Homelessness and police-recorded crime victimisation: a nationwide, register-based cohort study

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Summary

Background Homelessness is associated with crime victimisation, which is a leading cause of death, exacerbates health problems, and increases the risk of violence. We aimed to study the risk of police-recorded crime victimisation in individuals with experiences of homelessness compared with the general population.

Methods We did a nationwide, register-based cohort study of people aged 15 years or older, who were alive in 2001 and born in Denmark between 1980 and 2001. The cohort was constructed using the Danish Civil Registration System, with data linked across other registries (including the Danish Homeless Register, Danish Psychiatric Central Research Register, and the Danish Central Crime Register) by use of personal identification numbers. The exposure, experience of homelessness, was defined as at least one contact with a homeless shelter. The outcome was the date of first police-recorded crime victimisation. We calculated incidence rates per 1000 person-years, incidence rate ratios (IRRs), and cumulative probability of any crime victimisation and of violent crime victimisation. Psychiatric disorders, socioeconomic markers, and history of criminal offences were included as confounders.

Findings Within the study period (Jan 1, 2001, to Dec 31, 2015), 1 182 749 individuals (9 831 776 person-years) aged 15–35 years were included, of which 184 813 (15·6%) had at least one crime victimisation incident (73 999 [40%] of which were violent victimisations). 4286 individuals (22 240 person-years) had at least one homeless shelter contact. Relative to the general population, and adjusting for age and calendar year, individuals with experience of homelessness had an increased risk of any crime victimisation (IRR 2·7 [95% CI 2·4–3·0]) in females and 2·3 [2·1–2·5] in males), and especially of violent crime victimisation (7·2 [6·3–8·2] in females and 3·6 [3·2–4·0] in males). This increased risk remained significant after further adjustments for potential confounders. People with both a psychiatric diagnosis and experience of homelessness had the highest risk of violent victimisation (IRR 10·1 [95% CI 8·6–11·9] in females and 4·3 [3·8–4·9] in males), while people with no psychiatric diagnosis or experience of homelessness (the reference group) had the lowest risk. In the 5 years after an individual's first homeless shelter contact, the cumulative probabilities of any crime victimisation were 23% (95% CI 21–26) in females and 16% (15–18) in males, which were substantially higher than those of the general population.

Interpretation Homeless populations are at substantially increased risk of crime victimisation, highlighting the need for strategic and targeted approaches to prevent homelessness and to help people out of homelessness. Improvements in multiagency working (such as between homeless shelters, health-care services, substance misuse services, and police forces) might be important to reduce the risk of victimisation in marginalised populations, such as those with complex psychiatric or social problems, with experience of homelessness.

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Introduction

Homelessness is an increasing problem in high-income countries.[1] The life expectancy after an individual becomes homeless is reduced by around 20 years compared with the general population.[2] Besides mortality linked to homelessness[3] and social exclusion,[4] homelessness is reported to increase the likelihood of experiencing victimisation (ie, being a victim of criminal offences).[1,5,6] Victimisation is associated with substantial public health problems as it increases the risks of mental illness and physical health problems, exacerbates existing health problems, increases the likelihood of being a perpetrator of violence, reduces quality of life, and is

costly to health-care and social services.[7,8] According to WHO, in the European region, around 31 000 people die each year as a result of interpersonal violence (20% of the around 158 000 total deaths), with males being victims of violence and dying from violence more often than females. The risk of death due to interpersonal violence is more than seven times higher in low-income and middle-income countries than in high-income European countries.[9]

The prevalence of physical or sexual assault victimisation within the past year has been estimated to range from 27% to 52% in homeless populations.[1] Homeless individuals have complex health problems,

Research in context

Evidence before this study
We searched PubMed for studies of homelessness and victimisation using the search terms "homeless*" and "victim*", from database inception to Aug 6, 2018, with no language restrictions. We found no population-based studies focusing on the association between homelessness and victimisation. Most articles focused on the association between mental illness and victimisation, with some including homelessness as a risk factor. Three systematic reviews of the associations between homelessness and self-reported victimisation were identified. Two of these reviews focused on sexual victimisation and homeless people younger than 25 years of age, but it was unclear whether homelessness was prospectively associated with sexual victimisation. A systematic review of homeless adults with severe mental illness showed high short-term and lifetime prevalence of victimisation in this group, which was higher than that among housed adults with severe mental illness. Furthermore, female sex, childhood abuse, and depression were associated with victimisation, but none of the six studies included in the review were longitudinal, the study samples were highly selected, and the outcomes were defined very differently. Few studies had been done outside of the USA. We identified several gaps in the literature of the association between homelessness and victimisation: the lack of population-based studies and studies using comparison groups, detailed analyses including important confounders such as psychiatric disorders, analyses stratified by sex and type of victimisation, analyses with high statistical strength and complete follow-up, and data on the absolute rates of victimisation by homeless experience.

Added value of this study
To our knowledge, this is the first nationwide study to analyse the risk of police-recorded victimisation in a large population-based study of homeless shelter users, with results stratified by sex and by type of victimisation (violent and non-violent). Using the Danish national registers, including the Danish Homeless Register, we analysed absolute and relative risks of victimisation associated with homelessness in a cohort of 1 182 749 individuals aged 15–35 years for a 15-year period, considering several important confounders (psychiatric diagnoses, parental socioeconomic markers, and past criminal offences). We showed that experience of homelessness was significantly associated with increased risk of violent police-recorded crime victimisation, but not non-violent crime victimisation.

Implications of all the available evidence
The increased risk of violent victimisation in homeless individuals using shelters represents an underappreciated health problem. Violent victimisation can contribute to severe health problems and thereby potentially have large consequences for public health and increase health inequalities. Therefore, it is important that populations at high risk for homelessness be identified and supported to avoid homelessness. In addition, as we showed the highest risk for crime victimisation in people with co-occurring health and homelessness problems, improvements in multiagency collaboration—such as between homeless shelters, health-care services, substance misuse services, and police forces—are likely to be important in reducing the risk of victimisation in marginalised populations affected by homelessness. We suggest that future research studies examine the risk of victimisation in other countries and in other cohorts of homeless people, including young people. Longitudinal studies of the association between homelessness and victimisation could help to clarify the timing, magnitude, and interactions of risk factors, and identifying modifiable risk factors could provide evidence for prevention.

including psychiatric disorders,[2,10] and both substance use disorders and mental illnesses are linked to increased risk of victimisation.[1,11,12] Lifetime victimisation rates have been suggested to be higher in homeless adults with severe mental illness than in their housed counterparts.[13] A systematic review of homeless youth reported an unclear association with sexual crime victimisation, and highlighted the need for future prospective studies and studies taking into account the situational context of homelessness.[14]

Studies of the association between homelessness, psychiatric morbidity, and victimisation in a population-based sample are lacking.[5,7,13,14] Danish registers can provide unique nationwide information on homeless shelter use and police-recorded crime victimisation, as well as pre-existing psychiatric disorders. We aimed to study the absolute and relative risks of police-recorded crime victimisation among people experiencing homelessness compared with the general population, as well

as the combined effects of homelessness and psychiatric disorders.

Methods
Data sources and study participants
We did a nationwide, register-based cohort study including all people aged 15 years or older, who were alive in 2001 and were born in Denmark between 1980 and 2001. The study period covered Jan 1, 2001, to Dec 31, 2015. The cohort was constructed using the Danish Civil Registration System,[15] which contains complete information since 1968 on personal identification number (CPR number), sex, and age, as well as daily updated information on migration and vital status, which could be used for censoring. The CPR number makes it possible to link data from different registers accurately, since other registers also contain information on CPR number.[15] This use of the personal identification number in Denmark also facilitates linkage between parents and

offspring. We excluded individuals without a link to their mother (appendix p 1).

Danish municipalities must provide temporary accommodation to people who have no home or cannot stay in their own home and who need extra support. Individual-level information on the use of shelters offering residential stays to homeless people in Denmark, as prescribed under section 110 of the Social Services Act,[16] has been captured in the Danish Homeless Register since 1999. This register contains information on all check-in and check-out dates to these accommodations, as a valid CPR number is required and used for registration. Statistics Denmark is responsible for the validation of data, and the register has been cleared for certain errors including invalid CPR numbers and double registrations.[17] The first check-in date to a shelter during the study period was used to define the beginning of a period of homelessness. Thus, in this study, periods of homelessness are measured as periods of homeless shelter contact, in accordance with previous studies using the Danish Homeless Register.[2]

Information on psychiatric disorders was retrieved from the Danish Psychiatric Central Research Register,[18] which has included data on all psychiatric admission and discharge dates and psychiatric diagnoses since 1969 and psychiatric outpatient contacts since 1995. Diagnoses were defined according to the International Classification of Diseases 10th revision (ICD-10) since 1994.[19] Corresponding codes from ICD-8 were used for diagnoses received before 1994. Substance use diagnoses were also included from the Danish National Patient Register,[20] covering information on somatic inpatient contacts since 1977 and outpatient contacts since 1995.

An overall psychiatric covariate was used, defined as any psychiatric disorder including substance use disorders (codes F0–F9). Additionally, a hierarchical covariate was constructed from the specific psychiatric diagnostic groups, with the first listed being highest in the hierarchy: (1) substance use disorder (F10–19); (2) schizophrenia (F20) or bipolar disorder (F30–31); (3) depressive disorder (F32–33) or anxiety disorder and stress-related disorder (F40–48); and (4) any other diagnosis. Substance use disorder was placed at the top of the hierarchy as this diagnosis is among the most prevalent in homeless populations and is found to be the strongest predictor of severe health problems.[2,10]

Data on education were collected from the Integrated Database for Labour Market Research,[21] containing yearly updated data on highest completed educational level since 1980. Adjustment for parental socioeconomic status was made using information on the highest completed educational level for the mother and father in the year of the cohort member's 15th birthday (primary or lower secondary school, upper secondary education, vocational education and training, higher education, or missing information). A covariate of the father's status at birth (known *vs* unknown) was constructed. An individual's criminal offences were defined as guilty verdicts referring to the penal code (including sexual offences and crimes of violence), special law (Euphoriants Act and Offensive Weapons Act), and sentences to psychiatric treatment, based on information from the Central Criminal Register.[22–24]

Permission to use these data in the study was obtained from Statistics Denmark, the National Social Appeals Board, the National Health Data Authority, and the National Board of Health. Ethical permission was not required. All data were anonymised for analysis.

Outcomes

The outcome was the first date of being a victim of any police-recorded crime. This information was drawn from the Danish Central Crime Register, which has been available since 2001.[24,25] This outcome was also separated into violent and non-violent crime victimisation (with codes adhering to those used in a previous study by Dean and colleagues;[12] appendix p 2). Violent crime included physical assault, aggravated acquisitive crimes, violent threats, and sexual offences.[12]

Statistical analysis

Cohort members were followed up from Jan 1, 2001, or their 15th birthday, whichever came last, and until an event occurred (ie, first record of being a victim of any crime) or until censoring because of death, emigration, or end of study (Dec 31, 2015), whichever came first. The 15-year follow-up period started in 2001. Poisson regression was used in the survival analysis of the cohort[26] to calculate incidence rates per 1000 person-years and incidence rate ratios (IRRs) using log-likelihood estimation. Wald 95% CIs were calculated. The assumption of piecewise constant intensity in the 1-year age groups that should be met in Poisson analysis was fulfilled.[27] We selected confounders for our analyses based on theoretical information on associations with exposure (homelessness) and outcome (victimisation). Data were analysed according to our study protocol (appendix pp 10–14).

In model 1, all IRRs were adjusted for calendar year and age, both in 1-year bands, and were stratified by sex. Model 1 was chosen as our main model as the additional adjustments could confer risk of over-adjustment. In model 2, analyses were adjusted for the hierarchical psychiatric covariate as defined above, as well as the adjustments made in model 1. In model 3, we adjusted for parental educational level and having an unknown father, as well as for the adjustments made in models 1 and 2. Finally, in model 4, own criminal offence was included, along with the adjustments made in models 1–3.[12] We also analysed the combined effect of any psychiatric diagnosis, including substance use disorders, and homelessness experience according to the risk of violent police-recorded crime victimisation.

We analysed the absolute risks of any police-recorded crime victimisation and any violent victimisation during

	No homeless shelter contact			At least one homeless shelter contact		
	Number of individuals victimised	Person-years (%)	Incidence rate per 1000 person-years (95% CI)	Number of individuals victimised	Person-years (%)	Incidence rate per 1000 person-years (95% CI)
Total crime victimisation	183 926	9 809 536	18·8 (18·7–18·8)	887	22 240	39·9 (37·3–42·6)
Age, years						
15–19	79 398	4 105 780 (41·9%)	19·3 (19·2–19·5)	85	1269 (5·7%)	67·0 (54·2–82·8)
20–24	67 997	3 180 762 (32·4%)	21·4 (21·2–21·5)	392	8340 (37·5%)	47·0 (42·6–51·9)
25–29	28 520	1 786 890 (18·2%)	16·0 (15·8–16·2)	284	8278 (37·2%)	34·3 (30·5–38·5)
≥30	8011	736 104 (7·5%)	10·9 (10·7–11·1)	126	4352 (19·6%)	29·0 (24·3–34·5)
Sex						
Female	95 385	4 770 647 (48·6%)	20·0 (19·9–20·1)	368	7168 (32·2%)	51·3 (46·4–56·9)
Male	88 541	5 038 889 (51·4%)	17·6 (17·5–17·7)	519	15072 (67·8%)	34·4 (31·6–37·5)
Status of father at birth						
Known father	181 537	9 712 198 (99·0%)	18·7 (18·6–18·8)	862	21 577 (97·0%)	39·9 (37·4–42·7)
Unknown father	2389	97 338 (1·0%)	24·5 (23·6–25·5)	25	663 (3·0%)	37·7 (25·5–55·8)
Highest parental educational level completed*						
Primary or lower secondary education	24 007	1 269 639 (12·9%)	18·9 (18·7–19·1)	384	9114 (41·0%)	42·1 (38·1–46·6)
Upper secondary education	3912	186 678 (1·9%)	21·0 (20·3–21·6)	19	447 (2·0%)	42·5 (27·1–66·6)
Vocational education and training	75 835	4 426 477 (45·1%)	17·1 (17·0–17·3)	330	8855 (39·8%)	37·3 (33·5–41·5)
Higher education	79 006	3 866 099 (39·4%)	20·4 (20·3–20·6)	121	3157 (14·2%)	38·3 (32·1–45·8)
Missing information	1166	60 644 (0·6%)	19·2 (18·2–20·4)	33	667 (3·0%)	49·5 (35·2–69·6)
Any psychiatric disorder (including substance use disorder)	24 537	947 567 (9·7%)	25·9 (25·6–26·2)	576	13 813 (62·1%)	41·7 (38·4–45·2)
Specific psychiatric disorders†						
Substance use disorder	8203	239 391 (2·4%)	34·3 (33·5–35·0)	393	8846 (39·8%)	44·4 (40·2–49·0)
Schizophrenia or bipolar disorder	600	33 810 (0·3%)	17·8 (16·4–19·2)	14	561 (2·5%)	25·0 (14·8–42·2)
Depressive, anxiety, or stress-related disorder	9050	373 532 (3·8%)	24·2 (23·7–24·7)	91	2550 (11·5%)	35·7 (29·1–43·8)
Other mental disorder	6684	300 834 (3·1%)	22·2 (21·7–22·8)	78	1856 (8·3%)	42·0 (33·7–52·5)
No psychiatric disorder	159 389	8 861 969 (90·3%)	18·0 (17·9–18·1)	311	8427 (37·9%)	36·9 (33·0–41·2)
Own criminal offending						
Yes	9522	313 639 (3·2%)	30·4 (29·8–31·0)	438	10 273 (46·2%)	42·6 (38·8–46·8)
No	174 404	9 495 897 (96·8%)	18·4 (18·3–18·5)	449	11 966 (53·8%)	37·5 (34·2–41·2)

Because of rounding differences, the number of person-years summed up for each covariate can be different from the total number of person-years. *Determined for the year of the cohort member's 15th birthday. †Defined as a hierarchical covariate with the following hierarchy: substance use disorder; schizophrenia or bipolar disorder; depressive, anxiety, or stress-related disorder; and any other mental illness.

Table 1: Incidence rates for police-recorded crime victimisation by covariates among individuals with and without homeless experiences, 2001–15

the 5 years from first contact with a homeless shelter by calculating cumulative incidence curves stratified by sex. Adjustments for competing risks from death and emigration were made. To be able to compare the absolute rates of victimisation related to experiences of homelessness with the levels in the general population, we included population-based controls. These controls were matched by sex and exact birthday, and five controls per individual with experience of homelessness were randomly selected and followed from the date of the first homeless shelter contact by the corresponding case.

We did six sensitivity analyses. First, we analysed the association of homelessness and sexual victimisation. To study the association between homelessness and any victimisation we used other measures of homelessness (accumulated number of shelter contacts [none, one, two to four, or five or more] and at least two or at least three shelter contacts) as the definition of experience of homelessness, instead of at least one shelter contact. Additionally, stratified analyses by specific psychiatric disorders and by history of criminal offence were done to examine the effect of homelessness on victimisation in more detail. Finally, we checked whether restriction of the cohort to individuals born from 1986 to 2001 changed the results, as our cohort might include a few individuals with homeless shelter contact during 1995–98 without being recorded as homeless.

All analyses were done with use of SAS software (version 9.4.).

Role of the funding source

	Number of individuals victimised	Person-years	Incidence rate per 1000 person-years (95% CI)	Model 1*		Model 2†		Model 3‡		Model 4§	
				IRR (95% CI)	p value	IRR (95% CI)	p value	IRR (95% CI)	p value	IRR (95% CI)	p value
All crime victimisation (n=184 813)											
Females											
No homeless shelter contact	95 385	4 770 647	20·0 (19·9–20·1)	1·0 (ref)	..	1·0 (ref)	..	1·0 (ref)	..	1·0 (ref)	..
At least one homeless shelter contact	368	7168	51·3 (46·4–56·9)	2·7 (2·4–3·0)	<0·0001	2·1 (1·9–2·3)	<0·0001	2·1 (1·9–2·4)	<0·0001	1·9 (1·7–2·1)	<0·0001
Males											
No homeless shelter contact	88 541	5 038 889	17·6 (17·5–17·7)	1·0 (ref)	..	1·0 (ref)	..	1·0 (ref)	..	1·0 (ref)	..
At least one homeless shelter contact	519	15 072	34·4 (31·6–37·5)	2·3 (2·1–2·5)	<0·0001	1·6 (1·5–1·8)	<0·0001	1·6 (1·5–1·8)	<0·0001	1·4 (1·2–1·7)	<0·0001
Violent crime victimisation (n=73 999)											
Females											
No homeless shelter contact	24 705	5 199 943	4·8 (4·7–4·8)	1·0 (ref)	..	1·0 (ref)	..	1·0 (ref)	..	1·0 (ref)	..
At least one homeless shelter contact	224	8906	25·2 (22·1–28·7)	7·2 (6·3–8·2)	<0·0001	3·9 (3·4–4·4)	<0·0001	3·3 (2·9–3·8)	<0·0001	2·4 (2·1–2·8)	<0·0001
Males											
No homeless shelter contact	48 693	5 273 440	9·2 (9·2–9·3)	1·0 (ref)	..	1·0 (ref)	..	1·0 (ref)	..	1·0 (ref)	..
At least one homeless shelter contact	377	16 838	22·4 (20·2–24·8)	3·6 (3·2–4·0)	<0·0001	2·2 (2·0–2·4)	<0·0001	2·0 (1·8–2·2)	<0·0001	1·4 (1·3–1·6)	<0·0001
Non-violent crime victimisation (n=110 814)											
Females											
No homeless shelter contact	70 680	5 014 253	14·1 (14·0–14·2)	1·0 (ref)	..	1·0 (ref)	..	1·0 (ref)	..	1·0 (ref)	..
At least one homeless shelter contact	144	11 113	13·0 (11·0–15·3)	0·9 (0·8–1·1)	0·1843	0·9 (0·8–1·0)	0·1575	1·0 (0·8–1·2)	0·9607	1·0 (0·8–1·2)	0·9990
Males											
No homeless shelter contact	39 848	5 461 135	7·3 (7·2–7·4)	1·0 (ref)	..	1·0 (ref)	..	1·00 (ref)	..	1·0 (ref)	..
At least one homeless shelter contact	142	22 204	6·4 (5·4–7·5)	0·8 (0·7–1·0)	0·0204	0·8 (0·7–1·0)	0·0089	0·9 (0·8–1·1)	0·2716	0·9 (0·8–1·1)	0·4590

IRR=incidence rate ratio. *Adjusted for age and calendar year. †Adjusted for age, calendar year, and psychiatric disorders defined as a hierarchical covariate with the following hierarchy: substance use disorder; schizophrenia or bipolar disorder; depressive, anxiety, or stress-related disorder; and any other mental illness. ‡Adjusted for age, calendar year, psychiatric disorders, highest parental educational level at the year of the cohort member's 15th birthday, and father's status at birth (known vs unknown). §Adjusted for age, calendar year, psychiatric disorders, highest parental educational level, father's status, and own history of offending.
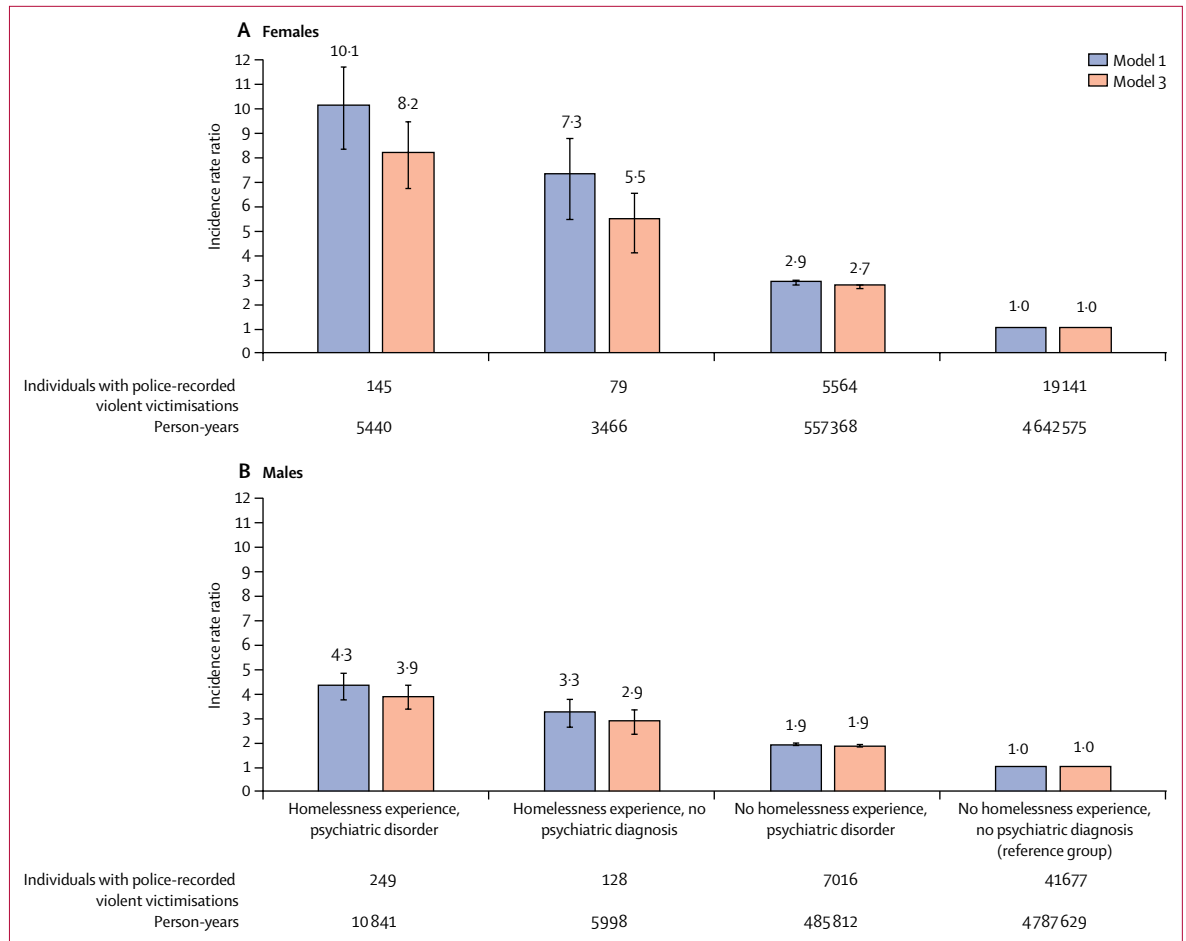
Table 2: Risk of police-recorded crime victimisation by homelessness experience, 2001–15

had final responsibility for the decision to submit for publication.

Results

From Jan 1, 2001, to Dec 31, 2015, a total of 1 182 749 individuals (574 535 [48·6%] females and 608 214 [51·4%] males) aged 15–35 years were included in the study cohort (see appendix p 1 for a flow diagram), after the exclusion of 618 (0·05%) individuals without a link to their mother. The entire cohort accounted for

9 831 776 person-years at risk for first police-recorded crime victimisation, during which 184 813 people (15·6% of the cohort) were victims of crime (73 999 [40·0%] of which were violent). The median length of follow-up was 8·3 years. The mean age of first victimisation was 21 years (SD 4; median 20 years [IQR 18–24; 5th–95th percentile 15–29]). 4286 individuals (22 240 person-years) in the study population had at least one contact with a homeless shelter, among which 887 experienced police-recorded crime victimisation (incidence rate 39·9 [95% CI 37·3–42·6]

Figure 1: **Combined effects of experience of homelessness and psychiatric disorders, including substance use disorders, on risk of violent police-recorded crime victimisation**

Incidence rate ratios for violent police-recorded crime victimisation in females (A) and males (B) by homelessness experience and psychiatric disorder. The reference group was individuals with no experience of homelessness during the study period (2001–15) and no psychiatric contact. Model 1 is adjusted for age and calendar year. Model 3 is adjusted for age, calendar year, highest parental educational level at the year of the cohort member's 15th birthday, and their father's status (known *vs* unknown). Error bars are 95% CIs.

per 1000 person-years). Incidence rates of crime victimisation by characteristic and by experience of homelessness are shown in table 1.

Adjusted for age and calendar year (model 1), the IRR of crime victimisation in individuals with experience of homelessness relative to those without was 2·7 (95% CI 2·4–3·0) in females and 2·3 (2·1–2·5) in males (table 2). The IRRs were attenuated but remained high when adjusting for psychiatric disorders and socioeconomic markers (models 2 and 3). Further adjustment for own criminal offending (model 4) resulted in an IRR of 1·9 (1·7–2·1) in females and 1·4 (1·2–1·7) in males with a homeless shelter contact compared with those without (table 2).

The results of analyses separated by violent and non-violent victimisation showed that homelessness was associated with an increased risk of violent victimisation. The basic adjusted IRR of violent victimisation for people with homeless shelter contact was 7·2 (6·3–8·2) for

females and 3·6 (3·2–4·0) for males compared with those without such contact (table 2).

Non-violent victimisation showed no association with experience of homelessness (table 2). An association between homeless shelter contact and increased risk of sexual victimisation was found in an analysis not stratified by sex (appendix p 3).

Figure 1 shows the combined effect of experience of homelessness and psychiatric disorder on the risk of violent crime victimisation. High IRRs adjusted for age and calendar year were found in females who had had homeless shelter contact and had a psychiatric disorder (10·1 [8·6–11·9]) compared with those with neither experience of homelessness or a psychiatric disorder (the reference group; figure 1A). This risk was lower in females who had experienced homelessness but had no psychiatric diagnosis (7·3 [5·8–9·1]), and further reduced in those with a psychiatric diagnosis but no homeless shelter contact (2·9 [2·8–3·0]), but both were significantly

increased compared with the reference group. In males, a similar risk pattern was found, but all IRRs were lower than those in the females (figure 1B; appendix p 4).

Figure 2 shows the cumulative probability, stratified by sex, of any victimisation and any violent victimisation up to 5 years after an individual's first homeless shelter contact (exact estimates are provided in the appendix p 5). A marked increase in the probability of any crime victimisation was found during the 5 years from first homeless shelter contact, especially in females. The probability of any crime victimisation occurring within 5 years of an individual's first homeless shelter contact was 23% (95% CI 21–26) in females and 16% (15–18) in males. These estimates were substantially higher than those in matched controls from the general population (10% [10–11] in females and 7% [7–8] in males 5 years after matching). Over the same time period, the probability of being the victim of a violent crime was 12% (10–14) in females and 11% (10–12) in males who had had contact with a homeless shelter (figure 2B; appendix p 5).

Restriction of the definition of homelessness to at least two or at least three homeless shelter contacts resulted in slightly increased risk of any crime victimisation compared with the results when homelessness was defined as at least one homeless shelter contact (table 2), but did not materially change the results (ie, risk was still significantly increased in people with versus those without homeless shelter contact; appendix p 6). In a further analysis of the association between accumulation of homeless shelter contacts and any crime victimisation, IRRs increased with number of homeless shelter contacts, with individuals who had had five or more shelter contacts showing the greatest risk (IRR 3·6 [95% CI 2·9–4·5] in males and 4·0 [2·6–6·0] in females, relative to no shelter contact; appendix p 7).

A subanalysis by hierarchically categorised psychiatric disorders showed that in both females and males, those with a substance use disorder, those with a depressive, anxiety, or stress-related disorder, those with other psychiatric disorders (except schizophrenia and bipolar disorder), and those without a psychiatric diagnosis all had an increased risk of any victimisation if they had had homeless shelter contact compared with those who had not. By contrast, homeless shelter contact was not associated with significantly increased risk in those with schizophrenia or bipolar disorder (appendix p 8).

Experience of homelessness was associated with an increased risk of any crime victimisation in people with and without a history of criminal offending. The highest risk was found in females, both without (IRR 2·4 [2·1–2·7]) and with (2·2 [1·8–2·7]) a history of criminal offending. Among males, the risk of victimisation associated with homeless shelter contact was higher in those without a history of criminal offending (2·0 [1·7–2·3]) than in those with such a history (1·6 [1·4–1·8]; appendix p 9). Compared with the results based on the entire study population (table 2), the analysis restricted to
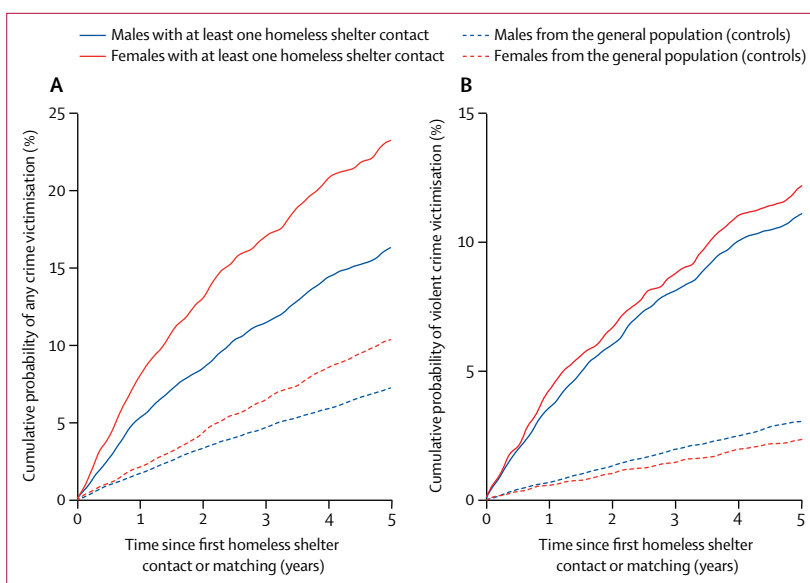
Figure 2: **Cumulative probability of any police-recorded crime victimisation (A) and violent police-recorded crime victimisation (B) in 5 years after first homeless shelter contact**
Probability of victimisation within 5 years is shown for individuals with homeless shelter contact and for age-matched and sex-matched controls from the general population.

the younger subcohort (born after 1985) showed slightly lower risk of any crime victimisation in models 1–3, but the risk was still significantly higher in those with homeless shelter contact than in those without (appendix p 10).

Discussion

In this Danish, nationwide, register-based cohort study, clear associations between homelessness and violent police-recorded crime victimisation were found in a large cohort of 1182749 individuals. Risk of violent crime victimisation, after adjustment for age and calendar year, was around seven times higher in females and four times higher in males with at least one homeless shelter contact compared with the general population, and this increased risk remained after adjustments for psychiatric disorders and markers of socioeconomic status. The highest violent victimisation risk associated with homelessness was found in those who also had a psychiatric diagnosis. However, no clear association with non-violent victimisation was identified. The probability of any crime victimisation occurring in the 5 years after first contact with a homeless shelter was around 23% in females and 16% in males with experience of home-lessness. Women had the highest risk of victimisation in both absolute and relative terms.

Although this study has confirmed previous suggestions of a high risk of violent victimisation related to home-lessness and severe mental illness,[8,12,13] we have, for the first time to our knowledge, shown this risk in a large population-based study, covering an entire population of homeless shelter users with matched controls from the

general population. We have also presented both relative and absolute rates of victimisation, and adjusted for several potential confounders with nearly complete information on all included data. Methodological differences in study design, population, outcome measure, and adjustments make comparison with previous investigations difficult.

Similar to observations in individuals with mental illnesses,[12] our results for people with experience of homelessness showed a higher risk of violent victimisation in females than in males. This contrasts with the general population, where violent victimisation is higher in males.[9,28] This different pattern in people with experience of homelessness is not easily explained, and multiple factors might contribute.[12] However, several differences between homeless populations and the general population exist (eg, childhood abuse is more prevalent among people experiencing homelessness).[29] Thus, one possible explanation is the link between childhood maltreatment and increased risk of criminal justice involvement and victimisation in homeless people,[30] since a higher proportion of homeless women than homeless men have a history of childhood sexual abuse.[29]

Homelessness was associated with any police-recorded crime victimisation in individuals with substance misuse and in those with severe mental illness, who previously have been found to have increased risk of victimisation.[12] In people with substance use problems, this increased risk might be mediated by the high rates of violence in settings where drugs are available, but might also be linked to direct consequences of drug and alcohol misuse, including disinhibition, risk taking, and paranoia. Homelessness was also associated with a high risk of police-recorded crime victimisation in those without psychiatric diagnosis. It is possible that these individuals have subthreshold or undiagnosed conditions.

This study has some important limitations. As information on victimisation was based on police records, we cannot generalise our results to all victimisations. Furthermore, our numbers of victimisations are very likely underestimates; Danish surveys have estimated that around 58% of violent victimisation incidents were not reported to the police in 2018.[25] It is expected that non-violent crimes will be particularly under-reported in homeless people,[28] as they often fear or dislike authority figures such as police officers, and police might take criminal reports from homeless people less seriously. Additionally, it is possible that victimisation experienced while being homeless is assumed by police to be expected in such a setting and thus not recognised as a crime. Overall, this risk of outcome misclassification is expected to result in estimates biased towards the null, and could explain the lack of an association between homelessness and non-violent crime victimisation. Furthermore, we did not have information on possible confounders, including undiagnosed disorders, treatment status, and childhood victimisation.[29,30]

A further limitation is that, by using homeless shelter contact as a measure of homelessness, we assume that some individuals will have been homeless only for a short time; however, others might have experienced other types of homelessness before their first shelter contact. Because young homeless people are likely to use other homelessness services or to be so-called sofa surfers, our cohort is not representative of the entire population of homeless people in Denmark.[31] Furthermore, we could not determine whether people were homeless at the time of becoming a victim. Whether our results are generalisable to other countries is difficult to conclude because crime rates vary between high-income countries. With regard to overall victimisation rates, Denmark has been found to be among the top ten countries worldwide, alongside high-income countries such as England, Wales, the USA, and Sweden.[32] Denmark's position might be explained by its high rates of burglary; violent crime rates are low in Denmark compared with in other European countries, and the reporting rate of crimes to the police is relatively high.[32] Additionally, the Danish public social and health services are well developed and homeless people are likely to get more help than in several other European countries.

In conclusion, our finding of an increased risk of violent victimisation in individuals using homeless shelters highlights an underappreciated health problem, which could contribute to severe health problems, thereby having potentially large consequences for public health and increasing health inequalities. On the basis of our findings, we suggest that future research studies examine risk of victimisation in other countries and other homeless cohorts, such as young people. Furthermore, longitudinal studies of the association between homelessness and victimisation will assist in clarifying the timing of risk factors, their magnitude and interaction, and assist in the evidence for prevention. Such studies should also be stratified by sex. Additionally, longitudinal studies of the relationships between homelessness, psychiatric disorders, criminality, and victimisation could improve our understanding of when and where to prioritise future interventions to reduce social and health-related problems in homeless people.

As victimisation leads to health problems and selectively targets marginalised populations, thus exacerbating health inequalities, the high risk of victimisation among homeless populations underscores the need to both prevent homelessness and to reduce the numbers of homeless people in high-income countries. Populations at high risk of homelessness should be identified and supported to avoid homelessness.

Future studies of the risk of homelessness following prison release or after leaving foster care or residential care should be considered, especially because these populations are typically already in contact with health and social services. Furthermore, studies of health service use before first experience of homelessness could

identify specific health and psychosocial needs, some of which might be modifiable and reduce the risk of homeless incidence.

This increased risk of violent victimisation in people experiencing homelessness suggests that health and social services should inquire and take account of a history of violent victimisation, and should consider managing the risk of consequent health problems, increased health service use, and repeat victimisation. Housing First intervention studies from a greater range of countries are needed to improve existing approaches to reducing homelessness, and should include victimisation as one of the trial outcomes. Given that we have shown the highest risk of victimisation in people with co-occurring health and homelessness problems, our study also suggests that improvements in multi-agency working (such as between homeless shelters, health-care services, substance misue services, and police) could be important to reduce the risk of victimisation in marginalised populations identified as having experience of homelessness.

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