Mortality among residents of shelters, rooming houses, and hotels in Canada: 11 year follow-up study

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ABSTRACT

Objective To examine mortality in a representative nationwide sample of homeless and marginally housed people living in shelters, rooming houses, and hotels.

Design Follow-up study.

Setting Canada 1991-2001.

Participants 15 100 homeless and marginally housed people enumerated in 1991 census.

Main outcome measures Age specific and age standardised mortality rates, remaining life expectancies at age 25, and probabilities of survival from age 25 to 75.

Data were compared with data from the poorest and richest income fifths as well as with data for the entire cohort.

Results Of the homeless and marginally housed people, 3280 died. Mortality rates among these people were substantially higher than rates in the poorest income fifth, with the highest rate ratios seen at younger ages. Among those who were homeless or marginally housed, the probability of survival to age 75 was 32% (95% confidence interval 30% to 34%) in men and 60% (56% to 63%) in women. Remaining life expectancy at age 25 was 42 years (42 to 43) and 52 years (50 to 53), respectively. Compared with the entire cohort, mortality rate ratios for men and women, respectively, were 11.5 (8.8 to 15.0) and 9.2 (5.5 to 15.2) for drug related deaths, 6.4 (5.3 to 7.7) and 8.2 (5.0 to 13.4) for alcohol related deaths, 4.8 (3.9 to 5.9) and 3.8 (2.7 to 5.4) for mental disorders, and 2.3 (1.8 to 3.1) and 5.6 (3.2 to 9.6) for suicide. For both sexes, the largest differences in mortality rates were for smoking related diseases, ischaemic heart disease, and respiratory diseases.

Conclusions Living in shelters, rooming houses, and hotels is associated with much higher mortality than expected on the basis of low income alone. Reducing the excessively high rates of premature mortality in this population would require interventions to address deaths related to smoking, alcohol, and drugs, and mental disorders and suicide, among other causes.

INTRODUCTION

Many studies have shown that low socioeconomic status, as measured by income, education, or occupation, is strongly associated with higher mortality.12 These differences are believed to exist, at least in part, because income, education, and occupation are markers for the material conditions of everyday life. Another such marker might be the type of housing in which a person lives. At the extreme end of the spectrum are homeless people sleeping rough on the street. More often, homeless people live in shelters, hostels, and missions.3 Somewhat less disadvantaged individuals, who are sometimes referred to as being “marginally housed,” might live in low cost collective dwellings such as YMCA/YWCA facilities, rooming and lodging houses, and single room occupancy hotels, where each resident has a bedroom and shared access to bathroom facilities.13 Individuals with limited housing options might also live in motels, sometimes with rent subsidised by welfare agencies. These housing situations can be important indicators of socioeconomic deprivation beyond that which can be determined on the basis of income alone.

Previous research on mortality among individuals living in settings consistent with severe disadvantage has focused primarily on homeless people. These studies have found high levels of excess mortality among the homeless compared with the general population. Most of these studies have been limited to homeless people sleeping rough on the street. Other markers of disadvantage, such as living in shelters, rooming houses, and hotels, are sometimes referred to as being “marginally housed.” Few studies have focused primarily on homeless people or on mortality rates among those who are marginally housed and living in shelters compared with those who are marginally housed and living in other categories of collective dwellings.

Our main goal was to determine age and sex specific mortality rates, causes of death, and probabilities of survival to various ages in a representative nationwide sample of homeless and marginally housed people living in shelters, rooming houses, and hotels in Canada.
research, which included a narrow set of comparison groups—typically only the general population, we also compared mortality rates among various categories of homeless and marginally housed people with rates in people in the poorest and richest fifths of income of the general population. By using these comparison groups, we sought to detect excess mortality associated with homelessness and marginal housing beyond that associated with low income alone.

**METHODS**

We used data from the Canadian census mortality follow-up study, which tracked mortality in a 15% sample of the adult population of Canada.17 People were eligible for the study cohort if they were aged 25 or older and a usual resident of Canada on the day of the census (4 June 1991), were not a long term resident of an institution such as a prison, hospital, or nursing home, and had been selected for census enumeration with a detailed “long form” questionnaire. About 3.6 million people met these criteria. The long form questionnaire was administered to one in five private households and to all people living in non-institutional collective dwellings, including the following types of collective dwellings serving homeless and marginally housed individuals: shelters and hostels for the homeless, missions, and YMCA/YWCA facilities (“shelters”); rooming and lodging houses (“rooming houses”); and hotels, motels, and tourist homes (“hotels”).

**Table 1** Census respondents, study cohort, linkage rate, deaths ascertained, and person years at risk, non-institutional population aged 25 and over at baseline, 1991*

| Sex and category | Census respondents | Study cohort | Linkage rate (%) | No of deaths | Person years at risk |
|------------------|--------------------|--------------|------------------|--------------|---------------------|
| **Both sexes**   |                    |              |                  |              |                     |
| Entire cohort    | 3 576 500          | 2 735 200    | 76               | 260 820      | 27 618 420          |
| Shelters, rooming houses, hotels | 41 800     | 15 100 | 36 | 3280 | 141 660 |
| Shelters | 5 700 | 1500 | 26 | 338 | 14 130 |
| Rooming houses | 19 200 | 7800 | 41 | 1864 | 72 380 |
| Hotels | 16 900 | 5800 | 34 | 1078 | 55 150 |
| Poorest income fifth | 715 400 | 470 400 | 66 | 75 229 | 4 589 150 |
| Richest income fifth | 715 100 | 587 400 | 82 | 36 593 | 6 033 060 |
| **Men**          |                    |              |                  |              |                     |
| Entire cohort    | 1 738 000          | 1 358 400    | 78               | 153 552      | 13 580 340          |
| Shelters, rooming houses, hotels | 29 700     | 10 500 | 35 | 2359 | 97 690 |
| Shelters | 3900 | 900 | 23 | 219 | 8 390 |
| Rooming houses | 13 500 | 5500 | 40 | 1267 | 50 670 |
| Hotels | 12 300 | 4100 | 33 | 873 | 38 640 |
| Poorest income fifth | 306 000 | 197 300 | 64 | 35 839 | 1 895 900 |
| Richest income fifth | 372 300 | 309 900 | 83 | 23 638 | 3 161 140 |
| **Women**        |                    |              |                  |              |                     |
| Entire cohort    | 1 838 500          | 1 376 800    | 75               | 107 268      | 14 038 080          |
| Shelters, rooming houses, hotels | 12 100     | 4600 | 38 | 921 | 43 970 |
| Shelters | 1800 | 600 | 33 | 119 | 5 750 |
| Rooming houses | 5700 | 2400 | 42 | 597 | 21 710 |
| Hotels | 4600 | 1700 | 36 | 205 | 16 510 |
| Poorest income fifth | 409 400 | 273 000 | 67 | 39 390 | 2 693 250 |
| Richest income fifth | 342 700 | 277 500 | 81 | 12 955 | 2 871 930 |

*Census population counts rounded to nearest 100. Percentages calculated before rounding. Person years at risk rounded to nearest 10.
purposes of brevity, we use the term “shelters, rooming houses, and hotels” to refer to these three categories of collective dwellings. For the 1991 census, no attempt was made to enumerate homeless people sleeping outside, and these individuals were not included in this study.

The electronic 1991 census database did not contain names, which were needed for ascertainment of mortality. To obtain names, census records were linked to tax filer data from 1990 and 1991 with probabilistic matching on the basis of dates of birth and postal codes of the individual and his or her spouse or common law partner (if any), as previously described. Deaths in the cohort were ascertained by linkage of census records to the Canadian mortality database with probabilistic methods described elsewhere. Ascertainment of deaths in the cohort followed for mortality was estimated to be about 97%. Deaths in the cohort were ascertained by linkage of census records to the Canadian mortality database with probabilistic methods described elsewhere. Corresponding 95% confidence intervals for age standardised mortality rates were calculated by using previously described methods.

Data obtained from the 1991 census long form included marital status, education, occupation, income, ethnic origins, Aboriginal status, place of birth, place of residence, and self reported limitation in activity. Data obtained from the Canadian mortality database included date of death and underlying cause of death. Cause of death was coded according to ICD-9 (international classification of diseases, ninth revision) for deaths occurring in 1991-9 and ICD-10 (10th revision) for deaths occurring in 2000-1. Causes of death were grouped by ICD-9 chapter, categories within chapters, and by risk factors (smoking related, alcohol related, drug related, or amenable to medical intervention) (see appendix A on bmj.com).

To construct income adequacy fifths, we determined the total pre-tax income from all sources for each household or unattached individual. For each applicable family size and community size group we calculated the ratio of total income to the 1991 low income cut-off from Statistics Canada. The population was then ranked according to this ratio, and income fifths were determined within each census metropolitan area, census agglomeration, or rural area.

For each member of the cohort, we calculated person days of follow-up from the day of the census (4 June 1991) to the date of death or the last day of the study period (31 December 2001). Person days of follow-up were divided by 365.25 to obtain person years at risk. We used mortality rates specific for age, sex, income fifth, and collective dwelling by five year age groups to calculate age standardised mortality rates, using the cohort population structure (person years at risk), both sexes together, as the standard population. Corresponding 95% confidence intervals for age standardised mortality rates were calculated by using previously described methods.

Table 2: Demographic and socioeconomic characteristics of entire cohort, cohort members living in shelters, rooming houses, and hotels, and all census respondents living in shelters, rooming houses, and hotels, by sex, at baseline, 1991. Figures are column percentages unless stated otherwise.

| Category                  | Men       | Women     |
|---------------------------|-----------|-----------|
| No of people              |           |           |
| Entire study cohort       | 1 358 400 | 1 376 800 |
| Cohort members in shelters, etc | 10 500   | 4600      |
| All census respondents in shelters, etc | 29 700   | 12 100    |
| Age 25-44                 | 53        | 56        |
| Age 45-64                 | 32        | 28        |
| Age ≥65                   | 15        | 16        |
| Married or common law     | 79        | 69        |
| Education less than high school graduation | 35        | 35        |
| Employed (any occupation) | 72        | 58        |
| Poorest two income adequacy fifths | 34        | 21        |
| Major source of income from government transfers | 16        | 21        |
| Visible minority          | 7         | 8         |
| Aboriginal                | 4         | 4         |
| Born outside Canada       | 21        | 21        |
| Any activity limitation   | 11        | 10        |

Fig 2: Probability of survival for men and women conditional on survival to age 25.
Mortality rate ratios and rate differences were used to compare age standardised mortality rates for those living in shelters, rooming houses, and hotels with those in the poorest income fifth, the richest income fifth, and the entire cohort. Mortality rate ratios and rate differences were also calculated separately for each of the subcategories of shelters, rooming houses, and hotels compared with the entire cohort.

We used the actuarial method\textsuperscript{23} to calculate life tables for each sex and income fifth and for different housing categories after transforming age from age at baseline to age at the beginning of each year of follow-up. Deaths and person years at risk were calculated separately for each year or partial year of follow-up, before the calculation of the life tables. Life tables were used to construct survival curves and to determine probability of survival to age 75, contingent on survival to age 25.

**RESULTS**

Table 1 shows the linkage rate for residents of shelters, rooming houses, and hotels combined and for each category separately. In total, 36% of the population living in those types of collective dwellings were successfully matched to the name file, resulting in 15 100 cohort members followed for mortality, of whom 3280 had died by the end of the follow-up period, during 141 660 person years at risk. Among the three categories of non-institutional collective dwellings studied, rooming houses had the highest linkage rate (41%) and shelters had the lowest linkage rate (26%).

Table 2 shows, despite the lower linkage rates, the demographic and socioeconomic profile of cohort members living in shelters, rooming houses, and hotels was similar to that of all the census respondents living in those types of collective dwellings. Table 2 also compares the baseline characteristics of cohort members living in shelters, rooming houses, and hotels with the entire cohort. For cohort members living in shelters, rooming houses, and hotels compared with the entire cohort, in the poorest income fifth, the richest income fifth, and the entire cohort, men were somewhat more likely to be middle aged (45-64), while women were more likely to be older (≥65). Compared with the entire cohort, both men and women, those living in shelters, rooming houses, and hotels were far less likely to have been married and were less likely to have completed a high school education or to have been born outside Canada. As expected, the income distribution of those residing in shelters, rooming houses, and hotels in 1991 differed from the entire cohort. In the entire cohort, only 34% of men and 39% of women were in the poorest two fifths, while among those living in shelters, rooming houses, and hotels the corresponding figures were 80% and 82%. In the entire cohort, 72% of men and 58% of women were employed compared with 43% of men and 45% of women living in shelters, rooming houses, and hotels.

Table 3 presents age standardised mortality rates per 100 000 person years at risk for the entire cohort, poorest and richest income fifths, and those living in shelters, rooming houses, and hotels.
women exceeding 5 at ages 25-34 and well over 4 at ages 35-44. Even when compared with the poorest income fifth, rate ratios were 2 or more at those ages for both men and women. In all comparisons, rate ratios converged toward 1 at ages 75 and over.

Figure 2 shows the probability of survival to various ages (conditional on survival to age 25) for men and women in the entire cohort, the poorest and richest income fifths, and those living in shelters, rooming houses, and hotels. For both men and women, the survival curves were considerably more rectangular for the richest fifth and for the entire cohort compared with the poorest fifth or with those living in shelters, rooming houses, and hotels, reflecting a more favourable mortality pattern.

Figure 3 shows the probabilities of survival to age 75 obtained from the life table analyses. Men living in shelters, rooming houses, and hotels had the lowest probability of survival to age 75 (32.1%, 95% confidence interval 30.2% to 33.9%). This was 19 percentage points lower than the probability of survival to age 75 for the poorest fifth (50.6%, 50.1% to 51.1%) and 40 percentage points lower than for the richest fifth (72.4%, 72.0% to 72.8%). For women, the differences between the groups were notably smaller. For women living in shelters, rooming houses, and hotels, the probability of survival to age 75 (59.6%, 56.0% to 63.1%) was 12 percentage points less than for the poorest fifth (71.5%, 71.0 to 71.9), and 24 percentage points less than for the richest income fifth (83.8%, 83.4% to 84.4%).

Table 4 shows life expectancy at age 25. The results are presented for the same four groups plus the three subcategories of the shelter, rooming house, and hotel population. For both men and women, remaining life expectancy was much lower for the combined category of shelters, rooming houses, and hotels compared with the richest income fifth, the entire cohort, or the poorest income fifth. Among the subcategories, it was lowest for people living in shelters and rooming houses, followed by people living in hotels.

For men, remaining life expectancy in the combined shelter, rooming house, and hotel category (42.3 years, 41.6 to 42.9) was 10 years lower than in the entire cohort, 13 years lower than in the richest income fifth, and six years lower than in the poorest income fifth. For men in the subcategory of shelters, remaining life expectancy (39.2 years, 37.0 to 41.5) was another three years lower than for the combined category. For women, remaining life expectancy in the combined shelter, rooming house, and hotel category (51.6 years, 50.4 to 52.7) was seven years lower than in the entire cohort, nine years lower than in the richest income fifth, and five years lower than in the poorest income fifth. For women in the subcategory of rooming houses, remaining life expectancy (49.7 years, 48.0 to 51.4) was another two years lower than for the combined category.

We also analysed cause specific mortality. Age standardised mortality rates for the total cohort, the poorest and richest income fifths, and those living in shelters, rooming houses, and hotels in 1991 are presented in appendix C (on bmj.com), while tables 5 (men) and 6 (women) and figure 4 show the rate ratios and rate differences for the entire cohort compared with those living in shelters, rooming houses, and hotels. Compared with the entire cohort, rate ratios for both sexes were higher for mental disorders (4.8 and 3.8 for men and women, respectively), cirrhosis of the liver (3.7 and 5.6), and external causes of death (3.3 and 3.7). Among the external causes, rate ratios for men were particularly higher for homicide (11.3) and poisoning (10.3), while rate ratios for women were highest for suicide (5.6) and all other external causes of death (4.2). For men, the rate ratio was also higher for deaths caused by diseases of the blood and blood forming organs (4.6). For both men and women, rate ratios were higher for deaths related to drugs (11.5 and 9.2, respectively) and alcohol (6.4 and 8.2). For both men and women, the largest rate differences (per
### Mortality rates and rate differences* (per 100 000 person years at risk), by major causes of death, comparing men living in shelters, rooming houses, and hotels† with men in entire cohort, Canada, 1991-2001

| Cause                                      | Rate (95% CI) | Difference (95% CI) |
|--------------------------------------------|---------------|---------------------|
| Total, all causes of death                 | 2.01 (1.92 to 2.09) | 1237.8 (1134.6 to 1341.0) |
| Infectious diseases                        | 2.80 (2.07 to 3.78) | 30.8 (16.3 to 45.3) |
| Cancer                                     | 1.56 (1.44 to 1.70) | 219.1 (168.9 to 269.4) |
| Trachea, bronchus, and lung                | 1.91 (1.67 to 2.18) | 107.2 (77.2 to 137.3) |
| Intestine and rectum                       | 1.39 (1.08 to 1.78) | 18.7 (1.8 to 35.7) |
| Oesophagus and stomach                     | 1.22 (0.86 to 1.74) | 5.7 (-5.4 to 16.7) |
| Pancreas                                   | 1.19 (0.75 to 1.86) | 3.4 (-6.3 to 13.1) |
| Prostate                                   | 0.95 (0.69 to 1.31) | -2.5 (-17.3 to 12.3) |
| Urinary system                             | 1.27 (0.85 to 1.90) | 5.9 (-5.2 to 17.0) |
| Lymphatic tissue and leukaemia             | 0.90 (0.62 to 1.31) | -3.6 (-15.7 to 8.5) |
| Other cancer                               | 2.18 (1.86 to 2.55) | 85.9 (60.8 to 111.0) |
| Endocrine system diseases                  | 2.01 (1.58 to 2.56) | 38.4 (19.8 to 57.0) |
| Diabetes mellitus                          | 1.75 (1.31 to 2.34) | 23.1 (7.4 to 38.7) |
| Other endocrine                            | 3.12 (2.01 to 4.84) | 15.4 (5.4 to 25.4) |
| Blood and blood forming organs             | 4.59 (2.67 to 7.87) | 14.1 (4.3 to 23.9) |
| Mental disorders                           | 4.82 (3.93 to 5.92) | 80.1 (59.2 to 101.0) |
| Nervous system diseases                    | 1.93 (1.47 to 2.54) | 28.8 (12.5 to 45.0) |
| Circulatory system diseases                | 1.71 (1.59 to 1.84) | 282.3 (269.1 to 387.6) |
| Ischaemic heart disease                    | 1.63 (1.48 to 1.80) | 182.4 (137.0 to 227.7) |
| Heart failure                              | 1.74 (1.24 to 2.46) | 17.1 (3.3 to 30.8) |
| Cerebrovascular disease                    | 1.87 (1.55 to 2.25) | 64.5 (38.8 to 90.1) |
| Other circulatory diseases                 | 1.82 (1.53 to 2.17) | 64.5 (38.8 to 89.1) |
| Respiratory system diseases                | 2.56 (2.26 to 2.90) | 175.6 (139.5 to 211.6) |
| Pneumonia                                  | 2.30 (1.82 to 2.91) | 44.5 (25.9 to 63.2) |
| Bronchitis, emphysema, and asthma          | 2.92 (2.49 to 3.42) | 118.7 (90.0 to 147.4) |
| Other respiratory system diseases          | 1.75 (1.18 to 2.61) | 12.3 (9.0 to 23.8) |
| Digestive system diseases                  | 3.07 (2.58 to 3.65) | 87.9 (65.0 to 110.7) |
| Cirrhosis of liver                         | 3.66 (2.83 to 4.75) | 37.3 (23.9 to 50.7) |
| Other digestive system diseases            | 2.78 (2.20 to 3.50) | 50.5 (32.1 to 69.0) |
| Genitourinary system diseases              | 1.51 (1.01 to 2.26) | 10.6 (-2.1 to 23.4) |
| Musculoskeletal system diseases            | 2.52 (1.29 to 4.94) | 5.7 (-0.7 to 12.1) |
| Ill defined conditions                     | 5.08 (4.01 to 6.43) | 55.9 (39.2 to 72.6) |
| External causes                            | 3.34 (2.92 to 3.81) | 158.4 (128.0 to 188.8) |
| Motor vehicle                              | 1.68 (1.09 to 2.60) | 9.3 (-0.6 to 19.2) |
| Suicide                                    | 2.23 (1.76 to 3.07) | 29.5 (15.0 to 43.9) |
| Falls                                      | 3.06 (2.23 to 4.21) | 26.5 (13.9 to 39.0) |
| Homicide                                   | 11.29 (7.21 to 17.69) | 18.4 (9.0 to 27.8) |
| Poisoning                                  | 10.34 (7.37 to 14.50) | 30.2 (18.6 to 41.8) |
| Other external causes                      | 4.15 (3.21 to 5.38) | 44.6 (29.2 to 59.9) |
| Other and unknown§                         | 2.00 (0.98 to 4.07) | 4.0 (-1.7 to 9.8) |
| Smoking related                            | 2.39 (2.18 to 2.62) | 281.3 (236.5 to 326.1) |
| Alcohol related                            | 6.35 (5.25 to 7.69) | 80.8 (62.2 to 99.4) |
| Drug related                               | 11.50 (8.79 to 15.04) | 48.3 (33.6 to 63.0) |
| Amenable to medical intervention (≥75 years) | 3.16 (2.72 to 3.68) | 113.1 (88.1 to 138.1) |

*Rates and ratio differences based on age standardised mortality rates (per 100 000 person years at risk).
†§Shelters, rooming houses, and hotels include homeless shelters and hostels, missions, YWCA/YMCAs, rooming and lodging houses, hotels, motels, and tourist homes.
§Reference population (person years at risk) for age standardisation taken from total cohort age distribution (5 year age groupings).
‡Includes deaths from diseases of skin (n=123), congenital anomalies (n=169), unknown (205 deaths ascertained from tax filer data only).

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**DISCUSSION**

Homeless and marginally housed individuals living in shelters, rooming houses, or hotels have significantly higher mortality rates than individuals with incomes in the lowest fifth of the distribution. The probability that a 25 year old living in shelters, rooming houses, or hotels would survive to age 75 was only 32% for men and 60% for women compared with 51% and 72%, respectively, in the lowest income fifth. To put this in context, men living in shelters, rooming houses, or hotels had about the same probability of surviving to age 75 as men in the general population of Canada in 1921 or men in Laos in 2006 (see appendix D on bmj.com).24-25 Women had about the same probability of surviving to age 75 as women in the general population of Canada in 1956 or women in Guatemala in 2006.

Our study, while consistent with previous studies showing excess mortality among people living in shelters, provides new information on disparities in the life expectancy of those living in shelters and those living in other categories of marginal housing. Compared with the entire cohort, life expectancy was shorter by 13 years for men and eight years for women living in shelters; 11 and nine years, respectively, for those living in rooming houses; and eight and five years, respectively, for those living in hotels.

**Other studies**

Most previous studies provided only age specific relative risks of death or standardised mortality ratios for homeless individuals in a single city.6-13 By contrast, we present survival curves and life expectancy estimates with a comparatively high level of precision based on 3280 deaths ascertained over an 11 year follow-up period among 15 100 people enumerated in shelters, rooming houses, and hotels across Canada. Perhaps the only previous study to estimate life expectancy among people living in shelters and other categories of marginal housing was based on much smaller samples in single cities—39 deaths among 103 shelter users in Oxford and 104 deaths among 927 residents of bed and breakfasts and bed& breakfasts in Brighton.26

**Implications**

A large part of the premature mortality in people living in shelters, rooming houses, and hotels was potentially avoidable. Many excess deaths were attributable to diseases related to alcohol and smoking and to violence and injuries, much of which might have been related to substance misuse. There were also many excess deaths related to mental disorders and suicides. Other research suggests that expanding the implementation of recent innovations in supported housing programmes for people with addictions and mental illness27 could be instrumental in reducing the number of excess deaths. Enhanced availability of treatment for substance misuse and smoking cessation programmes for homeless and marginally housed people could also play an important role in reducing disparities in mortality.28

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Table 6 | Mortality rate ratios and rate differences* (per 100 000 person years at risk), by major causes of death, comparing women living in shelters, rooming houses, and hotels† with women in entire cohort‡, Canada, 1991-2001

| Cause                                              | Rate ratio (95% CI) | Difference (95% CI) |
|----------------------------------------------------|---------------------|---------------------|
| Total, all causes of death                         | 1.79 (1.66 to 1.94) | 556.7 (459.3 to 654.1) |
| Infectious diseases                                | 1.37 (1.05 to 1.78) | 2.7 (-6.2 to 11.5) |
| Cancer                                             | 1.38 (1.18 to 1.62) | 93.0 (39.7 to 146.3) |
| Trachea, bronchus, and lung                        | 1.73 (1.26 to 2.36) | 37.8 (9.6 to 65.9) |
| Intestine and rectum                               | 1.67 (1.12 to 2.51) | 20.6 (-0.1 to 41.2) |
| Oesophagus and stomach                             | 1.48 (1.07 to 2.15) | 4.4 (-5.8 to 14.6) |
| Pancreas                                           | 0.73 (0.29 to 1.82) | -3.5 (-12.2 to 5.2) |
| Female breast                                      | 1.58 (1.11 to 2.24) | 26.4 (1.2 to 51.7) |
| Uterus, ovary, and adnexa                          | 1.25 (0.73 to 2.20) | 5.5 (-10.1 to 21.0) |
| Urinary system                                     | 0.76 (0.27 to 2.12) | -1.7 (-7.3 to 3.8) |
| Lymphatic tissue and leukaemia                     | 1.26 (0.72 to 2.22) | 5.4 (-9.4 to 20.2) |
| Other cancer                                       | 0.98 (0.64 to 1.56) | -0.9 (-18.6 to 16.9) |
| Endocrine system diseases                          | 2.39 (1.70 to 3.38) | 33.7 (13.8 to 53.7) |
| Diabetes mellitus                                  | 2.44 (1.66 to 3.59) | 27.2 (9.4 to 45.0) |
| Other endocrine ring                               | 2.23 (1.04 to 4.79) | 6.6 (-2.5 to 15.7) |
| Blood and blood forming organs                     | 1.45 (0.34 to 6.22) | 1.3 (-4.9 to 7.6) |
| Mental disorders                                   | 3.78 (2.67 to 5.35) | 42.6 (22.4 to 62.9) |
| Nervous system diseases                            | 2.24 (1.52 to 3.29) | 25.2 (7.7 to 42.8) |
| Circulatory system diseases                        | 1.61 (1.42 to 1.83) | 153.4 (101.8 to 204.9) |
| Ischaemic heart disease                            | 1.80 (1.52 to 2.12) | 105.3 (65.2 to 145.4) |
| Heart failure                                      | 1.41 (0.88 to 2.26) | 6.4 (-3.9 to 16.7) |
| Cerebrovascular disease                            | 1.25 (0.94 to 1.67) | 14.5 (-5.9 to 34.8) |
| Other circulatory diseases                         | 1.57 (1.15 to 2.14) | 27.2 (4.1 to 50.3) |
| Respiratory system diseases                        | 2.14 (1.67 to 2.75) | 60.9 (32.3 to 89.5) |
| Pneumonia                                          | 2.16 (1.43 to 3.25) | 21.2 (5.0 to 37.4) |
| Bronchitis, emphysema, and asthma                  | 2.40 (1.70 to 3.40) | 36.1 (14.5 to 57.8) |
| Other respiratory system diseases                  | 1.39 (0.66 to 2.91) | 3.6 (-5.9 to 13.0) |
| Digestive system diseases                          | 2.92 (2.11 to 4.04) | 51.4 (25.9 to 76.9) |
| Cirrhosis of liver                                 | 5.63 (3.31 to 9.56) | 287.1 (101.4 to 47.4) |
| Other digestive system diseases                    | 2.10 (1.41 to 3.14) | 22.7 (5.3 to 40.0) |
| Genitourinary system diseases                      | 1.43 (0.79 to 2.58) | 5.1 (-5.0 to 15.3) |
| Musculoskeletal system diseases                    | 1.63 (0.72 to 3.65) | 3.2 (-3.5 to 10.0) |
| Ill defined conditions                             | 2.09 (0.96 to 4.55) | 8.5 (-4.2 to 21.2) |
| External causes                                    | 3.68 (2.74 to 4.95) | 75.6 (44.7 to 106.4) |
| Suicide                                            | 5.59 (3.24 to 9.64) | 26.3 (8.8 to 43.9) |
| Falls                                              | 1.65 (0.89 to 3.08) | 6.0 (-3.4 to 15.4) |
| Other external causes                              | 4.24 (2.80 to 6.42) | 43.3 (19.7 to 66.8) |
| Other and unknown§                                 | 0.99 (0.23 to 4.33) | 0.0 (-4.9 to 4.8) |
| Smoking related                                    | 2.03 (1.63 to 2.54) | 87.7 (49.7 to 125.7) |
| Alcohol related                                    | 8.20 (5.03 to 13.38) | 36.5 (16.0 to 57.0) |
| Drug related                                       | 9.17 (5.54 to 15.01) | 32.3 (13.8 to 50.9) |
| Amenable to medical intervention (≥ 75 years)      | 1.82 (1.37 to 2.43) | 54.5 (19.0 to 85.6) |

*Rate ratios and rate differences based on age standardised mortality rates (per 100 000 person years at risk).
†Total, all causes of death, comparing men and women living in shelters, rooming houses, and hotels; includes homeless shelters and hostels, missions, YWCA/YMCAs, rooming and lodging houses, hotels, motels, and tourist homes.
‡Reference population (person years at risk) for age standardisation taken from total cohort age distribution (5 year age groupings).
§Reference population (person years at risk) for age standardisation taken from total cohort age distribution (5 year age groupings).

Limitations

Our study has certain limitations, most of which should result in underestimation of the excess mortality risks associated with homelessness and marginal housing. Firstly, and most importantly, only people who were enumerated by the census and linked to tax filer data could be part of the study cohort. The 1991 census failed to enumerate 3.4% of the Canadian population; missed individuals were more likely to be young, mobile, have low incomes, and be of Aboriginal ancestry.\textsuperscript{40} Relatively low linkage rates of 26-41% among residents of shelters, rooming houses, and hotels presumably reflect the fact that many such individuals would not have filed a tax return or remained for long at the same address. We speculate that mortality might have been higher among those who could not be linked to a tax filer record; if so, our data would underestimate the true mortality rate among people living in shelters, rooming houses, and hotels. Nonetheless, it was reassuring that the socioeconomic characteristics of the homeless and marginally housed men and women whom we were able to link to tax filer data and follow for mortality were similar to the characteristics of all homeless and marginally housed individuals who were enumerated by the census. Secondly, we did not include homeless people sleeping rough on the street because they were not enumerated by the 1991 census. Previous studies have shown that these individuals have extremely high mortality rates, even higher than those of shelter residents,\textsuperscript{30} and in Canada they are more likely to be of Aboriginal origin.\textsuperscript{31,32} Thirdly, small sized rooming and lodging houses operating without a licence might have been misclassified by the census as private rather than collective dwellings, so their residents would not have been included in any of our marginal housing categories. Fourthly,
men and women whose usual place of residence was a hotel, motel, or tourist home mainly included people living in low cost accommodation that serves disadvantaged populations but also included a small number of people with much higher incomes who choose to live in hotels that provide amenities for long term residents. The presence of the latter group would be expected to slightly decrease the level of observed mortality within this category of housing. Fifthly, the socioeconomic and housing situation of cohort members was determined only at baseline, and no information was available on transitions into or out of different categories of housing or socioeconomic situations during the follow-up period. Finally, for the sake of simplicity, we determined mortality rates by income fifth using everyone in the study cohort. If people living in shelters, rooming houses, and hotels were to be excluded in calculations of mortality rates in the poorest income fifth, the mortality differences between these two groups (as shown in figs 1, 2, and 3) would be even greater. The magnitude of this effect, however, would be slight, as people living in shelters, rooming houses, and hotels account for less than 2% of the poorest income fifth.

Conclusion
In conclusion, this large national cohort study shows that homeless and marginally housed people living in shelters, rooming houses, and hotels have much higher mortality and shorter life expectancy than could be expected on the basis of low income alone. Mortality from medically amenable causes of death was higher in both relative and absolute terms.

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Data sharing: No additional available.

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