

Psychiatric disorders and mortality among people in homeless shelters in Denmark: a nationwide register-based cohort study



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Summary

Background The increased mortality of homeless people compared with non-homeless people might be linked to psychiatric disorders. However, homeless people are, because of their insufficient accommodation, difficult to sample and monitor, which has limited previous studies. We aimed to assess registered psychiatric disorders, mortality, and predictors of mortality in the homeless shelter population in Denmark.

Methods We did a nationwide, prospective, register-based cohort study of homeless people aged 16 years and older who were registered in the Danish Homeless Register between Jan 1, 1999, and Dec 31, 2009. We calculated the proportion of registered psychiatric disorders, overall and cause-specific standardised mortality ratio (SMR), and life expectancy. Hazard ratios (HRs) were used to assess predictors of death.

Findings 32711 homeless people (23 040 men and 9671 women) were included in the study population. 14 381 men (62·4%) and 5632 women (58·2%) had registered psychiatric disorders, and 11 286 men (49·0%) and 3564 women (36·9%) had a substance abuse diagnosis. During the study period, 3839 men (16·7%) and 951 women (9·8%) died. The overall SMR for men was 5·6 (95% CI 5·4–5·8) and for women was 6·7 (6·2–7·1), and external causes accounted for 1161 (27·9%) of 4161 deaths for which information on the cause was available. Remaining life expectancy at age 15–24 years was 21·6 years (95% CI 21·2–22·1) and 17·4 years (16·4–18·5) lower for homeless men and women, respectively, than the general population. Registered substance abuse disorder was associated with the highest mortality risk compared with no psychiatric contact registered (adjusted HR 1·4, 95% CI 1·3–1·5 for men; 1·7, 1·4–2·1 for women).

Interpretation Health problems are extensive in the homeless shelter population and there is an urgent need for more sustained efforts to reduce the high morbidity and mortality, especially from external causes. Register data is an important resource to supplement existing knowledge on homeless people with more valid and detailed information.

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Introduction

An increased mortality among homeless people compared with the general population in developed countries has been described.^{1–17} Additionally, psychiatric morbidity in the homeless population is higher than in the general population in developed countries.^{18–20} Previous studies have linked mental illness, such as psychosis and schizophrenia, to lower mortality in homeless people.^{1,3,9,11,16} Although these findings only showed weak evidence of a difference in mortality, they do contrast with findings in the general population.²¹ Different types of substance abuse and dual diagnosis (a schizophrenia spectrum disorder and a substance abuse disorder) were identified as predictors of excess mortality among homeless people.^{1,3–5,12,14,16} The need for more prospective studies that investigate the factors associated with the excess mortality has been emphasised.^{9,11,12}

Homeless people are a transient population and, because of their insufficient accommodation, are difficult to sample and monitor. As such, studies on this population have generally had small and selected sample sizes, which do not ensure representative

findings. In Denmark, information on every contact with homeless shelters is contained in the Danish Homeless Register, which provides a new and unique opportunity to undertake detailed research of an unselected homeless population.

We aimed to estimate the proportion of registered psychiatric disorders among men and women in homeless shelters in Denmark, to calculate the overall and cause-specific standardised mortality ratio (SMR; the ratio between observed mortality in the studied population and the expected mortality) and life expectancy, and to identify predictors for mortality. We hypothesised that psychiatric disorders, especially substance abuse, are highly prevalent among homeless people.²⁰ Additionally, we expected that homeless people would have an increased SMR and a reduced life expectancy compared with the general population.^{1,15} We also expected that substance abuse would be a strong predictor of death, and more harmful to health than both no psychiatric disorders and schizophrenia spectrum disorders.^{1,3,11} Finally, we hypothesised that the number of contacts with homeless shelters within the first year

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of contact would be a predictor of death, with increased risk associated with an increasing number of contacts.¹

Methods

Study population

We included people aged 16 years and older who had a valid Civil Registration System (CRS) number (a personal identification number that is assigned to all Danish residents) and who had had at least one contact with a homeless shelter in Denmark between Jan 1, 1999, and Dec 31, 2009. Children under 16 years of age were excluded because we did not judge their homelessness situation to be comparable to that of adults (eg, in Denmark they would usually only be admitted to shelters

in the company of an adult). A person was defined as homeless from the date when they first stayed in a homeless shelter onwards—ie, the homeless definition covers people who either are living in or have a history of staying in a homeless shelter during the study period.

Permission to use the data was obtained from the Danish Data Protection Agency. Also, we obtained permission from the National Social Appeals Board to use information about homeless shelter contacts and from the National Board of Health to use information about psychiatric contacts and deaths.

Procedures

We did a register-based follow-up cohort study using information from the Danish Homeless Register,²² the Danish Civil Registration System,²³ the Danish Psychiatric Central Register,²⁴ and the Danish Cause of Death Register.²⁵ The CRS number enables accurate linkage between the registers.²³

In Denmark, the municipal council has the duty to offer a temporary stay for a small fee per night to people who do not have a home or cannot live in their own home. As an administrative procedure, all residents in homeless shelters are registered with their CRS number in the Danish Homeless Register, which is maintained by the National Social Appeals Board.²² The register contains data on, for example, dates of admission and discharge, nationality, and income. The Danish Civil Registration System contains basic information on, for example, birthday and vital status, and is updated to 2009.²³ Information about total number of deaths was obtained from this register. Information about psychiatric disorders was obtained from the Danish Psychiatric Central Register, which contains information on all admissions to psychiatric hospitals since 1969 as well as outpatient contacts from 1995.²⁴

Until Dec 31, 1993, psychiatric disorders were registered according to the Danish modification of the International Classification of Diseases, 8th Revision (ICD-8)²⁶ and since 1994 with the ICD-10.²⁷ People in the register are separated into the following groups of disorders: schizophrenia spectrum disorders (ICD-8: 295, 297, 298.29, 298.39, 298.89, 298.99, 299.05, 299.09, 301.09, and 301.29, and ICD-10: F20–F29), substance abuse disorders (ICD-8: 291, 303, and 304, and ICD-10: F10–F19), affective disorders (ICD-8: 296, 298.09, 298.19, 300.49, 301.19, and ICD-10: F30–F39), and personality disorders (ICD-8: 300.19, 301.49, 301.59, 301.69, 301.79–301.84, and ICD-10: F60–F69).

We obtained information about causes of death according to the ICD-10 classification from the Danish Cause of Death Register, which was updated on Dec 31, 2008. Thus, causes of death were only available for 1999–2008. Causes of death were classed as suicide (X60–X84 and Y87.0), unintentional injury (V01–V89, V90–V99, W00–X59, Y40–Y86, Y87.1–Y87.2, and Y88–Y89), other external causes (X85–Y36), and diseases and

	Men (n=23040)	Women (n=9671)	p value*
Age at first contact in the Danish Homeless Register (years)			
16–24	2788 (12.1%)	1831 (18.9%)	<0.0001
25–34	5294 (23.0%)	2699 (27.9%)	
35–44	7032 (30.5%)	2555 (26.4%)	
45–54	5276 (22.9%)	1771 (18.3%)	
55–64	2213 (9.6%)	697 (7.2%)	
≥65	437 (1.9%)	118 (1.2%)	
Country of origin			
Denmark	18 874 (81.9%)	6793 (70.2%)	<0.0001
Nordic countries (excluding Denmark)†	501 (2.2%)	259 (2.7%)	
EU (excluding Denmark, Sweden, and Finland)‡	404 (1.8%)	163 (1.7%)	
Other high-income countries (excluding the EU and Iceland, the Faroe Islands, and Norway)§	68 (0.3%)	26 (0.3%)	
Low-income and middle-income countries¶	3193 (13.9%)	2430 (25.1%)	
Income at the last contact in the Danish Homeless Register			
Cash benefit	8456 (36.7%)	4060 (42.0%)	<0.0001
Pension	4839 (21.0%)	1730 (17.9%)	
Income from employment	1892 (8.2%)	859 (8.9%)	
Other	3973 (17.2%)	1643 (17.0%)	
Unknown	3880 (16.8%)	1379 (14.3%)	
Contacts in the Danish Homeless Register			
1	10 190 (44.2%)	5899 (61.0%)	<0.0001
2–5	8118 (35.2%)	2762 (28.6%)	
6–20	3491 (15.2%)	812 (8.4%)	
>20	1241 (5.4%)	198 (2.0%)	
Diagnosis			
Schizophrenia spectrum disorder	3264 (14.2%)	1121 (11.6%)	<0.0001
Any substance abuse	11286 (49.0%)	3564 (36.9%)	
Abuse of alcohol	8844 (38.4%)	2857 (29.5%)	
Any abuse of illicit drugs	5537 (24.0%)	1778 (18.4%)	
Abuse of opioids	1717 (7.5%)	563 (5.8%)	
Abuse of cannabis	2369 (10.3%)	521 (5.4%)	
Abuse of sedatives	1062 (4.6%)	617 (6.4%)	
Abuse of cocaine	415 (1.8%)	110 (1.1%)	
Abuse of other drugs	3828 (16.6%)	1106 (11.4%)	
Dual diagnosis**	2502 (10.9%)	708 (7.3%)	
Affective disorder	3882 (16.8%)	2116 (21.9%)	
Personality disorder	4689 (20.4%)	2248 (23.2%)	
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medical conditions (all other causes).²⁵ To compare the mortality of the homeless people with the general population, we obtained data on deaths in the Danish general population from Statbank Denmark.^{28–32}

Statistical analysis

Sex-specific life expectancy for people aged 15–24 years was calculated by constructing abridged period life tables with 10-year age groups and data on the homeless and general populations from 1999 to 2009.³³ SMR was calculated by sex and age with 5-year age groups for the period 1999–2009 and by cause with 10-year age groups for 1999–2008 by comparing the reported mortality in the study population with the expected mortality in the age-standardised and sex-standardised Danish general population. For the SMR and life expectancy calculations, we decided to include 15-year olds to make results comparable with standard age intervals (ie, 15–19 years). The number of contacts with homeless shelters for adolescents were few: whereas five, two, and six contacts were recorded for young men aged 15, 16, and 17 years, respectively, no contacts were recorded for women of these ages.

Predictors of mortality were identified by age-adjusted univariable and multivariable Cox proportional hazard regression analyses. All analyses were calculated for men and women separately. By using Cox regression for the analyses we were able to include people with different lengths of follow-up and therefore we did not need to exclude data. Overall, all individuals had the same risk of dying, which was 1, but we assessed only the mortality risk from age 16 years and within a period of 11 years (Jan 1, 1999, to Dec 31, 2009). Thus, people were deemed at risk of death from their first contact in the Danish Homeless Register and until the first of the following events: death, loss to follow-up, emigration, or end of the study.

A priori, we chose which variables to include in the survival analysis, and we constructed Cox proportional hazards models. To adjust for age we used the square effect of age at first contact in the Danish Homeless Register. The first multivariable Cox model included four independent variables: age at first contact in the Danish Homeless Register, country of origin, income (defined as income at last contact in the Danish Homeless Register), and a binary variable of registered psychiatric disorder. In the second model, a more detailed variable was included: registered psychiatric disorder, which listed five hierarchical, mutually exclusive categories with the following priority: (1) no psychiatric contact since 1969, (2) dual diagnosis, (3) schizophrenia spectrum disorder, (4) substance abuse disorder, and (5) other psychiatric disorders. Also, we examined the effect of registered psychiatric disorders on mortality with age-adjusted cumulative mortality curves.

To investigate whether the number of contacts with homeless shelters within the first year of contact was associated with mortality, we did a multivariable analysis

	Men (n=23 040)	Women (n=9671)	p value*
(Continued from previous page)			
Registered with any psychiatric disorder	14 381 (62.4%)	5632 (58.2%)	<0.0001
Psychiatric disorders			
No psychiatric contact since 1969	8659 (37.6%)	4039 (41.8%)	<0.0001
Schizophrenia spectrum disorder	762 (3.3%)	413 (4.3%)	
Substance abuse disorder††	8784 (38.1%)	2856 (29.5%)	
Dual diagnosis**	2502 (10.9%)	708 (7.3%)	
Other psychiatric disorders	2333 (10.1%)	1655 (17.1%)	
Contacts in the Danish Psychiatric Central Register			
0	8659 (37.6%)	4039 (41.8%)	<0.0001
1	2812 (12.2%)	972 (10.1%)	
2–5	4908 (21.3%)	1845 (19.1%)	
6–20	4394 (19.1%)	1877 (19.4%)	
>20	2267 (9.8%)	938 (9.7%)	
Number of days receiving treatment as inpatient			
0	11 948 (51.9%)	5498 (56.9%)	<0.0001
1	285 (1.2%)	94 (1.0%)	
2–7	2305 (10.0%)	818 (8.5%)	
8–30	2547 (11.1%)	855 (8.8%)	
31–90	2138 (9.3%)	899 (9.3%)	
91–365	2474 (10.7%)	1038 (10.7%)	
>365	1343 (5.8%)	469 (4.8%)	
Deaths	3839 (16.7%)	951 (9.8%)	<0.0001

Data are number (%). Percentages do not add up to 100 in some cases because of rounding. *p is the overall p value for the group comparison. †Sweden, Finland, Iceland, Norway, and the Faroe Islands. ‡Belgium, Bulgaria, Cyprus, Estonia, France, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, UK, Czech Republic, Germany, Hungary, and Austria. §USA, Australia, Canada, New Zealand, Switzerland, Liechtenstein, Monaco, Andorra, San Marino, and Vatican City. ¶All other countries. ||Diagnosis received during a psychiatric hospital contact at some point since 1969 (does not exclude other diagnoses). **Registered with both schizophrenia spectrum disorder and substance abuse disorder. ††Defined as ever having a substance abuse diagnosis during a psychiatric hospital contact since 1969 but excludes people with dual diagnosis who have received a diagnosis of both substance abuse and schizophrenia spectrum disorder.

Table 1: Characteristics of participants

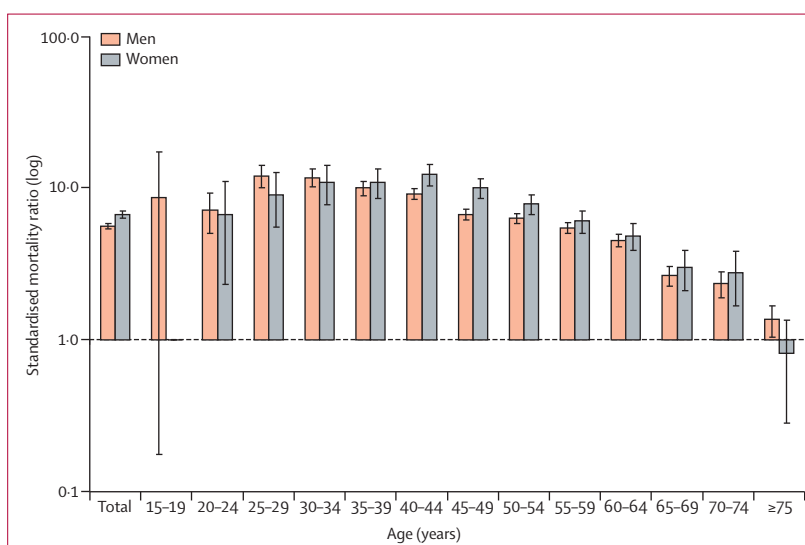


Figure 1: Standardised mortality ratio according to age
Bars=95% CI.

with a separate observation time, which began a year after the first contact. Separate multivariable Cox regression analyses were done for each of the following types of substance abuse: alcohol, opioid, cannabis, sedative, cocaine, and other drugs.

To assess the effect of intensity of psychiatric treatment, the association between risk of dying and duration of inpatient admissions and contact type (inpatient, outpatient only, or emergency room only) during the 5 years before the first registered shelter contact was analysed. We used log-minus-log plots to confirm that the proportionality assumption was valid for all variables

used in the Cox proportional hazard regression models. Sociodemographic and clinical characteristics of the homeless people were tested against sex with χ^2 tests. All analyses were done with SPSS (version 18).

Role of the funding source

The sponsor of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. All authors had full access to all the data in the study, take responsibility for the integrity of the data and the accuracy of the data analysis, and had final responsibility for the decision to submit for publication.

	Deaths (n/N [%])	Univariable age-adjusted		Multivariable adjusted	
		HR (95% CI)*	p value†	HR (95% CI)*	p value†
Age at first contact in the Danish Homeless Register (years)‡					
16–24	125/2788 (4.5%)	1.0	<0.0001	1.0	<0.0001
25–34	509/5294 (9.6%)	1.9 (1.6–2.3)		1.8 (1.5–2.2)	
35–44	1043/7032 (14.8%)	3.1 (2.6–3.7)		2.7 (2.2–3.3)	
45–54	1275/5276 (24.2%)	5.6 (4.7–6.7)		4.5 (3.7–5.4)	
55–64	703/2213 (31.8%)	8.4 (7.0–10.2)		6.4 (5.3–7.8)	
≥65	184/437 (42.1%)	12.5 (9.9–15.6)		9.1 (7.2–11.5)	
Country of origin					
Denmark	3543/18 874 (18.8%)	1.0	<0.0001	1.0	<0.0001
Nordic countries (excluding Denmark)§	96/501 (19.2%)	1.0 (0.9–1.3)		1.0 (0.9–1.3)	
EU (excluding Denmark, Sweden, and Finland)¶	55/404 (13.6%)	0.8 (0.6–1.1)		0.9 (0.7–1.2)	
Other high-income countries (excluding the EU and Iceland, the Faroe Islands, and Norway)	12/68 (17.6%)	1.0 (0.6–1.8)		1.0 (0.6–1.8)	
Low-income and middle-income countries**	133/3193 (4.2%)	0.3 (0.2–0.3)		0.4 (0.3–0.4)	
Income					
Cash benefit	972/8456 (11.5%)	1.0	<0.0001	1.0	<0.0001
Pension	1416/4839 (29.3%)	1.5 (1.4–1.6)		1.3 (1.2–1.4)	
Income from employment	162/1892 (8.6%)	0.6 (0.5–0.7)		0.6 (0.5–0.7)	
Other	608/3973 (15.3%)	1.1 (1.0–1.2)		1.0 (0.9–1.1)	
Unknown	681/3880 (17.6%)	1.1 (1.0–1.2)		1.0 (0.9–1.1)	
Registered psychiatric disorder					
No psychiatric contact	1036/8659 (12.0%)	1.0	<0.0001	1.0	<0.0001
Schizophrenia spectrum disorder	74/762 (9.7%)	0.8 (0.6–1.0)		0.8 (0.6–1.0)	
Substance abuse disorder	2021/8784 (23.0%)	1.6 (1.5–1.7)		1.4 (1.3–1.5)	
Dual diagnosis††	470/2502 (18.8%)	1.6 (1.4–1.7)		1.3 (1.2–1.5)	
Other psychiatric disorder	238/2333 (10.2%)	0.9 (0.8–1.0)		0.9 (0.7–1.0)	
Number of contacts to homeless shelters within the first year of contact‡‡					
1	1985/13 399 (14.8%)	1.0	<0.0001	1.0	<0.0001
2	748/4420 (16.9%)	1.2 (1.1–1.3)		1.1 (1.0–1.2)	
3–5	705/3568 (19.8%)	1.3 (1.2–1.5)		1.2 (1.1–1.3)	
6–10	250/1084 (23.1%)	1.6 (1.4–1.8)		1.3 (1.2–1.5)	
>10	151/569 (26.5%)	2.1 (1.7–2.5)		1.7 (1.4–2.0)	

HR=hazard ratio. *The square effect of age at first contact in the Danish Homeless Register is used for adjustment of age. The multivariable model includes age at first contact to the Danish Homeless Register, country of origin, income at last contact in the Danish Homeless Register, and registered psychiatric disorder. †p is the overall p value for the group comparison. ‡HR estimates of the categorical variable of age are presented to show the effect of age. Univariable estimates of age are not adjusted. §Sweden, Finland, Iceland, Norway, and the Faroe Islands. ¶Belgium, Bulgaria, Cyprus, Estonia, France, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, UK, Czech Republic, Germany, Hungary, and Austria. ||USA, Australia, Canada, New Zealand, Switzerland, Liechtenstein, Monaco, Andorra, San Marino, and Vatican City. **All other countries. ††Registered with both schizophrenia spectrum disorder and substance abuse disorder. ‡‡The Cox analyses include only participants who were alive at least 1 year after the first contact to a homeless shelter (n=21 768). The multivariable estimates are adjusted for age at first contact to the Danish Homeless Register, country of origin, income, and registered psychiatric disorder.

Table 2: Cox regression analyses of mortality among men

	Deaths (n/N [%])	Univariable age-adjusted		Multivariable adjusted	
		HR (95% CI)*	p value†	HR (95% CI)*	p value†
Age at first contact in the Danish Homeless Register (years)‡					
16–24	25/1831 (1.4%)	1.0	<0.0001	1.0	<0.0001
25–34	106/2699 (3.9%)	2.7 (1.8–4.2)		2.6 (1.7–4.0)	
35–44	285/2555 (11.2%)	8.1 (5.4–12.2)		5.1 (3.4–7.8)	
45–54	337/1771 (19.0%)	14.9 (10.0–22.4)		7.3 (4.8–11.2)	
55–64	157/697 (22.5%)	19.1 (12.5–29.2)		9.0 (5.8–14.0)	
≥65	41/118 (34.7%)	32.0 (19.5–52.7)		15.3 (9.1–25.6)	
Country of origin					
Denmark	871/6793 (12.8%)	1.0	<0.0001	1.0	<0.0001
Nordic countries (excluding Denmark)§	40/259 (15.4%)	1.2 (0.8–1.6)		1.1 (0.8–1.5)	
EU (excluding Denmark, Sweden, and Finland)¶	11/163 (6.7%)	0.7 (0.4–1.3)		0.9 (0.5–1.7)	
Other high-income countries (excluding the EU and Iceland, the Faroe Islands, and Norway)	2/26 (7.7%)	0.6 (0.2–2.5)		0.6 (0.1–2.4)	
Low-income and middle-income countries**	27/2430 (1.1%)	0.2 (0.1–0.2)		0.2 (0.1–0.3)	
Income					
Cash benefit	214/4060 (5.3%)	1.0	<0.0001	1.0	<0.0001
Pension	436/1730 (25.2%)	2.1 (1.8–2.5)		1.6 (1.3–1.9)	
Income from employment	21/859 (2.4%)	0.3 (0.2–0.5)		0.3 (0.2–0.5)	
Other	138/1643 (8.4%)	1.2 (0.9–1.4)		1.0 (0.8–1.2)	
Unknown	142/1379 (10.3%)	1.2 (1.0–1.5)		1.0 (0.8–1.2)	
Registered psychiatric disorder					
No psychiatric contact	175/4039 (4.3%)	1.0	<0.0001	1.0	<0.0001
Schizophrenia spectrum disorder	24/413 (5.8%)	1.0 (0.7–1.6)		0.8 (0.5–1.2)	
Substance abuse disorder	551/2856 (19.3%)	2.6 (2.1–3.1)		1.7 (1.4–2.1)	
Dual diagnosis††	131/708 (18.5%)	2.9 (2.3–3.6)		1.7 (1.3–2.1)	
Other psychiatric disorders	70/1655 (4.2%)	0.9 (0.7–1.2)		0.7 (0.5–1.0)	
Number of contacts to homeless shelters within the first year of contact‡‡					
1	521/6917 (7.5%)	1.0	<0.0001	1.0	<0.0001
2	190/1474 (12.9%)	1.5 (1.3–1.8)		1.3 (1.1–1.5)	
3–5	172/966 (17.8%)	1.9 (1.5–2.3)		1.4 (1.1–1.6)	
6–10	44/219 (20.1%)	2.1 (1.5–2.9)		1.4 (1.0–2.0)	
>10	24/95 (25.3%)	3.0 (2.0–4.5)		1.9 (1.2–2.8)	

HR=hazard ratio. *The square effect of age at first contact in the Danish Homeless Register is used for adjustment of age. The multivariable model includes age at first contact to the Danish Homeless Register, country of origin, income at last contact in the Danish Homeless Register, and registered psychiatric disorder. †p is the overall p value for the group comparison. ‡HR estimates of the categorical variable of age are presented to show the effect of age. The univariable estimates of age are not adjusted. §Sweden, Finland, Iceland, Norway, and the Faroe Islands. ¶Belgium, Bulgaria, Cyprus, Estonia, France, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, UK, Czech Republic, Germany, Hungary, and Austria. ||USA, Australia, Canada, New Zealand, Switzerland, Liechtenstein, Monaco, Andorra, San Marino, and Vatican City. **All other countries. ††Both schizophrenia spectrum disorder and substance abuse disorder. ‡‡The Cox analyses include only participants who were alive at least 1 year after the first contact to a homeless shelter (n=9208). The multivariable estimates are adjusted for age at first contact to the Danish Homeless Register, country of origin, income, and registered psychiatric disorder.

Table 3: Cox regression analyses of mortality among women

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Results

From Jan 1, 1999, to Dec 31, 2009, 34755 people were registered in the Danish Homeless Register; 2044 were excluded from this study, 1896 because they could not be matched in the CRS and 148 because they were below 16 years of age, leaving 32711 people in the study cohort. 189 (0.6%) of people were lost to follow-up and 811 (2.5%) emigrated during the study period. Mean age at first contact in the Danish Homeless Register was 39.7 years (SD 11.9) for men and 36.6 years (12.0) for women. The mean age at death among the 4790 deaths

was 49.9 years (SD 11.7) for men and 49.6 years (10.8) for women. Table 1 lists demographics and clinical characteristics of the study population. The proportion of registered psychiatric disorders among homeless people in Denmark was high; over 60% of homeless men and just under 60% of homeless women had a registered psychiatric diagnosis. Substance abuse was the most frequently recorded diagnosis for both sexes. We noted sex differences in the number of contacts in the Danish Homeless Register and in the Danish Psychiatric Central Register. Compared with men, women seemed to be

Men (n=23 040)				Women (n=9671)			
	Deaths (n/N [%])	Multivariable adjusted HR (95% CI)*	p value	Deaths (n/N [%])	Multivariable adjusted HR (95% CI)*	p value	
Abuse of alcohol	2179/8844 (24.6%)	1.4 (1.3–1.5)	<0.0001	585/2857 (20.5%)	1.9 (1.6–2.2)	<0.0001	
Abuse of opioids	399/1717 (23.2%)	1.8 (1.6–2.0)	<0.0001	125/563 (22.2%)	2.7 (2.2–3.4)	<0.0001	
Abuse of cannabis	329/2369 (13.9%)	1.2 (1.1–1.4)	0.005	60/521 (11.5%)	1.6 (1.2–2.2)	0.001	
Abuse of sedatives	288/1062 (27.1%)	1.7 (1.5–2.0)	<0.0001	156/617 (25.3%)	2.2 (1.8–2.7)	<0.0001	
Abuse of cocaine	63/415 (15.2%)	1.7 (1.3–2.2)	<0.0001	12/110 (10.9%)	2.2 (1.2–3.9)	0.009	
Abuse of other drugs	749/3828 (19.6%)	1.6 (1.5–1.8)	<0.0001	218/1106 (19.7%)	2.4 (2.0–2.9)	<0.0001	

HR=hazard ratio. Diagnoses were received during a psychiatric hospital contact at some point since 1969. *No substance abuse disorder registered is the reference group in all six multivariable analyses. The analyses are adjusted for the square effect of age at first contact in the Danish Homeless Register, country of origin, income at last contact in the Danish Homeless Register, schizophrenia spectrum disorder, and abuse of all other types of drugs.

Table 4: Cox regression analyses of mortality among participants with some form of substance abuse

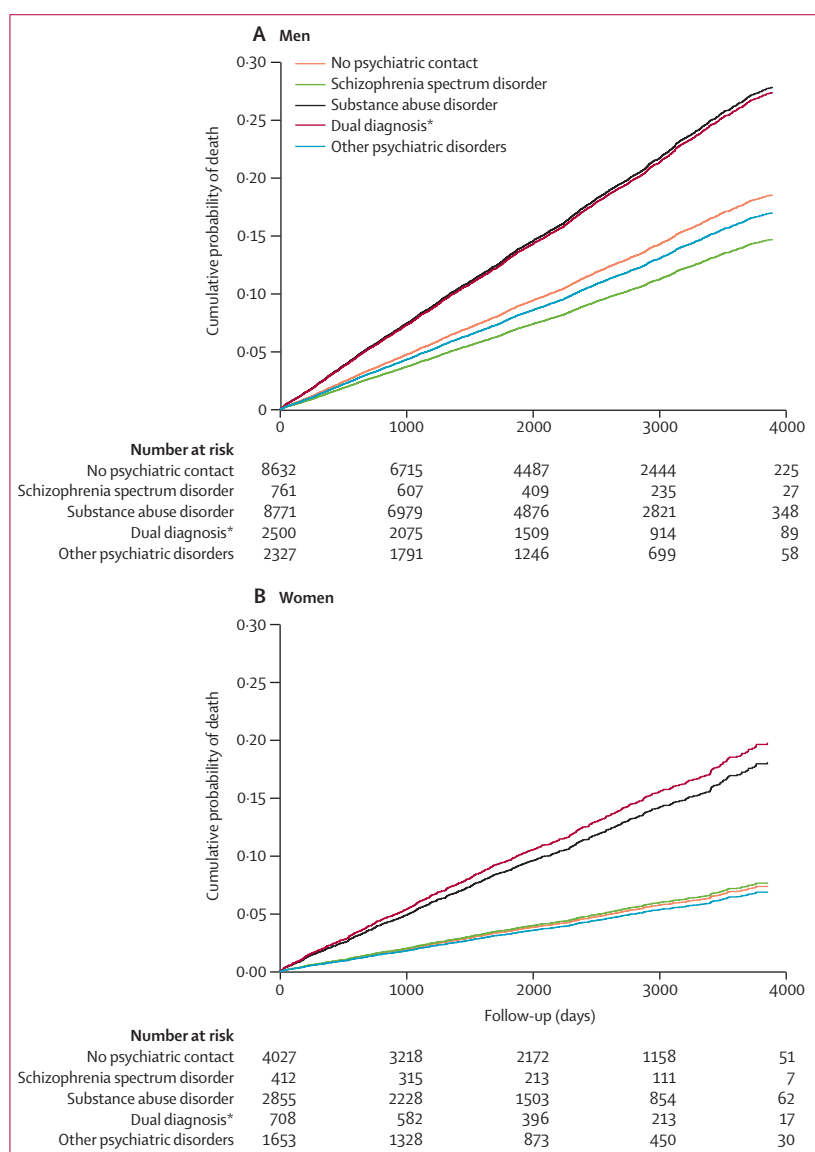


Figure 2: Age-adjusted Cox cumulative mortality curves

*People with both schizophrenia spectrum disorder and substance abuse disorder.

younger at their first contact with homeless shelters and had fewer contacts in both the Danish Homeless Register and in the Danish Psychiatric Central Register. Homeless men had a higher risk of dying than homeless women (reference group; age-adjusted HR 1.4, 95% CI 1.3–1.5; data not shown).

Figure 1 shows SMR by sex and age group. The overall SMR for all causes of death was higher for women (6.7, 95% CI 6.2–7.1) than for men (5.6, CI 5.4–5.8). For men and women, respectively, the SMR for diseases and medical conditions was 4.0 (95% CI 3.8–4.1) and 4.2 (3.9–4.5), for suicide was 7.3 (6.3–8.3) and 14.8 (10.9–18.8), for unintentional injuries was 12.3 (11.3–13.4) and 19.0 (15.6–22.5), and for other external causes was 19.7 (16.9–22.6) and 32.1 (23.4–40.8). External causes accounted for 1161 (27.9%) of the 4161 deaths for which information on cause was available.

The remaining life expectancy for homeless men aged 15–24 years was 38.7 years (95% CI 38.3–39.2) and for the women it was 47.4 years (46.4–48.5). During the same period, the general population of men and women in Denmark aged 15–24 years had a remaining life expectancy of 60.3 years (95% CI 60.3–60.4) and 64.8 years (64.7–64.8), respectively. Compared with the general population, life expectancy at age 15–24 years was 21.6 years (95% CI 21.2–22.1) lower for homeless men and 17.4 years (16.4–18.5) lower for homeless women.

We did Cox analyses on 32 646 people: 22 991 men and 9655 women; data from 65 people could not be included in this analysis because of negative follow-up time (eg, if a person was registered as dead before they were registered in some of the other registries). The mean follow-up was 2172.5 days (SD 1164.2; range 1–4018). Table 2 and table 3 show predictors associated with all-cause mortality for men and women, respectively. People with a registered psychiatric disorder had a higher risk of mortality than those without any psychiatric contact registered (reference group; data not shown). In a multivariable analysis, compared with people with no record of psychiatric contact, registered substance abuse disorder was associated with a 1.4-times (95% CI 1.3–1.5) higher risk of dying for men and a 1.7-times

(1.7, 1.4–2.1) higher risk for women. Registered dual diagnosis was also associated with an increased risk of death in both men and women.

The number of contacts to homeless shelters within the first year of contact was associated with mortality, with higher numbers of contacts associated with increased risk of dying (table 2 and table 3). Duration of inpatient hospital stays during the last 5 years before the first registered shelter contact was not associated with risk of dying (data not shown), and there was no significant difference in mortality between inpatient contact and emergency room contact only (data not shown). However, these two types of contact were associated with significantly increased risk of dying compared with both no contact registered and outpatient contact (data not shown).

Table 4 shows the effect of different types of registered substance abuse diagnoses on the risk of mortality. Abuse of opioids was associated with the highest risk of dying in men and women compared with no record of substance abuse diagnosis. Additionally, abuse of alcohol, sedatives, cocaine, cannabis, and other drugs predicted increased risk of mortality compared with no record of substance abuse diagnosis.

Figure 2 shows age-adjusted cumulative mortality rates. People with substance abuse disorders and those with dual diagnosis had the highest probability of dying, whereas the probability of dying for people with schizophrenia spectrum disorders was equivalent to (women) or lower than (men) those without psychiatric contact registered and people with other psychiatric disorders.

Discussion

Our results show the high proportion of psychiatric disorders registered among homeless people. Registered substance abuse disorder predicted a higher risk of dying in both men and women who had contact with homeless shelters in Denmark than individuals without any registered psychiatric contact. There was a high excess mortality for all causes of death in the homeless shelter population, especially for external causes—ie, suicide and unintentional injuries (panel). The high proportion of psychiatric disorders registered in the Danish homeless population, with substance abuse as the most frequent diagnosis, is consistent with the results from a meta-analysis by Fazel and colleagues.²⁰ However, these prevalence estimates were based primarily on men. Little data has been reported specifically on psychiatric disorders in homeless women.

Using individual, nationwide register data, we were able to address some of the limitations of previous studies, such as small sample sizes, problems with linking of information, and loss to follow-up. We were able to provide complete information on hospital contacts and cause-specific SMR for both sexes for a homeless shelter population. We were able to calculate valid estimates with greater power than previously,^{1,16,17} while taking into

Panel: Research in context

Systematic review

We searched PubMed, with no date restrictions set, for articles with the following terms: “homeless” or “homelessness” in combination with “mortality”, “death”, “risk factors”, “predictors”, “psychiatric disorders”, or “mental illness”. We also searched the MeSH database, with no date restrictions set, with the following MeSH terms in combination: “homeless persons”, and “mental disorders”, and/or “mortality”. All articles that were deemed not relevant on the basis of their titles alone were excluded. Abstracts of the remaining articles were reviewed to identify potentially relevant articles, and, on the basis of this selection, full-text articles were read. Additionally, we scanned reference lists of relevant articles. The main criteria for the selection of relevant articles were inclusion of homeless people living in homeless shelters, hostels, or rooming houses, or homeless people living on the streets; studies from developed countries to delimit the research field to countries that offer comparable living circumstances for homeless; studies written in English or Danish; and studies having homelessness and mortality or psychiatric disorders, or both, as the major topic. We identified 32 relevant articles published between 1975 and 2011. A meta-regression analysis noted high prevalence of psychiatric disorders among homeless people.²⁰ However, substantial heterogeneity was reported in the prevalence estimates for mental disorders and the results were based on small samples of homeless people. Few studies have investigated psychiatric disorders in homeless women. The evidence of mortality among homeless people is limited, and methodological problems with small sample sizes, loss to follow-up, uncertain linkage of data, and few numbers of deaths have been prevalent. However, the mortality figures were high in all the studies. Substance abuse has been linked to the higher mortality.^{1,3,5,12,14,16} However, the results for mental disorders were not clear.^{1,3,5,9,11,14,16} No previous studies provided complete information on psychiatric hospital contact and death and optimum linkage of data in a nationwide homeless shelter population.

Interpretation

This study is the first to be based on an established nationwide homeless register that represents a complete homeless shelter population. 62.4% of men and 58.2% of women were registered with at least one psychiatric disorder. Men and women in the homeless shelter population had 5.6-times and 6.7-times higher mortality, respectively, than the general population. There was a larger disparity in life expectancy between the homeless shelter population and the general population than previous studies have found.¹⁵ Cause-specific standardised mortality ratios for both sexes showed high excess mortality by suicide and unintentional injuries. With complete record linkage and up to 11 years follow-up, we were able to calculate cumulative mortality curves for men and women by registered psychiatric disorder and we found substance abuse to be the diagnosis associated with the highest mortality risk. This study suggests that homeless people living in shelters constitute a high-risk population in a public health perspective. This study underlines that this marginalised population needs more attention on the health agenda.

account loss to follow-up and emigration. This study also presents a useful cohort database on the Danish homeless shelter population, which will continue to provide useful information and new possibilities for research on the mental health and mortality of homeless people.

Our overall SMR estimates were high compared with estimates from other studies, in which SMRs ranged from 2.8 to 7.6 for men and from 3.8 to 6.5 for women.^{1,11,14} Because of the study design, whether homelessness itself is a risk factor for higher mortality or whether it is a marker for the already increased mortality risk among people with psychiatric disorders is not clear.

The SMR reported in this study was about twice as high as reported for Denmark in a study on mortality among people with severe mental disorders,³⁴ which suggests that individuals with psychiatric disorders who also are homeless have a higher mortality rate than the general psychiatric population. Also, a study that compared the mortality risk of homeless people with non-homeless people reported that homelessness itself confers additional risk after adjusting for morbidity.¹³

Few studies have previously examined cause-specific SMR among homeless people. A Swedish study reported that excess mortality among homeless men was highest from accidents, with 12-times higher mortality compared with the general Swedish population.¹⁷ However, no 95% CIs were presented and these results were based on only 65 accidental deaths among the homeless. Compared with a previous Danish study, which presented data for both men and women together,¹ our SMR for suicide was higher for both sexes, especially for women, and for unintentional injury our estimate was higher for women.

Few previous studies have assessed life expectancy among homeless people. In a study in Canada,¹⁵ life expectancy was 13 years shorter for men and 8 years shorter for women than a representative sample of the population. We noted an even higher discrepancy in life expectancy. The identification of substance abuse and dual diagnosis as predictors of death in this Danish homeless sample are consistent with previous findings.^{1,3-5,12,14,16}

People with a record of schizophrenia spectrum disorder had a lower risk of dying than those with a substance abuse disorder. However, this finding does not imply that schizophrenia spectrum disorders are not associated with an increased risk of dying. Had these results been compared with the general population, we would probably have found an excess mortality among persons with schizophrenia in the homeless shelter population, because people with schizophrenia are known to have increased mortality levels and the precarious social conditions of homeless people might further complicate their situation. Our results suggest that the health consequences associated with substance abuse were more hazardous than those of schizophrenia spectrum disorders in this Danish homeless shelter population. Previous studies document that a substance use disorder reduces the rates of treatment adherence in patients with schizophrenia.³⁵ People with schizophrenia but no substance abuse might comply better with treatment than those who also have substance abuse (ie, dual diagnosis). People with schizophrenia spectrum disorder without contact to the mental health system might have an even higher mortality risk than those who do have contact. The probability of dying for people with no psychiatric contact registered was comparable to or higher than those who had been registered with schizophrenia spectrum disorders and other psychiatric

disorders. This finding was not as expected, and might suggest that many homeless people have untreated psychiatric disorders¹ or other problems, such as physical diseases.³⁶ Additionally, the association between increased number of contacts to homeless shelters within the first year of contact and higher mortality could suggest that the transient homeless population is the most vulnerable.¹

Our findings that people from low-income and middle-income countries had a lower mortality risk than those with Danish origin were in line with our expectations. The threshold to become homeless in Denmark for people with Danish origin might be higher than those not of Danish origin because they have better access to cash benefit and widespread knowledge about how to access health care and social services. People from low-income and middle-income countries do probably, to a greater extent than those of Danish origin, become homeless for reasons other than psychiatric disorders, such as housing problems and unemployment. In other words, we would expect that homeless individuals of Danish origin might to a greater extent have treated or untreated psychiatric disorders than homeless people from low-income or middle-income countries. Findings from a Canadian study are consistent with this hypothesis.³⁷ Our results suggest that people in homeless shelters who are from low-income or middle-income countries might have other service needs than the people from Denmark and other high-income countries.

Our study has several strengths. First, our results are based on a large homeless sample, which is representative of the homeless shelter population in Denmark. We have no reason to expect that the Danish homeless shelter population differ markedly from those in other welfare states that have well-developed social safety nets. Second, the use of registers ensures prospective, uniformly and neutrally collected data, which restrict the methodological problems of loss to follow-up and selection bias. Additionally, we were able to take loss to follow-up and emigration into account. Third, the information on psychiatric hospital contact and death is complete. Finally, the CRS number ensures optimum conditions for linking data on homeless shelter status with psychiatric hospital contacts and deaths.

However, our study has some limitations. First, homeless people who do not choose to stay in homeless shelters but instead sleep rough on the street were not included in this study. We cannot be sure that the results are representative of this subgroup. In previous studies, non-sheltered homeless people had a higher morbidity and mortality rate and were less likely to use health services than the sheltered homeless.^{2,38} We would expect our estimates to be conservative, but we cannot know if homeless people who do not visit homeless shelters are healthier than those who do. Thus, the potential biases could go in either direction. Additionally, 5.5% of the homeless sample could not be matched in the CRS,

partly because some homeless people provided invalid CRS numbers. Second, our homeless definition was broad and classed people as homeless if they had had any contact with a homeless shelter from 1999 to 2009. Thus, we have not taken into account that some people might have temporarily or permanently ceased to be homeless during the study period. We expect this factor led to an underestimation of our estimates.² Third, we cannot make any statements regarding the causality between psychiatric disorders and homelessness. However, both homelessness and psychiatric morbidity probably contribute to the excess mortality in this population, and efforts to address both of these problems would probably be the most effective way to improve the health status of the homeless shelter population. Fourth, only psychiatric disorders treated in psychiatric inpatient and outpatient facilities in Denmark were included; visits to primary health settings were not. Use of register data does not provide optimum conditions for estimation of the proportion of psychiatric disorders among homeless people, who often are ostracised and isolated from societal institutions. Supplementation of register data with validated diagnostic interviews would be ideal to estimate the exact prevalence of diagnosed psychiatric disorders in the homeless shelter population. However, we were unable to do diagnostic interviews because we were investigating such a large sample. Previous research has shown that psychiatric emergency contact is common among homeless people³⁹ whereas contact with general medical services is not.⁴⁰ We would expect that the actual prevalence of psychiatric disorders in this Danish homeless shelter population is higher than our estimates. Fifth, we were unable to control for all potentially relevant confounding factors in the analyses—eg, physical diseases,³⁶ social network, and family contact. Finally, the Danish Homeless Register has only existed for 11 years, which implies that mean age at first contact will have been overestimated.

In this study, we confirm previous findings that homeless people have complex psychiatric problems and suggest that especially substance abuse disorders are associated with increased mortality risk. Our findings underline the urgent need for more sustained efforts to reduce the high psychiatric morbidity and mortality in this high-risk group. Additionally, the high excess mortality for suicide and unintentional injuries suggests that prevention of death from external causes is very important in this socially marginalised population.

Contributors

MN obtained the funding. SFN and MN designed the study and acquired the data. SFN wrote the protocol. CRH and MN supervised the protocol design. CRH constructed the database. SFN did all the statistical analyses with supervision from CRH and MN. AE constructed the life tables. SFN, CRH, AE, and MN analysed and interpreted data. SFN drafted the manuscript, and CRH, AE, and MN revised the manuscript. All authors approved the final version.

Conflicts of interest

We declare that we have no conflicts of interest.

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