Mortality in single fathers compared with single mothers and partnered parents: a population-based cohort study

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Summary

Background Single parent families, including families headed by single fathers, are becoming increasingly common around the world. Previous evidence suggests that single parenthood is associated with adverse health outcomes and increased mortality; however, most studies have focused on single mothers, with little known about the health of single fathers. This study aimed to examine mortality in a large population-based sample of Canadian single fathers compared with single mothers and partnered fathers and mothers.

Methods We used a representative sample of 871 single fathers, 4590 single mothers, 16 341 partnered fathers, and 18 688 partnered mothers from the Canadian Community Health Survey (cycles 2001–12; earliest survey date: Sept 5, 2000; latest survey date: Dec 24, 2012). We anonymously linked survey participants to health administrative database records to ascertain health status at baseline and mortality from survey date up to Oct 28, 2016. We included individuals who were aged 15 years or older, living in a household with one or more biological or adopted child younger than 25 years, and living in Ontario, and we excluded those who left Ontario during the study period or had data discrepancies. Single parents were defined as those who were divorced, separated, widowed, or single, never-married, and non-cohabitating, and partnered parents were defined as those who were married or common-law partners. We investigated differences in mortality using Cox proportional hazards models with adjustment for sociodemographic, lifestyle, and clinical factors.

Findings Median follow-up was 11·10 years (IQR 7·36–13·54). Mortality in single fathers (5·8 per 1000 person-years) was three-times higher than rates in single mothers (1·74 per 1000 person-years) and partnered fathers (1·94 per 1000 person-years). Single fathers had a significantly higher adjusted risk of dying than both single mothers (hazard ratio [HR] 2·49, 95% CI 1·20–5·15; p=0·01) and partnered fathers (2·06, 1·11–3·83; p=0·02).

Interpretation In this first head-to-head comparison of mortality across single and partnered parent groups, we found that single fathers had the least favourable risk factor profile and greatest risk of mortality. Social histories might help physicians identify these high-risk patients. Further work is needed to understand the causes of this high mortality risk and how clinical and public health interventions can improve lifestyle and behavioural risk factors.

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Introduction

Single-parent families headed by fathers are a growing demographic in many regions of the world, which is largely due to increasing rates of divorce, separations, and non-marital childbearing.[1–3] In 2011, more than 2·6 million households in the USA (a nine-times increase since the 1960s) and approximately 330 000 (3·5%) of all census households in Canada were headed by single fathers.[4,5] There are nearly 3 million single parent families in the UK, of which approximately 10% are single fathers with dependent children.[6] Although parental status might not be directly modifiable by clinicians, single parenthood is readily ascertainable and is an important social factor that has been shown to adversely affect health.[7–9] To date, research on single parents has largely focused on single mothers. Single mothers generally have lower socioeconomic status, poorer self-rated health and mental health, higher levels of psychological distress, and more health-related problems and hospital admissions than the general population.[7–10] Emerging evidence shows that single fatherhood is also associated with some of these sociodemographic and health-related disparities.[9,11] Findings from an earlier study[11] by our group showed that single fathers were twice as likely to report poor self-rated health and mental health than single mothers, but were only half as likely to access health services. However, data on the health profiles and mortality risk in single fathers are scarce. Such information could be relevant to physicians, who are often aware of their patient's marital and parental status as part of their social history.

Previous studies[7,8,10] have shown that single mothers have a 1·2 to 1·7-times greater mortality than partnered mothers when followed up for up to two decades, which might be associated with inadequate household resources, social assistance, and employment status. Only one study[11] has examined the association between single fatherhood and mortality, and found that single fathers had a 30% greater risk of mortality than partnered fathers. However, it

Research in context

Evidence before this study

Much research has investigated the health outcomes of single mothers; however, the impact of single fatherhood on mortality remains unclear. On Feb 26, 2017, we searched Embase, MEDLINE, PsychInfo, and PubMed for articles with the search terms "mortality", "death", "single mother", "single father", "lone mother", "lone father", "single parent", and "lone parent". The search results found numerous studies showing that single mothers have a greater risk of mortality than partnered mothers; however, only one study examined the association between single fatherhood and mortality. Although single fathers had a greater risk of mortality than partnered fathers, evidence on their risk of mortality compared with single mothers is scarce.

Added value of this study

To our knowledge, this is the first population-based cohort study to investigate the risk of mortality associated with single fatherhood compared with single mothers, partnered mothers, and partnered fathers. Our study shows that single fathers had the least favourable risk factor profile and a mortality rate three-times higher than that of single mothers and partnered fathers. Single fathers also had a two-times higher adjusted hazard of death compared with both single mothers and partnered fathers.

Implications of all the available evidence

We found that single fathers, a growing population that has been largely understudied, have a poor behavioural and lifestyle risk factor profile, and higher risk of mortality than single mothers, partnered mothers, and partnered fathers. This research highlights single fathers as a high-risk group requiring close monitoring and management of lifestyle factors. Public health policies and clinical strategies might be needed to help identify and manage risk factors in single fathers. Further research is needed to understand the causes of their higher risk of mortality and to evaluate differences across study settings to help mitigate risk in this vulnerable population.

remains unclear how mortality in single fathers compare with single mothers and whether any difference can be explained by socioeconomic factors, lifestyle factors, health services, and other determinants of mortality.

The objectives of this study were to estimate mortality in a population-based sample of single fathers compared with partnered fathers and single and partnered mothers; and to explore whether any observed differences could be explained by measured determinants of health.

Methods

Study population

Our study population was derived from Statistics Canada's cross-sectional Canadian Community Health Survey (CCHS) pooled cycles from 2001 to 2012 (response rate 67·0–84·7%; earliest survey date: Sept 5, 2000; latest survey date: Dec 24, 2012).[12] Details about the CCHS methodology have been described elsewhere.[13,14] Briefly, the CCHS is a nationally representative survey, which uses a consistent, multistage, stratified cluster sampling strategy to collect self-reported sociodemographic and health-related information from a representative sample of people in private dwellings. This study was approved by the research ethics board at Sunnybrook Health Sciences Centre. Informed consent was obtained from all study participants for administrative data linkages.

Exposures and outcomes

The CCHS defined single parents as divorced, separated, widowed, or single never married, non-cohabitating men (single fathers) or women (single mothers) aged 15 years or older living in a household with one or more biological or adopted child younger than 25 years and no other adults. Partnered parents were defined as married or common-law men (partnered fathers) or women (partnered mothers) aged 15 years or older living in a household with one or more biological or adopted child younger than 25 years.

Using unique encoded identifiers (encrypted health card numbers), we anonymously linked the CCHS respondents to Ontario health administrative databases held at the Institute for Clinical Evaluative Sciences. We obtained vital statistics and death dates from the Ontario Registered Persons Database and cause-specific mortality from the Office of the Registrar General Vital Statistics Death Database. We grouped causes of death into International Classification of Diseases (ICD)-9 classifications: neoplasms, diseases of the circulatory system, external causes of injury and poisoning, mental health-related causes, diseases of the respiratory system, and other causes.

Sociodemographic characteristics included in this study were age, urban dwelling, white ethnicity, marital status, and education. Psychosocial stressor variables included were household income (<CAN$30 000, $30 000–59 999, ≥$60 000), unemployment in the past year, not owning a home, living with at least one child younger than 6 years, living with at least one child between 6 and 11 years, and household size of three people or higher. Lifestyle factors included were current smoking, low fruit and vegetable consumption (<3 times per day), physical inactivity (energy expenditure <1·5 kcal/kg per day), obesity (body-mass index ≥30 kg/m²), and monthly binge drinking (≥5 drinks in a sitting at least once a month). We also examined an indicator of social support, categorised as somewhat weak or very weak sense of belonging to a local community and very strong or somewhat strong sense of belonging (reference group). We linked the survey data to administrative databases to ascertain baseline prevalent medical conditions (cardiovascular disease, cancer,

	Single fathers (n=871)	Single mothers (n=4590)		Partnered fathers (n=16 341)		Partnered mothers (n=18 688)	
	n (weighted %)	n (weighted %)	p value	n (weighted %)	p value	n (weighted %)	p value
Median follow-up, years (IQR)	11·20 (7·55–13·67)	11·17 (7·57–13·63)	0·22	11·08 (7·29–13·54)	0·04	11·09 (7·35–13·49)	0·008
Demographics							
Mean age, years (SD)	45·7 (0·40)	40·6 (0·26)	<0·0001	43·1 (0·10)	<0·0001	40·7 (0·10)	<0·0001
Age group, in years							
<35	141 (7·6%)	1911 (26·9%)	<0·0001	3904 (16·5%)	<0·0001	6254 (23·3%)	<0·0001
35–44	387 (38·3%)	1737 (34·6%)	..	7557 (41·1%)	..	8456 (43·6%)	..
45–50	183 (27·5%)	616 (23·0%)	..	2684 (22·1%)	..	2585 (20·8%)	..
>50	160 (26·7%)	326 (15·5%)	..	2196 (20·3%)	..	1393 (12·3%)	..
Urban dwelling	704 (88·0%)	4019 (92·3%)	0·001	12572 (84·5%)	0·02	14 321 (84·7%)	0·03
Marital status							
Single or never married	175 (15·2%)	1780 (31·7%)	<0·0001	..	..	..	..
Separated or divorced	621 (72·4%)	2589 (61·6%)	..	..	..	..	..
Widowed	75 (12·4%)	218 (6·5%)	..	..	..	..	..
White ethnicity	772 (87·9%)	3755 (72·2%)	0·0002	13766 (74·9%)	0·03	15859 (74·2%)	0·008
Education (high school or less)	296 (34·8%)	1572 (32·1%)	0·36	4315 (24·9%)	<0·0001	4702 (25·5%)	0·0003
Stressors							
Income group							
<CAN$30 000	191 (19·0%)	2344 (44·0%)	<0·0001	941 (6·5%)	<0·0001	1246 (6·9%)	<0·0001
$30 000–$59 999	292 (27·9%)	1426 (32·1%)	..	3277 (18·4%)	..	4130 (20·6%)	..
≥$60 000	359 (46·5%)	666 (20·1%)	..	11235 (66·8%)	..	11 979 (61·7%)	..
Unemployed in past year	101 (12·5%)	1053 (23·1%)	<0·0001	590 (4·0%)	<0·0001	3433 (19·8%)	0·0001
Not owning home	329 (38·5%)	2725 (54·4%)	<0·0001	2229 (15·8%)	<0·0001	2722 (17·1%)	<0·0001
Living with child aged <6 years	158 (9·0%)	1818 (25·7%)	<0·0001	7954 (37·3%)	<0·0001	9020 (35·7%)	<0·0001
Living with child aged 6–11 years	431 (32·4%)	2327 (39·0%)	0·02	7291 (38·3%)	0·02	8450 (38·9%)	0·009
Household size (≥3 people)	367 (46·3%)	2244 (53·8%)	0·02	16341 (100%)	..	18 688 (100%)	..
Lifestyle factors							
Current smoker	366 (35·0%)	1965 (36·4%)	0·64	4170 (24·1%)	<0·0001	3656 (16·6%)	<0·0001
Fruit and vegetable consumption (<3 times per day)	321 (34·4%)	1317 (27·9%)	0·02	4581 (26·7%)	0·003	3131 (16·4%)	<0·0001
Physical inactivity (<1·5 kcal/kg per day)	389 (41·5%)	2307 (54·5%)	<0·0001	7666 (50·6%)	0·001	9362 (54·0%)	<0·0001
Obese (BMI ≥30 kg/m²)	148 (18·7%)	821 (15·5%)	0·33	3486 (19·4%)	0·78	2988 (14·5%)	0·12
Monthly binge drinking*	279 (30·2%)	668 (10·5%)	<0·0001	4492 (23·3%)	0·005	1421 (6·7%)	<0·0001
Chronic conditions							
Cancer	17 (4·7%)	67 (1·6%)	0·02	207 (1·3%)	0·004	289 (2·0%)	0·05
Cardiovascular disease	16 (1·6%)	7 (0·1%)	<0·0001	155 (1·4%)	0·61	42 (0·3%)	<0·0001
Respiratory conditions	103 (13·2%)	812 (17·2%)	0·11	1541 (9·9%)	0·07	2426 (12·8%)	0·82
Diabetes	37 (3·3%)	169 (5·7%)	0·06	665 (5·5%)	0·02	576 (4·2%)	0·33
Hypertension	125 (16·7%)	408 (12·4%)	0·05	2121 (15·9%)	0·70	1473 (9·8%)	<0·0001
Health service use in past year							
Any outpatient visit	692 (80·7%)	4246 (92·7%)	<0·0001	12722 (79·8%)	0·68	16 950 (91·0%)	<0·0001
Any emergency department visit	208 (22·1%)	1472 (25·7%)	0·19	3372 (16·5%)	0·009	4092 (18·2%)	0·07
Any hospital admissions	27 (3·9%)	426 (7·0%)	0·07	363 (2·0%)	0·03	2419 (10·1%)	0·002
Social support							
Weak sense of belonging†	317 (37·0%)	1724 (39·9%)	0·30	4972 (32·0%)	0·08	5536 (31·4%)	0·05

Percentages were weighted by the sample weight and bootstrap methods were used to estimate p values. Single mothers, partnered mothers, and partnered fathers were compared with single fathers (reference group). BMI=body-mass index. *Consuming five or more alcoholic drinks in a sitting once or more a month. †Somewhat weak or very weak versus very strong or somewhat strong (reference group).

Table 1: **Baseline characteristics of single fathers, single mothers, and partnered fathers**

respiratory conditions, hypertension, and diabetes) using previously validated algorithms,[15–20] health-service use data (outpatient visits, emergency department visits, and hospital admissions in the past year), and cancer registries.

Statistical analysis

We compared the baseline characteristics of single fathers with partnered fathers and single and partnered mothers and using χ^2 tests. We assessed continuous variables using one-way ANOVA for means and SDs and Kruskal-Wallis test for the median and IQR. We included individuals living in Ontario and excluded those who left Ontario during the study period or had data discrepancies (eg, date of death earlier than survey date). Respondents were followed up from the date of the survey and censored at loss of provincial health coverage, which would censor those who emigrated out of the province, or end of study (Oct 28, 2016). We initially ran a model with an interaction term for single parent status and sex, which was found to be statistically significant (p=0·02), confirming that sex was an effect modifier. We then estimated mortality for single and partnered fathers and mothers and produced unadjusted cumulative incidence curves, which were compared using pairwise log-rank tests. We used Cox proportional hazards models to examine the association between single parenthood and mortality. For multivariable, adjusted hazards models, we added covariates sequentially in the following blocks: sociodemographics (age, urban dwelling, marital status, ethnicity, and education), psychosocial stressors (household income, employment, home ownership, living with child younger than 6 years, living with child aged 6–11 years, and household size), lifestyle factors (smoking status, fruit and vegetable consumption, physical inactivity, body-mass index, and monthly binge drinking), chronic conditions (cardiovascular, cancer, respiratory conditions, hypertension, and diabetes), health-service use in the past year (any outpatient visit, emergency department visit, and hospital admission), and sense of belonging. All covariates were retained in the adjusted model on the basis of their clinical significance, irrespective of statistical significance. We also created cumulative incidence curves adjusted for all covariates using the group prognosis method.[21] To ensure that findings were generalisable to the population of Ontario, all estimates were weighted by the sample weights provided by Statistics Canada and bootstrap methods using 500 bootstrap weights were used to calculate 95% CIs and p values.

To ensure that we adequately adjusted for age, we controlled for this variable in two ways: as a linear term in the main analysis, and as a restricted cubic spline with three knots to account for the potential non-linear relationship between age and death in a sensitivity analysis.[22] Most covariates had up to 1% missing with the exception of household income, which had at most 11% missing; missing values were excluded from analyses. As a sensitivity analysis, we adjusted the fully adjusted models for household income with imputed values derived with multiple imputations based on all covariates in the study, using SAS procedure PROC MI with a default of five imputed datasets.[23] We regarded p<0·05 as significant, and did not adjust for multiple testing. Statistical analyses were done in SAS (version 9.3).

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. CL had full access to all the data in the study and the corresponding author had final responsibility for the decision to submit for publication.

Results

The pooled CCHS cycles had a total of 200 922 respondents, of which 40 521 were single or partnered parents. We excluded six individuals because of data discrepancies and 25 individuals who were ineligible for provincial health care, resulting in our study population of 871 single fathers, 4590 single mothers, 16 341 partnered fathers, and 18 688 partnered mothers. Single fathers were significantly older than single mothers, partnered fathers, and partnered mothers and were more likely to be separated, divorced, or widowed than single mothers (table 1). Single fathers had significantly lower income and were more likely to be unemployed in the past year than partnered fathers, but not single mothers. Single fathers were more likely to be white, had lower fruit and vegetable consumption, and were more likely to monthly binge drink than single mothers and partnered fathers

	n	Number of deaths	Mortality per 1000 person-years (95% CIs)	Mortality rate ratio (*vs* partnered counterparts)	Mortality rate ratio (*vs* single mothers)
Single fathers	871	35	5·81 (3·21–8·99)	2·99	3·34
Partnered fathers	16 341	345	1·94 (1·67–2·26)	..	..
Single mothers	4590	85	1·74 (1·23–2·41)	1·46	..
Partnered mothers	18 688	228	1·19 (0·97–1·44)	..	..

Data are from Canadian Community Health Survey years 2001–12, respondents were followed up for a median of 11·10 years (IQR 7·36–13·54). All estimates are weighted by the survey weights and 95% CIs were estimated using bootstrap methods.

Table 2: **Mortality for single fathers, single mothers, partnered fathers, and partnered mothers**

and mothers. At baseline, cancer was more prevalent in single fathers than in the other three study groups and cardiovascular diseases were more prevalent in single fathers than single mothers and partnered mothers. A greater proportion of single fathers had an emergency department visit and hospital admission in the past year than partnered fathers (table 1).

Each group was followed up for a maximum of 15 years, totalling 425 073 person-years. Median follow-up was 11·10 years (IQR 7·36–13·54) and was similar across the four exposure groups, as was the degree of censoring. Partnered mothers had the lowest mortality, followed by similar rates between single mothers and partnered fathers, and single fathers had the highest mortality (5·81 per 1000 person-years), three-times greater than single mothers and partnered fathers (table 2, figure 1). This higher rate corresponded to unadjusted hazard ratios [HRs] of 3·34 (95% CI 1·78–6·25) versus single mothers, and 3·02 (1·75–5·24) versus partnered fathers (figure 2, appendix).

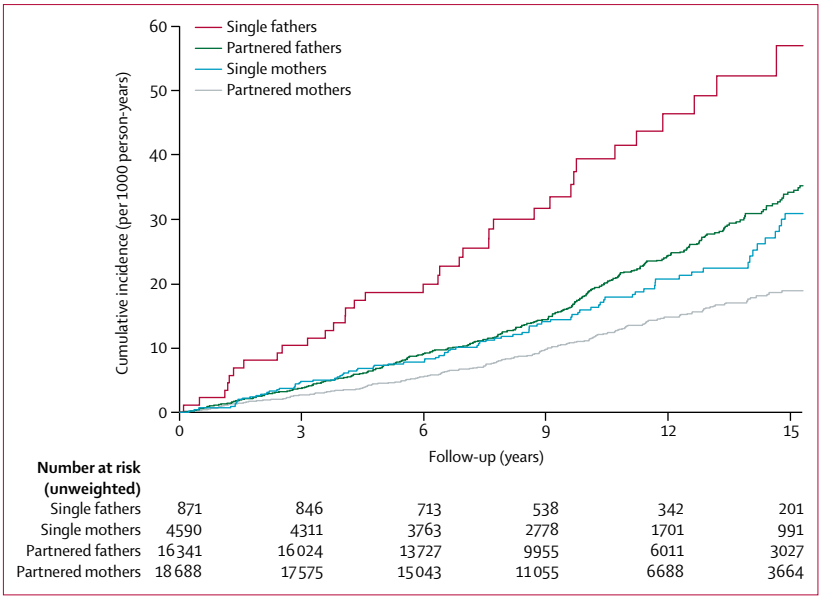
The HRs decreased, but remained significant after adjustment for age and other sociodemographic characteristics, stressors, lifestyle factors, chronic conditions, health-service use, and sense of belonging (HR 2·49, 95% CI 1·20–5·15; p=0·01 for single fathers *vs* single mothers, and 2·06, 1·11–3·83; p=0·02 for single fathers *vs* partnered fathers; figures 2, 3, appendix). Incidence of death was more similar between single and partnered mothers than between single and partnered fathers (figure 3).

Neoplasms were the leading cause of death in partnered parents, whereas the most likely cause of death was "other causes" (most of which were listed as unknown in the Vital Statistics Death Database) followed by neoplasms in single parents (appendix). External causes of injury and poisoning were also substantial contributors to mortality among single mothers. Low numbers of deaths resulted in wide, overlapping confidence intervals, and categories with fewer than six deaths were not reported (to reduce risk of deanonymisation) precluding further categorisation of other causes of death (appendix).

HRs for single fathers remained consistently elevated after adjustment for age using restricted cubic splines (HR 2·48, 95% CI 1·19–5·18, p=0·02 compared with single mothers, and 2·06, 1·11–3·82, p=0·02 compared with partnered fathers; appendix). The results were similar to the main analysis after adjustment for the imputed household income values, irrespective of whether age was included as a linear term or restricted cubic splines. We also ran the final model with 20 imputations, which produced similar results as those run with five imputed datasets (appendix).

Discussion

In this population-based study of single and partnered parents followed up for a median of 11 years, we found that single fathers had several risk factors that were



Number at risk (unweighted)						
Single fathers	871	846	713	538	342	201
Single mothers	4590	4311	3763	2778	1701	991
Partnered fathers	16 341	16 024	13 727	9955	6011	3027
Partnered mothers	18 688	17 575	15 043	11 055	6688	3664

Figure 1: **Unadjusted cumulative incidence of death in single fathers, single mothers, partnered fathers, and partnered mothers**
Single fathers *vs* partnered fathers: HR 3·02 (95% CI 1·75–5·24; p<0·0001; $p_{log\text{-}rank}$=0·0006). Single fathers *vs* single mothers: 3·34 (1·78–6·25; p=0·0002; $p_{log\text{-}rank}$=0·0008). Single fathers *vs* partnered mothers: 4·94 (2·82–8·67; p<0·0001; $p_{log\text{-}rank}$<0·0001).

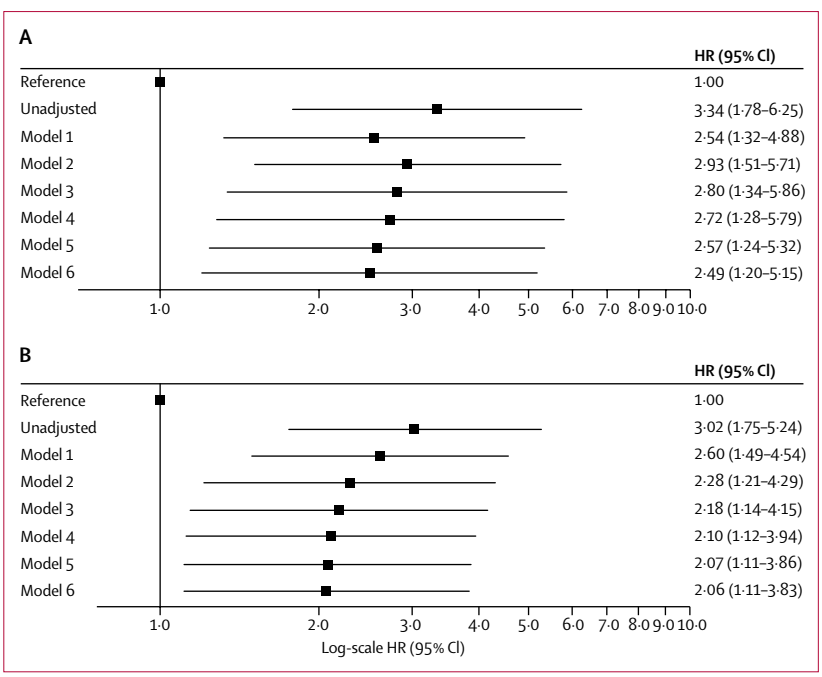
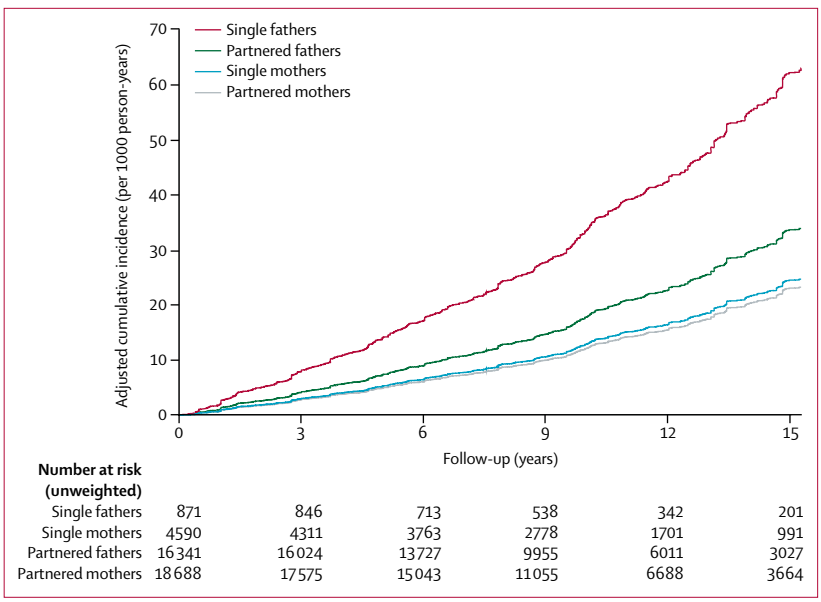


Figure 2: **HRs for mortality of single fathers *vs* single mothers and partnered fathers**
(A) Single fathers *vs* single mothers. (B) Single fathers *vs* partnered fathers. Model 1 adjusted for sociodemographics (age, urban dwelling, marital status, ethnicity, and education). Model 2 adjusted for model 1 covariates and stressors (household income, employment, home ownership, living with child younger than 6 years, living with child aged 6–11 years, and household size). Model 3 adjusted for model 2 covariates and lifestyle factors (smoking status, fruit and vegetable consumption, physical inactivity, body-mass index, and monthly binge drinking). Model 4 adjusted for model 3 covariates and medical comorbidities at baseline (cardiovascular, cancer, respiratory conditions, hypertension, and diabetes). Model 5 adjusted for model 4 and health-service use in the past year (any outpatient visit, emergency department visit, or hospital admission). Model 6 adjusted for model 5 and sense of belonging. HR=hazard ratio.



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Partnered mothers	18 688	17 575	15 043	11 055	6688	3664

***Figure 3*: Adjusted cumulative incidence of death in single fathers, single mothers, partnered fathers, and partnered mothers using group prognosis method**

Single fathers *vs* partnered fathers: HR 2·06 (95% CI 1·11–3·83; p=0·02). Single fathers *vs* single mothers: 2·49 (1·20–5·15; p=0·01). Single fathers *vs* partnered mothers: 2·71 (1·33–5·54; p=0·006). Cox proportional hazards models were adjusted for the following: model 1 adjusted for sociodemographics (age, urban dwelling, marital status, ethnicity, and education); model 2 adjusted for model 1 covariates and stressors (household income, employment, home ownership, living with child younger than 6 years, living with child aged 6–11 years, and household size); model 3 adjusted for model 2 covariates and lifestyle factors (smoking status, fruit and vegetable consumption, physical inactivity, body-mass index, and monthly binge drinking); model 4 adjusted for model 3 covariates and medical comorbidities at baseline (cardiovascular, cancer, respiratory conditions, hypertension, and diabetes); model 5 adjusted for model 4 and health-service use in the past year (any outpatient visit, emergency department visit, or hospital admission); model 6 adjusted for model 5 and sense of belonging. HR=hazard ratio. ref=reference.

See Online for appendix

associated with premature mortality, including lower fruit and vegetable consumption and greater monthly binge drinking. Single fathers had by far the highest mortality and after adjustment for age, other sociodemographic factors, stressors, lifestyle, chronic conditions, health-service use, and sense of belonging, the risk of mortality remained significantly higher than both single mothers and partnered fathers.

To our knowledge, only one earlier study[11] by Ringbäck Weitoft and colleagues using Swedish national register and census data has assessed the risk of mortality in single fathers. Findings from the study,[11] which analysed mortality data from 1991–2000, showed that single fathers had a significant 30% higher risk of mortality than cohabiting fathers after controlling for health selection effects (eg, previous inpatient history) and socioeconomic circumstances. Although both our study and the study from Sweden showed an elevated risk in single fathers compared with partnered fathers, the difference in the effect sizes might be explained by the different populations and settings and the use of more contemporary data and longer follow-up in our study. No previous study has directly compared mortality risk in single fathers and single or partnered mothers. Our mortality estimates in both single and partnered mothers, however, are similar to those observed in previous population-based research.[7,8,10] Similar to our study showing that single mothers had a higher mortality for external causes of injury and poisoning compared with partnered mothers, Ringbäck Weitoft and colleagues[8] found that single mothers were at highest risk of death from injuries and poisoning than any other causes of death compared with partnered mothers. Only one previous study[11] has examined cause of death in single fathers; this study showed that long-term lone custodial fathers were at the highest risk of death from ischaemic heart disease and traffic injury compared with other lone and cohabiting males. Given the different definitions for causes of death and single and partnered fathers, we were unable to make direct comparisons with our findings and those from the earlier study.

Studies on social support in the single father population are scarce. However, research has shown that single fathers are significantly less likely to have relationships and connections within and between social networks that could help to enhance their health, productivity, and wellbeing in society.[24] Having fewer trusted companions to rely on and confide in could have a substantial effect on the risk of mortality in single fathers. Growing evidence in the medical literature suggests that loneliness and social isolation are important risk factors for early death and could be just as important as smoking and obesity in predicting premature mortality.[25,26] Loneliness has also been associated with disrupted sleep patterns, higher levels of stress hormones, altered immune system, accelerated cognitive decline, and increased risk of heart disease.[25–28] Nevertheless, further research is needed to establish a causal relationship between loneliness and premature mortality. Furthermore, given that there are more single mothers than fathers,[4] support (eg, financial assistance, educational grants, and support groups) is more commonly available for single mothers and structural barriers, either real or perceived, might prevent men from accessing these community services. Other potential explanations for why single fathers fare worse than single mothers could be sex differences in occupational choices and the underuse of safety nets, such as social assistance and child support,[11,29–31] which warrant future investigation.

Additionally, differences in the pathways into single parenthood for men and women might affect social risk and protective factors (eg, stress exposure and coping resources), resulting in differing health effects. For example, common pathways into single parenthood include divorce and separation.[32] However, in our study, spousal bereavement was more common in single fathers than in single mothers, which could add sources of stress such as grief to their experiences.[33] Although incomes of single fathers are higher than those of single mothers, largely due to higher rates of employment in men than women,[34] the dual burden of working and being primary caregiver puts increased stress on men,

who traditionally do not find themselves in sole-parenting roles and might find it difficult to cope.[35] Furthermore, parental conflict after separation worsens parental and child health.[36] As such, children typically reside with their mothers after divorce or separation, so paternal custody might be an indicator of mental health and social functioning issues among the mother, which can further complicate matters and distress the single father.

Marriage has long been shown to have a protective effect on men's health and social behaviours, in that married men are less likely to engage in risky activities and behaviours, such as risky driving and sexual behaviour, cigarette smoking, poor diet, alcohol consumption, and drug use, or delay seeking help.[37,38] Differences in access to care might also explain the disadvantage observed in single fathers compared with single mothers. Although Ontario has the benefit of a universal health-care system, men are less likely to seek care than women.[39] Research has shown that men have poorer engagement with primary care and substantially fewer consultations with general practitioners than women. Specifically, lower awareness of symptoms, behavioural paradigms related to masculinity, and a general reluctance to access services could make men unwilling to overcome practical barriers to accessing health services, such as unpredictable waiting times and absence of extended clinic opening hours.[40] Nevertheless, our study found that single fathers were more likely to have health-care encounters than partnered fathers. These encounters are opportunities for physicians to learn more about the social and life circumstances of this high-risk group and assess patients' social environments.[41] A common dilemma experienced by doctors is the constraint on time spent talking with patients and the need to better understand the personal circumstances experienced by the patient. Research has shown that high-quality time spent talking to the patient and collecting information (eg, social histories) can help motivate patients to adhere to treatment plans, make better decisions about their health, and influence their behaviour and recovery.[42] A detailed social history could allow physicians to ask about single fathers' lifestyles and give advice on behavioural and lifestyle changes. Standard social history questions taught to medical students and implemented within daily health-care routines, such as "What do you do for a living?", "Are you single or married?", "Do you have children?", and "Do you smoke or drink?" could promote the development of tailored strategies and help to identify struggling single fathers.

To our knowledge, this study is the first to compare the risk of mortality in single fathers with that of single mothers and partnered fathers. The use of survey and health administrative data collected under Ontario's single-payer health-care system allowed us to study the profile of single fathers and follow up individuals longitudinally for up to 15 years to assess mortality, while adjusting for a comprehensive list of social, demographic, lifestyle, behavioural, chronic conditions, and health-service factors. Our survey sample of single and partnered parents was also representative of the census population.[4]

This study has some limitations. First, we did not have information about the length of time individuals were single or partnered parents; however, there is no reason to believe that the arbitrary survey date created any differential bias between the single fathers and the reference groups. Second, some baseline data such as smoking, monthly binge drinking, and fruit and vegetable consumption were self-reported; however, we used administrative databases where possible to ascertain factors such as baseline chronic medical conditions and health-service use. Third, we had information only about the exposure and covariates at baseline and we were not able to track changes over time. Fourth, although our analysis adjusted for key risk factors, such as smoking, fruit and vegetable consumption, and monthly binge drinking, there might be nuances in the lifestyle and behavioural profile of single fathers (eg, pack-years of cigarettes smoked, other dimensions of social support, occupational type, other measures of alcohol consumption to adequately capture differences in exposure to alcohol across groups, or other risky behaviours) that the study was not able to capture. Fifth, we relied on the survey definitions of single parents and children in a given household. The CCHS survey defines a single parent as someone who is divorced, separated, widowed, or single and never married, but some single parents are separated and still married. Similarly, 25 years is a high age cutoff for the definition of children in the household. Sixth, given the low number of deaths in our study, there is uncertainty as to the degree of the increase in mortality risk in single fathers compared with the other groups, as well as our interpretation of cause-specific death. Further research is needed to understand the causes of death and the causal pathways between single fatherhood and death, including when all study participants are healthy at cohort inception. Future research should also investigate different living arrangements, because improved health outcomes in parents and children have been shown when children spend time equally between separated parents.[43]

In conclusion, in this population-based study comparing single fathers to single mothers and partnered fathers, we found that single fathers had a poor profile of behavioural and lifestyle risk factors and the highest mortality, which was only partly explained by sociodemographic and lifestyle factors. Our study highlights that single fathers, a growing demographic that is largely neglected, represent a particularly high-risk group in terms of mortality. Given the trend towards patient-centred care and a growing recognition of the effect of social isolation and loneliness on premature death, close monitoring of risk factors in single fathers could provide physicians with opportunities to better

manage lifestyle and behavioural factors and intervene in a timely manner. Further work is needed to understand the causes of the increased mortality in single fathers and initiatives that might help support and mitigate risk.

Contributors

MC was the principal investigator and was responsible for the study concept and design, drafting of the manuscript, administrative, technical, or material support and study supervision. FR was responsible for drafting the manuscript and administrative, technical, or material support. CL had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. All authors were responsible for the acquisition, analysis, and interpretation of the data and for critical revision of the manuscript for important intellectual content.

Declaration of interests

We declare no competing interests.

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