Single fathers high risk to die – A longitudinal analysis of mortality for single and partnered parents in Denmark

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Abstract

The proportion of single parent households headed by men is increasing in many developed countries. However, the vast majority of studies have investigated single mothers and very few focus on single fathers. The purpose of the present study is to examine the mortality of single fathers in comparison with single mothers and partnered parents. The study is conducted by linking high-quality register data on the total Danish population. Survival analyses were used to investigate differences in mortality among the single parents and partnered households. By providing longitudinal characteristics, such as the length of single parenthood and the pathways into single parenthood, we consider the heterogeneity among single parents. The results show that single fathers face the highest mortality risk. While single fathers suffered most from widowhood, single mothers have the highest disadvantage in mortality when they were divorced.

Introduction

The number of single parent families has increased steadily around the world. In most industrialized countries single parent households became a regular part of census household typologies and make over 20% of all households with children e.g. in Australia, Canada, the United Kingdom, the United States, Sweden and New Zealand (Collings, Jenkin, Carter, & Signal, 2014). Family patterns in Denmark has been constantly changing. Denmark has one of the highest divorce rates in Europe (Eurostat[1]). In 2014, the divorce rate in Demark reached a peak of 54.4%. Since then, it slightly declined, but in 2017 it is still comparably high, with 46.8% (Statistics Denmark; see www.statbank.dk). At the same time, there is a trend towards fewer people getting married, while more people are living alone or cohabiting (Statistics Denmark). These patterns of marriage, divorce and cohabitation have contributed to considerable numbers of single parents in Denmark, while coupled parent households have decreased. From 1986 to 2016, there was an increase from 107,811 to 151,036 single parent households with underage children. The proportion of single parent households among households with dependent children increased from 16% to 23% over the past 30 years (Supplementary Materials, Figure S.1).

Several studies have shown that single mothers are a disadvantaged group in terms of health. Research examined higher prevalence of depressive symptoms (Cooper et al., 2008; Crosier, Butterworth, & Rodgers, 2007; Lipman, Offord, & Boyle, 1997; Wang, 2004), psychological distress (Franz, Lensche, & Schmitz, 2003), anxiety disorders (Afifi, Cox, & Enns, 2006), lower levels of well-being (Bull & Mittelmark, 2009), lung cancer, suicide (attempts), inflicted violence, traffic injury, and addiction (Weitoft, Haglund, Hjern, & Rosén, 2002) as well as a higher risk of mortality for single mothers compared to partnered mothers. These health disadvantages were mostly explained by financial hardship and unemployment (Curtis & Phipps, 2004; Kühn, 2018; Targosz et al., 2003).

Much less is known about single fathers due to scarce data as the vast majority of single parent households are headed by women. However, the proportion of single father households has increased for many developed countries in the last decades (Chiu et al., 2017). In Denmark, the number of single fathers increased from 15,515 in 1986 to 23,831 in 2017. While in most other countries single fathers make approximately 10% of single parent households, Denmark has with 14% to 16% a stable and higher percentage of single father households Supplementary Materials, Figure S.2).

Research has shown that single fathers are, similarly to single mothers, a vulnerable group. They have lower income and social support and are more likely to be unemployed in comparison to partnered

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[1] http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_ndivind&lang=en; 31.08.2018

fathers (Janzen, Green, & Muhajarine, 2006). There is also evidence that single fathers might be as disadvantaged as single mothers in regard of health.

There is evidence that single custodial fathers report worse health than their partnered counterparts. They have lower self-rated health and a higher risk for mental illness compared to married or cohabiting fathers (Benzeval, 1998; Collings et al., 2014; Meadows, 2009; Popay & Jones, 1990; Tobias, Gerritsen, Kokaua, & Templeton, 2009). Studies examining health outcomes of single fathers compared to single mothers are less consistent. Chiu et al. (2017) found in a cross-sectional study based on Canadian data, similar levels of self-rated health and mental health for single fathers and single mothers. In another cross-sectional study with Swedish data, the authors identified similar unadjusted prevalences in poor self-rated health for single fathers and single mothers, but with single fathers having the highest prevalence in poor self-rated health among these four groups (Westin & Westerling, 2007). Contrasting results were found by Collings et al. (2014). They considered in their analyses patterns of gender differences in health and compared sex differences in mental health for single parents and partnered parents. The findings suggest that single mothers have poorer mental health than single fathers and that sex differences in mental health are higher among single parents than partnered parents.

There are only a few attempts studying the association between mortality and single fatherhood. Ringbäck Weitoft, Burström, and Rosén (2004) examined in their study based on Swedish national registers the premature mortality (1991-2000) of men, who were classified in both 1985 and 1990 as cohabiting custodial fathers, lone custodial fathers, lone non-custodial fathers, cohabiting childless men, and lone childless men. Their results suggest that the mortality risks were highest among lone childless men and lone non-custodial fathers, while lone custodial fathers also had a higher mortality risk, although to a lesser extent. A recently published study using Canadian data found a three times higher mortality rate in single fathers than for single mothers and partnered fathers. The risk of mortality remained significantly higher for single fathers after adjusting for several variables, such as socioeconomic characteristics or health behavior (Chiu et al., 2018). However, less attention has been paid to the fact that the episode of single parenthood is dynamic and that single parents are not a homogenous group.

Therefore, the present paper aims to examine the association between mortality and single parenthood with a specific focus on single fathers. To be able to compare partnered and single parents longitudinally, we used the age of 17 for the youngest child as a reference time point to identify retrospectively mothers and fathers, who by this time 1) never have been a single parent, 2) have been a

single parent in the past or 3) are currently a single parent. All mothers and fathers categorized in one of these three groups were followed-up until out-migration, the last year of observation (2014), or until death, whichever came first. We hypothesize, that single fathers and single mothers have a higher mortality risk than their partnered counterparts. Considering the higher mortality risk of single parents, but also following the gender pattern of mortality – that women outlive men at almost all ages (e.g. Barford, 2006) - we further expect that single fathers have the highest mortality risk and partnered mothers the lowest mortality risk among all parent groups.

Methods

Data

This study is based on Danish register data covering the whole population of Denmark from 1980 to 2014. We used information from the Civil Registration System (CRS) (Pedersen, 2011), the Register of Causes of Death (Helweg-Larsen, 2011), the Education Register (Jensen & Rasmussen, 2011) and the Employment Classification Module (AKM) (Petersson, Baadsgaard, & Thygesen, 2011). All the registers are linked through a unique 10-digit personal number (CPR number).

In the CRS, each family has a unique identification number, which is used to link the other registers at the family level, as well as to identify the individuals belonging to each family. From the CRS we extracted demographic information at the individual level (date of birth, sex, vital status, civil status, date of in- and out-migration) and information at the family level. Information about the type of family (single individual, couple without children, couple with children, single parent) is provided by Statistics Denmark from 1986, based on the CRS. From the Register of Causes of Death, we extracted the date of death and the underlying cause of death. The highest education attained is obtained from the Education Register, and the employment status is obtained from the AKM register.

Study population

The base for the selection of our population of interest is given by all individuals residing in Denmark from 1986 to 2014 and living in a family with children[2]. We restrict the population to consider only individuals born from 1935 onwards and individuals older than 18.

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[2] Statistics Denmark defines children as each individual under 25 years old, never married and who lives at the same address as one of the parents. We changed this definition to consider children as individuals under the age of 18 years.

Definition Single Parent

Single parents are men and women, who had at least one child under the age of 18, living together without a partner living in same household.

Single Parenthood characteristics

Following this definition, it is possible to observe several episodes of single parenthood for the same individual. To identify the first episode ever of single parenthood for each individual, we restrict the data from 1991[3] and we consider only cases for which the first episode of single parenthood happened from 1991 onwards, and no other episodes are registered in the period 1986-1990 for the same individual. For everyone, who has experienced at least one episode of single parenthood, we computed the total number of episodes and the total length of episodes. Furthermore, the civil status of the individual in his/her first year as single parent is included as a proxy for the reason/cause of single parenthood. The pathways that lead to single parenthood include separation and divorce, widowhood and having children out of marriage.

Study Design

We started following each individual from the 1st of January of the year in which the youngest child in the family was older than 17. We defined this moment as our baseline t_0 (Supplementary Materials, Figure S.3). We follow each individual from time t_0 until attrition due to death or emigration, or end of follow-up (31st of December 2014) whichever came first.

At time t_0 each individual was identified either as a single parent or a partnered parent. In case of partnered individuals, we check retrospectively whether those who were partnered at t_0, had experienced at least one episode of single parenthood before. These mothers and fathers were considered as *previously single parent*.

Because of our definition of the baseline t_0, we decide to include in the sample only individuals with the age at t_0 greater or equal to 35 years[4].

Statistical analysis

First, we compare the baseline characteristics of the three groups of parents for both sexes separately in Table 1. Then, we show the Kaplan-Meier survival curves for the three groups and for both sexes,

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[3] 1991 is the first year in which we have information about the employment.
[4] Under the condition that they were older than 18 when they became parents.

separately for each age at baseline t_0. Finally, we present the estimated proportional hazard Cox model (Therneau & Grambsch, 2013) for the hazard of dying $\lambda_i(t)$ (for the $i-th$ individual), stratified by age at baseline and with time-varying covariates:

$$\lambda_i(t) = \lambda_k(t)e^{\{X_i\beta\}}$$

where $k = 1,2,3,4$ are the age groups, and X_i is a vector of covariates for the $i-th$ individual.

The outcome for our model is death and the main exposure is the type of parent (single parent, previous single parent and partnered parent). We show how the estimates of the hazard risk change with the inclusion of the control variables (education, employment, total length of the single parent episodes). We present also the result of the Cox model in which we differentiate further the single parents and previous single parent according to the reason for being a single parent (in the year of the first episode).

Control variables:

We categorize the age at t_0 of each individual in four categories, according to the distribution of the variable in our sample; 35-44, 45-49, 50-54, and 50+. Highest education attained is categorized according to the ISCED classification in low, medium and high[5] (European Commission/EACEA/Eurydice, 2017). Employment in the year of death is categorized as employed, unemployed and out of the labor force (which category includes people in retirement).

All analyses are performed using R, version 3.3.2, the package *survival (Therneau, 2015)* and R-studio, version 1.0.136 (R Core Team, 2017).

Results

Comparison of partnered and single parents

In total, the study population included 622,090 fathers and 674,910 mothers of which 572,409 were partnered fathers, 15,681 were previously single fathers and 34,000 were single fathers. Among mothers, 536,924 were partnered, 53,942 were previously single and 84,044 were single mothers (Table 1). The mean age of fathers was higher than of mothers (all groups). Fathers tended to have lower education than mothers – irrespective of whether they were single or partnered. While differences in education were rather small among fathers, single mothers had a slightly higher education than

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[5] ISCED = 1,2 low education, ISCED = 3 medium education and ISCED = 5,6,7,8 high education. We also included the category "missing/unknown" because of the non-ignorable proportion of missing values for the highest education attained.

partnered mothers. The very clear majority of all parent groups (75.7% for single mothers to 88.5% partnered fathers) were employed. Both, single fathers (79.8%) and single mothers had the lowest employment percentages among all groups. However, single mothers' percentage (18.8%) in out of labor was slightly higher than that of single fathers (14.5%).

Comparison among single parents

The comparison of single parenthood characteristics showed that (previously) single mothers had on average more episodes of single parenthood than (previously) single fathers. The total length of being in single parenthood was highest for single mothers, while previously single parents tended to have less time in single parenthood. The most frequent reason for being single parent was for all groups due to separation (but still married). However, there were gender differences in the pathways of single parenthood. Single fathers were relatively more often divorced than single mothers, single mothers were relatively more often single than single fathers, and previously single mothers were less often (3.2%) widowed than (previously) single fathers (8.1% and 9.5%) and single mothers (8.3%). There were also differences regarding the age of the youngest child. Single mothers tended to have younger children, especially in the category 0 to 5 years.

Table 1 - Baseline characteristics of Danish parents (partnered, previous single and single) born between 1935 and 1978 and alive in Denmark between 1980 and 2014.

	Partnered fathers	Previous single fathers	Single fathers	Partnered mothers	Previous single mothers	Single mothers
Numbers (%)	572,409 (44.1)	15,681 (1.2)	34,000 (2.62)	536,924 (41.4)	53,942 (4.2)	84,044 (6.5)
Number of deaths (%)	56,984 (10.0)	664 (4.2)	2,510 (7.4)	37,092 (6.9)	1,169 (2.2)	3,162 (3.8)
Mean age (SD), years	49.6 (5.1)	49.4 (5.6)	48.8 (5.8)	47.6 (4.4)	46.7 (4.6)	47.5 (5.0)
Age group						
35-44	98,657 (17.2)	3,454 (22.0)	9,283 (27.3)	155,961 (29.1)	20,087 (37.2)	26,731 (31.8)
45-49	217,329 (38.0)	5,690 (36.3)	11,823 (34.8)	227,745 (42.4)	21,550 (40.0)	32,210 (38.3)
50-54	176,063 (30.8)	4,149 (26.5)	7,947 (23.4)	124,676 (23.2)	9,928 (18.4)	19,029 (22.6)
55+	80,360 (14.0)	2,388 (15.2)	4,947 (14.6)	28,542 (5.3)	2,377 (4.4)	6,074 (7.2)
Education						
Low	142,332 (25.3)	4,035 (26.3)	9,156 (27.6)	171,748 (32.6)	14,209 (26.8)	22,043 (26.9)
Medium	281,880 (50.1)	7,600 (49.6)	16,035 (48.4)	216,335 (41.0)	23,541 (44.4)	33,282 (40.6)
High	138,205 (24.6)	3,692 (24.1)	7,952 (24.0)	139,456 (26.4)	15,312 (28.9)	26,660 (32.5)
Employment						
Employed	506,813 (88.5)	13,149 (83.9)	27,124 (79.8)	449,094 (83.6)	43,732 (81.1)	63,641 (75.7)
Unemployed	19,034 (3.3)	596 (3.8)	1,800 (5.3)	26,590 (5.0)	2,358 (4.4)	4,572 (5.4)
Out of labor	46,562 (8.1)	1,936 (12.4)	5,076 (14.9)	61,240 (11.4)	7,852 (14.6)	15,831 (18.8)
Single parents characteristic						
Mean number of episodes (SD)		1.1 (0.4)	1.2 (0.5)		1.3 (0.6)	1.4 (0.7)
Mean total length of being single parent (SD), years		2.9 (2.4)	4.4 (3.6)		4.2 (3.5)	7.7 (5.2)

Path into single parenthood				
Married/separated	7,772 (49.6)	13,929 (41.0)	29,708 (55.1)	42,626 (50.7)
Divorced	4,074 (26.0)	10,721 (31.5)	8,446 (15.7)	14,831 (17.7)
Widowed	1,263 (8.1)	3,235 (9.5)	1,707 (3.2)	7,013 (8.3)
Single	2,572 (16.4)	6,115 (18.0)	14,081 (26.1)	19,574 (23.3)
Age of youngest child at first episode of being single (SD)				
<1	81 (0.5)	69 (0.2)	4,609 (8.5)	5,742 (6.8)
1-2	687 (4.4)	642 (1.9)	8,329 (15.5)	8,950 (10.7)
3-5	1,991 (12.7)	1,882 (5.5)	11,840 (22.0)	11,669 (13.9)
6-12	7,178 (45.8)	8,336 (24.5)	20,896 (38.7)	25,973 (30.9)
13-18	5,744 (36.6)	23,071 (67.9)	8,268 (15.3)	31,710 (37.7)

Numbers are N (%) unless stated otherwise. Missing data are excluded from percentage calculations.

Figure 1: Kaplan-Meier survival curves by parent type and age groups
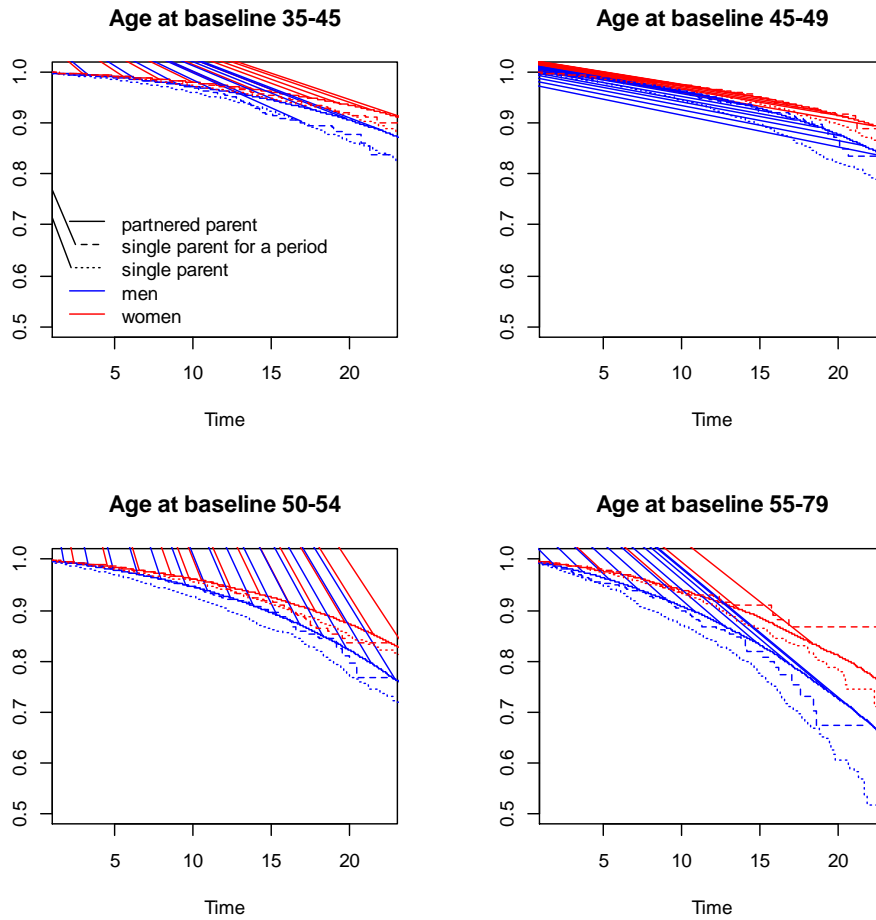
The comparison of the KM survival curves by age groups showed that the mortality risk increased with older ages at entrance. There were differences in mortality risk within the age groups for the six parent groups, however they were less pronounced for the younger age groups. Figure 1 could demonstrate that in all age groups men had a higher risk to die than women and that single parents had a higher mortality risk than their partnered counterparts. Thus, partnered women had the lowest risk and single fathers the highest risk of dying in all age groups.

Multivariate

Table 2 showed the hazard ratios for all-cause mortality. The models were stratified by age at baseline. The results were in line with the Kaplan-Meier curves suggesting that single fathers and single mothers

followed by previously single mothers and father had a higher mortality risk than their partnered counterparts. Partnered fathers had a lower risk than (previously) single fathers and single fathers but a higher mortality risk than single mothers. Partnered mothers had the lowest and single fathers the highest mortality risk (model 1).

This pattern did not change when socioeconomic characteristics were included in the model (model 2). However, the hazard ratios decreased for previously single mothers and single mothers and were not significant for previously single mothers after adjusting for education and employment. Higher education and being employed lowered the risk of mortality, while especially being out of labor had a high negative effect on mortality.

In model 3, we included the length of single parenthood, which lowered the mortality risk due to its distribution strongly inflated around "0" because of the partnered parents, but made the effects of single parent types more pronounced.

The estimated hazard ratios for each group and each model were graphically presented, with confidence intervals in Figure 2.

Table 2: All-cause mortality for all parent types.

	Model 1	Model 2	Model 3
	Hazard ratios (CI 95%)	Hazard ratios (CI 95%)	Hazard ratios (CI 95%)
Exposure: ref. Partnered mothers			
Partnered fathers	1.47*** (1.45, 1.49)	1.76*** (1.74, 1.79)	1.76*** (1.74, 1.79)
Previous single fathers	1.62*** (1.49, 1.75)	1.79*** (1.66, 1.93)	1.87*** (1.73, 2.02)
Single fathers	2.09*** (2.01, 2.18)	2.20*** (2.11, 2.29)	2.34*** (2.23, 2.45)
Previous single mother	1.07** (1.01, 1.13)	1.01 (0.95, 1.07)	1.07** (1.00, 1.14)
Single mothers	1.25*** (1.21, 1.30)	1.15*** (1.11, 1.20)	1.26*** (1.20, 1.33)

Model 1: Controlling for age. Model 2: model 1 + employment and education. Model 3: model 2 + length of single parenthood.
Significance level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figure 2: Hazard ratios and 95% confidence intervals for models 1 to 3, and for each group of parents in comparison with partnered mothers.
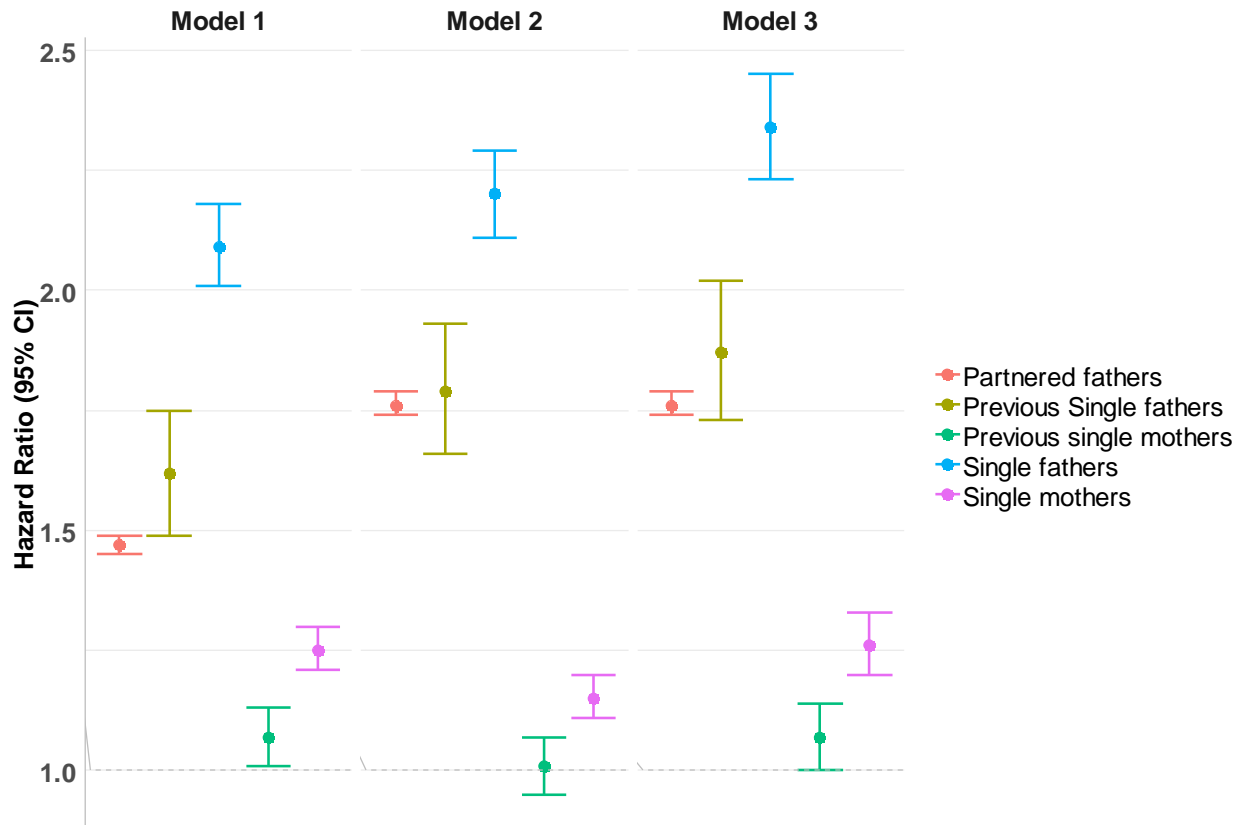
In Table 3, and graphically in Figure 3, estimated hazards of dying were presented considering the pathways into single parenthood for previously single parents and single parents at baseline under consideration of education, employment and the total length of single parenthood. The results showed for previous single fathers and single fathers that those who never had been married had the lowest risk of dying, followed by those who were still married but separated and divorced. Single fathers, who were widowed have the highest risk of dying. The results for single mothers were differing from single fathers. Previously single mothers and single mothers, who were divorced had the highest mortality risk, while the other previously single mother groups did not show a significantly higher risk of mortality in comparison to partnered mothers. In contrast, single mothers showed for all groups a high and similar

significant risk of dying with the exception of widowed mothers, who had the lowest risk of mortality among the single mothers.

Figure 3: Hazard ratios and 95% confidence intervals of all-cause mortality for each group of parents in comparison with partnered mothers, and for single parents according to their path into single parenthood.
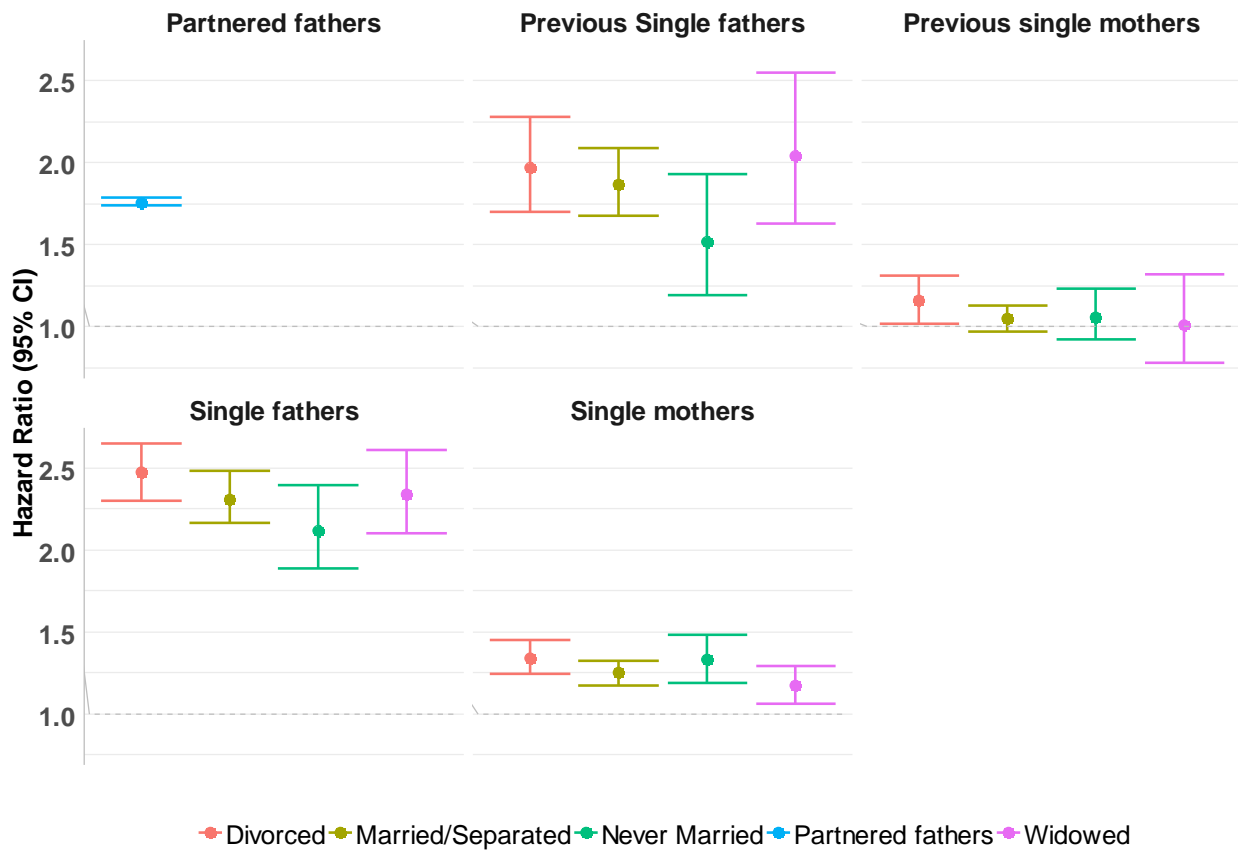
Table 3: Hazard Ratios estimates from the proportional hazard Cox model for the hazard of dying, stratified by age at baseline.

	HR (95% CI)
Exposure: ref. Partnered mothers	
Partnered fathers	1.76*** (1.74, 1.79)
Previous single fathers - divorced	1.97*** (1.70, 2.28)
Previous single fathers - married/separated	1.87*** (1.68, 2.09)
Previous single fathers - never married	1.52*** (1.19, 1.93)
Previous single fathers - widowed	2.04*** (1.63, 2.55)
Single fathers - divorced	2.47*** (2.30, 2.65)
Single fathers - married/separated	2.31*** (2.16, 2.48)
Single fathers - never married	2.12*** (1.89, 2.39)
Single fathers - widowed	2.34*** (2.10, 2.61)
Previous single mothers - divorced	1.16** (1.02, 1.31)
Previous single mothers - married/separated	1.05 (0.97, 1.13)
Previous single mothers - never married	1.06 (0.92, 1.23)
Previous single mothers - widowed	1.01 (0.78, 1.32)
Single mothers - divorced	1.34*** (1.24, 1.45)
Single mothers - married/separated	1.25*** (1.17, 1.32)
Single mothers - never married	1.33*** (1.19, 1.48)
Single mothers - widowed	1.17** (1.06, 1.29)

Controlling for age, education, employment and length of single parenthood.
Significance level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Discussion

In this longitudinal study based on Danish register data covering the whole population of Denmark for more than 30 years, we demonstrated that single fathers and single mothers face a major elevated risk of mortality in comparison to their partnered counterparts. Single fathers had the highest mortality, while partnered mothers had the lowest mortality risk. These findings contribute to the literature, examining the association between single fathers and mortality, as we were able to consider 1) longitudinal characteristics about education and employment, 2) heterogeneity among single parents: length of single parenthood and pathways into single parenthood.

Baseline characteristics could show that differences between single mothers and single fathers exist for their marital status and the age of the youngest child, which indicates that single mothers and single fathers are not necessarily at the same stage in their life course (Table 1). This makes it

indispensable to consider the above mentioned individual characteristics of single fathers and single mothers.

The Kaplan-Meier survival curves and the Cox-models demonstrated that single fathers had the highest risk of dying, followed by the previously single fathers and partnered fathers. Partnered mothers and (previously) single mothers had a lower mortality risk than partnered fathers or (previously) single fathers. These findings remained consistently elevated after adjusting for education, employment (model 1) and the length of single parenthood (model 3). This clear gender pattern of mortality is in line with empirical analyses that have consistently shown that women live longer than men in almost all countries, although the magnitude of the gender gap varies across high-, middle-, and low-income countries (Barford, 2006; Clark & Peck, 2012).

The adjustment of education and employment show that these socioeconomic factors were the driving explanations for single mothers, especially for previously single mothers, while single fathers seemed to be affected by other than socioeconomic characteristics (model 2). There is plenty of evidence in the literature demonstrating that health differences between partnered mothers and single mothers can be explained by differences in material resource (Roos, Burström, Saastamoinen, & Lahelma, 2005; Wickrama et al., 2006). However, considering that in Denmark female employment is high (Table 1) and the social safety net is very strong, one would assume that the financial consequences of a Danish divorce should be less associated with stress for the single mothers. Including the length of the single parent episode was important. It affected the model in the way that the gap between previous single fathers and single fathers and previous single mothers and single mothers increased, which result in the highest mortality gap of single fathers in comparison to partnered fathers or single mothers. This indicates that the length of being single parent had a higher negative effect on mortality than for single mothers.

Another important finding of our study was that the pathways into single parenthood play a decisive role in explaining the mortality risk of single parents. The results could show that the effects were very different for women and men, but also that they differed for those, who had been single parent before the baseline (the youngest child is 17) and those, who were single parent at the baseline (Table 3). This was particularly true for widowhood. Previously single fathers had the highest and single fathers the second highest mortality risk if the reason of being single father was widowhood. Spousal bereavement seems to be significantly associated with more stress for men. Grief could be a long-lasting source of stress for men, while for women spousal bereavement is even associated with the lowest mortality risk. This could be explained by the above mentioned strong effect of socioeconomic factors

on single mothers' mortality risk. In contrast, widowed single mothers and each of their children (under 21 years) receive survivors' benefit, which could help these single mother households to achieve more financial security than divorced or separated single mothers.

Indeed, divorced single mothers were the most disadvantaged group regarding their mortality risk. While, previously single mothers seemed to overcome the negative effect of being single mother when they re-partner, the negative divorce effect remained significant in this groups. One can assume that with re-partnering, single mothers, except for divorced mothers, recover from the stressful situation of being single parent. That divorced mothers suffered most is in line with previous research that showed negative health consequences of parental conflict after separation and divorce (Amato, 2000). However, reasons for this result should not only lie in material reasons and the loss of wealth after marital dissolution, but in the long-lasting effects of the stressful life event divorce and chronic strains (Cairney, Boyle, Offord, & Racine, 2003).

The causality between family situation and mortality risk and the direction of this association is controversial as instead of health causation the higher mortality risk of single fathers and single mothers could be due to health and social selection (Ringbäck Weitoft et al., 2004). To control for potential health-selection bias, we estimated the mortality risk, for those who had been hospitalized by the age of 20 years and for those who had not been hospitalized by the age of 20 years. The sensitivity analyzes demonstrated that both models had the same direction and that effect sizes are similar, which implies that the higher mortality risk of single parents was not due to health selection (Supplementary Table S. 1). Moreover, it must be considered that single parents, but especially single fathers are rather positively selected in the way that they would not obtain their children's custody with serious diseases or problematic alcohol or drug abuse.

This study has limitations. Although registry data has many important variables available, some aspects of a single parents' life situation cannot be captured. For example, we had no information about social networks or social support or about any experienced stress of the parents. These could be important explanations for the higher mortality risk of single parents. Further, we could not distinguish between different forms of arrangements as any child living with just one parent, referred as the custodial parent. In the last years shared custody has become more common (Ringbäck Weitoft et al., 2004). In contrast, for some single parents it is true that their children do not meet their biological parents at all. That means that circumstances among single parents can be very different but are not distinguishable.

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Supplementary Materials

Figure S.1: Partnered and single parents in Denmark

Partnered parents ■ Single parents
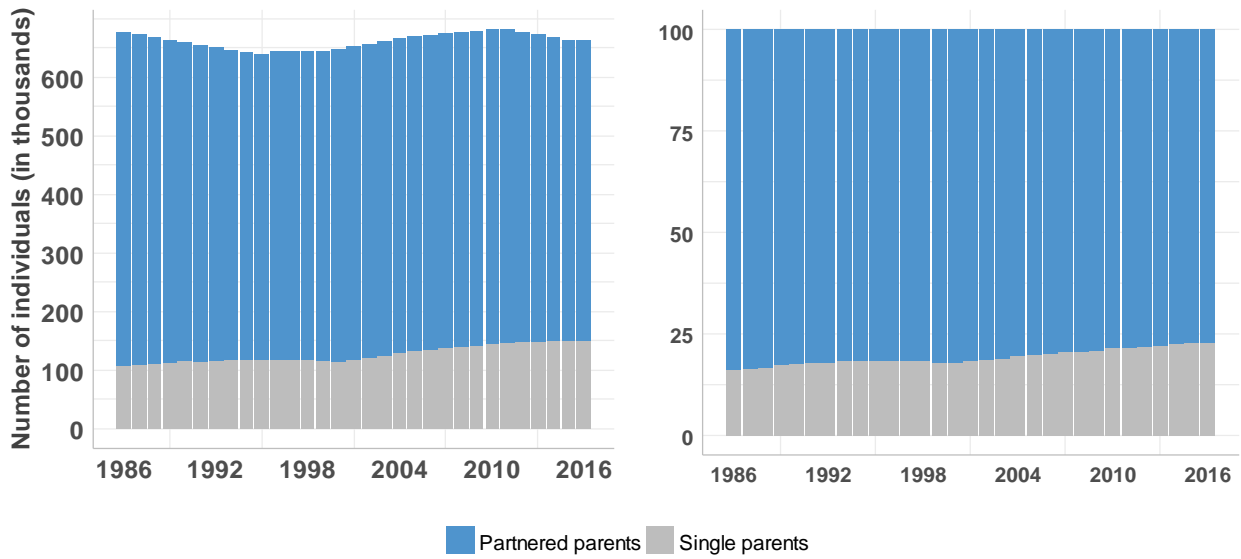
Figure S.2: Absolute numbers and percentages of single mothers and fathers in Denmark

— Single mothers — Single fathers
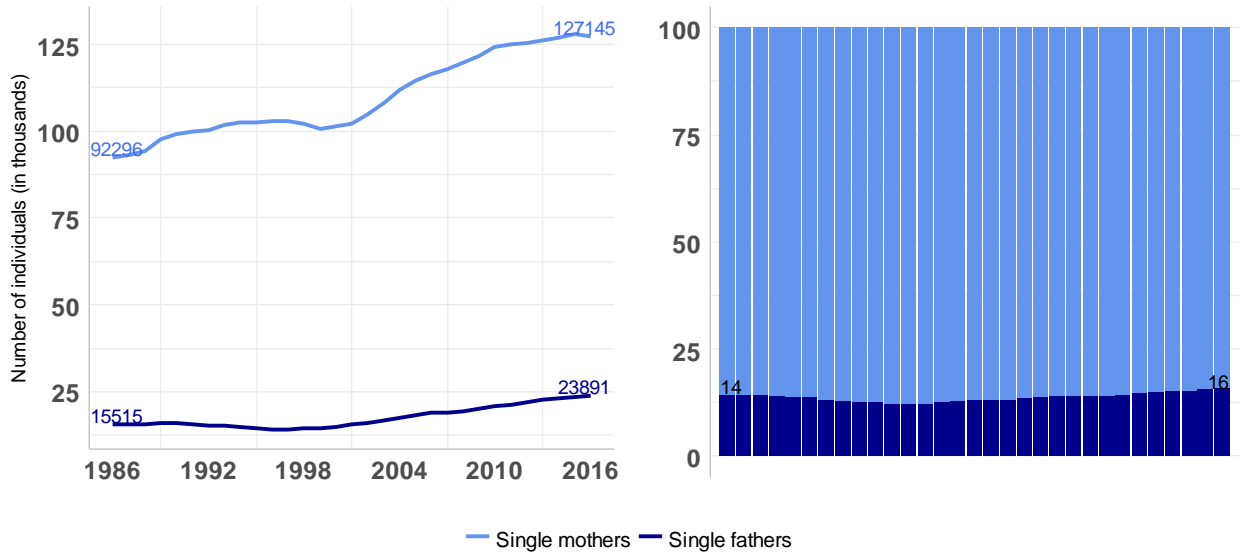
Figure S.3: Study Design for the longitudinal comparison of partnered and single parents

Group I: partnered parent in t_0

Group II : single parent in t_0

Group III : partnered parent in t_0 with a single parent episode

1986 T_0 19   2014

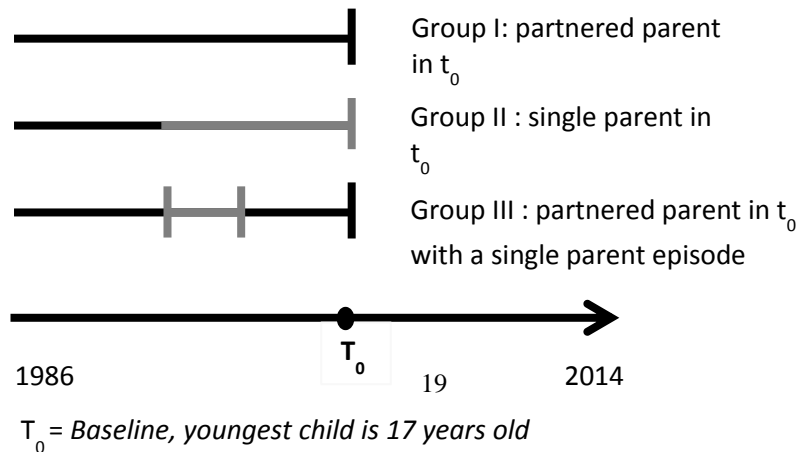T_0 = *Baseline, youngest child is 17 years old*

Table S.1

Hazard Ratios (95% confidence interval) estimates from the proportional hazard Cox full model for the

hazard of dying (subsample, Model 1) and controlling for being hospitalized before the age of 20

(subsample, Model 2). Each model is stratified by age at baseline.

	Model 1	Model 2
	Hazard ratios (CI 95%)	Hazard ratios (CI 95%)
Exposure: ref. Partnered mothers		
Partnered fathers	1.76*** (1.72, 1.80)	1.76*** (1.72, 1.80)
Previous single fathers	1.84*** (1.68, 2.03)	1.84*** (1.68, 2.03)
Single fathers	2.33*** (2.19, 2.47)	2.32*** (2.19, 2.47)
Previous single mother	1.10*** (1.03, 1.18)	1.11*** (1.03, 1.18)
Single mothers	1.27*** (1.20, 1.35)	1.27*** (1.20, 1.35)

Controlling for age, employment, education, length of single parenthood.
Significance level: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.