
f.dead		0.967	-0.056	0.946	0.114	0.627
parity:sex						
:female			-0.025	0.975	0.009	0.008

Events	5942
Total time at risk	151641
Max. log. likelihood	-46831
Overall p-value	0

	Df	AIC	LRT	Pr(Chi)	
<none>		93680			
birthdate	1	93694	16	6.059e-05	***
bthpar	1	93684	7	0.009541	**
m.death.age	1	93700	23	1.869e-06	***
f.death.age	1	93693	16	7.058e-05	***
m.dead	1	93679	2	0.199705	
f.dead	1	93678	0.2324	0.629767	
parity:sex	1	93685	7	0.007836	**

Table 2: Females.

Covariate		Mean	Coef	Rel.Risk	S.E.	Wald p
birthdate		1809.854	0.002	1.002	0.001	0.046
bthpar						
	no	0.077	0	1 (reference)		
	yes	0.923	0.147	1.158	0.076	0.054
parity		4.246	-0.020	0.981	0.007	0.003
m.death.age		70.779	-0.005	0.995	0.001	0.000
f.death.age		69.614	-0.003	0.997	0.001	0.009
m.dead		0.936	0.130	1.139	0.125	0.298
f.dead		0.966	-0.077	0.926	0.156	0.623

Events	3007
Total time at risk	79742
Max. log. likelihood	-21671
Overall p-value	0.0000004

	Df	AIC	LRT	Pr(Chi)	
<none>		43357			
birthdate	1	43359	4	0.0453631	*
bthpar	1	43358	4	0.0497197	*
parity	1	43363	9	0.0031103	**
m.death.age	1	43368	13	0.0003004	***
f.death.age	1	43361	7	0.0091117	**
m.dead	1	43356	1	0.2904445	
f.dead	1	43355	0.2366	0.6266694	

Table 3: Males.

Covariate		Mean	Coef	Rel.Risk	S.E.	Wald p
birthdate		1811.060	0.004	1.004	0.001	0.000
bthpar						
	no	0.091	0	1 (reference)		
	yes	0.909	0.119	1.126	0.072	0.101
parity		4.184	0.006	1.006	0.007	0.416
m.death.age		70.294	-0.004	0.996	0.001	0.002
f.death.age		69.316	-0.004	0.996	0.001	0.002
m.dead		0.932	0.094	1.098	0.122	0.442
f.dead		0.967	-0.026	0.975	0.168	0.878

Events	2935
Total time at risk	71900
Max. log. likelihood	-21065
Overall p-value	0.000006

	Df	AIC	LRT	Pr(Chi)	
<none>		42144			
birthdate	1	42156	14	0.0001771	***
bthpar	1	42145	3	0.0955817	.
parity	1	42143	1	0.4172465	
m.death.age	1	42152	9	0.0020928	**
f.death.age	1	42152	10	0.0020361	**
m.dead	1	42143	1	0.4372588	
f.dead	1	42142	0.0233	0.8786801	