

The prevalence and geographic distribution of complex co-occurring disorders: a population study

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Aims. A subset of people with co-occurring substance use and mental disorders require coordinated support from health, social welfare and justice agencies to achieve diversion from homelessness, criminal recidivism and further health and social harms. Integrated models of care are typically concentrated in large urban centres. The present study aimed to empirically measure the prevalence and distribution of complex co-occurring disorders (CCD) in a large geographic region that includes urban as well as rural and remote settings.

Methods. Linked data were examined in a population of roughly 3.7 million adults. Inclusion criteria for the CCD sub-population were: physician diagnosed substance use and mental disorders; psychiatric hospitalisation; shelter assistance; and criminal convictions. Prevalence per 100 000 was calculated in 91 small areas representing urban, rural and remote settings.

Results. 2202 individuals met our inclusion criteria for CCD. Participants had high rates of hospitalisation (8.2 admissions), criminal convictions (8.6 sentences) and social assistance payments (over \$36 000 CDN) in the past 5 years. There was wide variability in the geographic distribution of people with CCD, with high prevalence rates in rural and remote settings.

Conclusions. People with CCD are not restricted to areas with large populations or to urban settings. The highest per capita rates of CCD were observed in relatively remote locations, where mental health and substance use services are typically in limited supply. Empirically supported interventions must be adapted to meet the needs of people living outside of urban settings with high rates of CCD.

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Introduction

The co-occurrence of mental illness and substance use is associated with increased risk of criminal conviction (Baillargeon *et al.* 2009a; Ruiz *et al.* 2012; Rezansoff *et al.* 2013), unemployment (Visher *et al.* 2005), as well as poverty and homelessness (Fazel *et al.* 2014). The prevalence of co-occurring substance use and mental disorders is 2.5% in the general US population (SAMHSA, 2007) but 49% in US jails (James & Glaze, 2006). Criminality and co-occurring disorders are often mutually exacerbating and together they contribute to additional risks, including suicide (Baillargeon *et al.* 2009b) and mortality on release from prison (Kariminia *et al.* 2007).

An important subpopulation experiences the confluence of mental illness, substance dependence,

corrections involvement and homelessness (or precarious housing) and can be described as having complex co-occurring disorders (CCD). Individuals with CCD require coordinated professional supports in order to address inter-dependent medical, psychiatric, housing, social and legal issues. Service models that have empirical support for people with CCD include specialised courts, such as mental health (McNiel & Binder, 2007) and drug treatment court (Somers *et al.* 2012, 2013b), Forensic Assertive Community Treatment (Cusack *et al.* 2010) and certain models of supported housing such as Housing First (Tsemberis *et al.* 2012; Somers *et al.* 2013a). In each case, these service models involve collaborative care spanning diverse professional and community resources.

Front-line service providers (e.g., police and clinicians) have sounded alarm that the number of individuals with CCD is increasing (Szkopek-Szkopowski *et al.* 2013). In the absence of sufficient appropriate resources, the justice system can be the primary point of engagement in the lives of people with CCD (Steadman *et al.* 2009). There are few empirically

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derived estimates of the prevalence and geographic distribution of CCD. Previous research has found that people with severe mental illnesses are more likely to change their location than individuals with serious physical illnesses (Lix *et al.* 2006), and that people with mental illness often move to locations where they have previously received care (Lamont *et al.* 2000). Several studies have reported concentrations of people with CCD in urban centres (Culhane *et al.* 1996; Luciano *et al.* 2014). But it is not clear how people with CCD are distributed over large regions, and if they are relatively less prevalent in rural and remote settings compared with urban centres. This information has crucial implications for the location and delivery of relevant interventions. In order to add to this area of knowledge, the present study examined the prevalence and geographic distribution of CCD in a large Canadian province (over 900 000 km²) with an adult population of approximately 3.7 million people. The goal of this study was to empirically estimate the rate and geographic distribution of individuals with CCD.

Method

Data sources

We examined linked administrative data spanning three provincial government ministries: justice, health services, and social development and social innovation. The respective ministries are responsible for comprehensive health, justice and social services to the entire adult population in the province of British Columbia (BC), Canada. The completeness of these data reflects the central organisational and funding role provided by the provincial government in the administration of these various services.

Non-identifying data were provided by the Government of BC through the Inter-Ministry Research Initiative (IMRI)

The purpose of the IMRI is to produce knowledge that supports the development and evaluation of multi-agency programmes involving the health and justice sectors. The IMRI is governed by Information Sharing Agreements between the partnering ministries and the host university. Planned analyses were reviewed and developed by a Steering Committee with representatives from each of the partnering institutions. Access to data is restricted to a designated secure off-line environment and is subject to police security clearance and other provisions to protect privacy. The present analysis used de-identified linked data spanning from 1997 to 2012.

Study population

The population available for analysis consisted of all individuals who had at least one conviction (including bail) between April 1st 1997 and March 31st 2012. We included only those individuals who were at least 18 years of age as of April 1st 2007, and who were not deceased prior to March 31st 2012 (the 5-year period used for observations in this study). Only individuals with linkable health records were included.

Variable details

Residents of BC are required to enrol with the Provincial Medical Services Plan (MSP). Hospital admissions and physician services are reported to the Provincial Ministry of Health, along with diagnostic details related to each admission or outpatient visit. The Ministry of Social Development and Social Innovation administers and records financial support to citizens based on demonstration of need, including shelter payments for those in need of housing. Details related to criminal convictions, including length of sentence in custody or community, are retained by the Ministry of Justice.

MSP records based on the International Classification of Diseases, 9th edition (ICD-9) were examined for physician diagnosed mental disorders between April 1st, 2007 and March 31st, 2012. All disorders were included within the ICD-9 range of 290–319 (mental disorders). Substance-related disorders were identified using the three-digit codes of 291, 292, 303, 304 and 305. Non-substance-related disorders consisted of all other codes within the range identified. Further details concerning these variables are described elsewhere (Rezansoff *et al.* 2013; Somers *et al.* 2013a, b).

CCD inclusion criteria

Integrating the domains of health, social assistance and criminality, we selected the following criteria to define the CCD sub-population. The date range for all sources of data was between April 1st, 2007 and March 31st, 2012:

- (1) At least one psychiatric hospitalisation (including substance-related admissions);
- (2) *And* at least two MSP encounters involving diagnoses of mental disorders (excluding substance use disorders);
- (3) *And* at least two MSP encounters involving diagnoses of substance use disorders;
- (4) *And* at least two convictions (delivered by any Provincial Court);
- (5) *And* at least \$5000 (CAD) in shelter payments.

Analysis

We first identified the total number of individuals meeting CCD inclusion criteria (above). Socio-demographic and service use characteristics were compared between the CCD sub-population and the remainder of the eligible offender population. Parametric tests (e.g., Student's *t* test) were used to compare continuous variables among groups. Chi-square tests (non-parametric) were used to examine relationships between categorical variables (such as gender and ethnicity) and the CCD groups. The regional distribution of the CCD sub-population was tabulated and examined at four geographic levels of increasing size: local health area (LHA); health service delivery area (HSDA); regional health authority (HA); total province (see maps in Appendices 1–3). For each individual, location was based on the most recent year of observation. For each region, the rate of CCD was estimated using the total number of CCD cases divided by the total adult population and expressed as a rate per 100 000. The adult population included all individuals who were at least 20 years of age or older in 2012. Population estimates (as of 2012) for the entire province as well as for each geographical area were obtained from BCStats (2013).

Results

Characteristics of the overall offender population ($n = 188\,625$) alongside the CCD sub-population ($n = 2202$) are listed in Table 1. Significance tests were conducted comparing those who met the CCD inclusion criteria with all other offenders (non-CCD participants). Results indicate that CCD and non-CCD individuals differed significantly on all variables examined. Compared with the non-CCD population, those who met the CCD criteria were younger, less well educated, more likely to be female, more likely to be aboriginal (descendants of original inhabitants) and less likely to be of other (i.e., neither white nor aboriginal) ethnicity. Members of the CCD sample were ten times more likely than others to have been diagnosed with Schizophrenia (41% *v.* 4%) and personality disorders (30% *v.* 3%) and six times more likely to have been diagnosed with drug dependence (86% *v.* 14%) and alcohol dependence (58% *v.* 9%). Those in the CCD subsample had eight times as many sentences as other offenders (8.6 *v.* 1.1), six times as many violent offences (1.2 *v.* 0.2) and nearly 50 times the number of psychiatric admissions (4.9 *v.* 0.1). Finally, those in the CCD group received approximately four times as much financial support as other offenders for shelter (19 155 *v.* 4968) and in total (36 258 *v.* 8798). Although our inclusion criteria included at least one

psychiatric hospitalisation and at least two criminal convictions, the observed amounts greatly exceeded our minimal inclusion levels (means of 4.9 and 8.6, respectively). As appropriate, the values presented in Table 1 are either means with standard deviations (s.d.), or numbers of participants (n) with percentages (%) represented by each category.

Geographic distribution

We examined the geographic distribution of those who met all of the CCD criteria (i.e., mental disorders, substance use disorders, criminal convictions, psychiatric hospitalisations and shelter support). Results are tabulated beginning with LHA (see map, Appendix 1), which represent the smallest available geographic units used to organise data by the BC Ministry of Health, BC Stats, Statistics Canada and the Canadian Institute for Health Information. LHAs are also used to examine and compare the health of communities in different parts of BC. There are 89 LHAs representing adult populations ranging from 420 to over 300 000 people over 19 years of age. Results were then aggregated into 16 HSDAs (see map, Appendix 2) and then the five geographic HAs (see map, Appendix 3). In each table, we included the size of the adult (20 years and older) population as of 2012 and reported the prevalence of CCD per 100 000 adults. At the provincial level (adult population 3 660 314) the prevalence of CCD was 60 per 100 000 adults.

LHA

The number of people in each LHA meeting the CCD criteria is listed in Table 2. LHAs are arranged in rows from those with the highest number of CCD individuals to those with the fewest. No results are shown for LHAs in which fewer than 15 people met the inclusion criteria. As expected, the highest rate was observed in the most urbanised region of the Province – the Downtown Eastside of Vancouver (330/100 000). The designation 'Vancouver Unknown Place' includes people with no fixed address, encompassing those who are homeless. The results indicate that the prevalence of CCD varied considerably between LHAs, and was not reliably related to geographic location in the province or population size. For example, regions of Greater Vancouver had relatively high rates in some instances (Downtown Eastside: 330/100 000) and relatively low rates in others (Burnaby 25/100 000). As a further reflection of geographic diversity, the threshold of at least 100 cases per 100 000 was exceeded in LHAs with relatively small populations (roughly 10 000 adults)

Table 1. Comparisons of socio-demographic and other related characteristics between CCD clients and non-CCD clients

Variables ^a	All participants (n = 188 625) Mean (s.d.) or n (%)	Non-CCD participants (n = 186 423) Mean (s.d.) or n (%)	CCD participants (n = 2202) Mean (s.d.) or n (%)	P value
Age at enrolment in years ^b				
Mean (s.d.)	37.7 (11.8)	37.7 (11.8)	34.0 (9.5)	<0.001
Gender*				
Male	154 290 (82)	152 721 (82)	1569 (71)	<0.001
Female	34 305 (18)	33 672 (18)	633 (29)	
Ethnicity*				
Caucasian	115 639 (68)	114 113 (68)	1526 (71)	<0.001
Aboriginals	25 132 (15)	24 649 (15)	483 (22)	
Other	28 137 (17)	27 988 (17)	149 (7)	
Education level*				
Grade 9 or less	19 499 (13)	19 150 (12)	349 (17)	<0.001
Grade 10/11	46 589 (30)	45 839 (30)	750 (36)	
Grade 12	61 288 (39)	60 571 (40)	717 (34)	
Vocational/University	28 209 (18)	27 945 (18)	264 (13)	
Specific mental disorders* ^c				
Schizophrenia	8047 (4)	7153 (4)	894 (41)	<0.001
Bipolar disorder	15 276 (8)	14 036 (7)	1240 (56)	<0.001
Personality disorder	5745 (3)	5090 (3)	655 (30)	<0.001
Anxiety disorder	38 422 (20)	36 800 (20)	1622 (74)	<0.001
Drug dependence	28 510 (15)	26 262 (14)	1888 (86)	<0.001
Alcohol dependence	17 577 (9)	16 283 (9)	1274 (58)	<0.001
Any sentence in past 5 years				
Mean (s.d.)	1.2 (3.6)	1.1 (3.4)	8.6 (8.8)	<0.001
Median (Min, Max)	0 (0, 95)	0 (0, 71)	5 (2, 95)	
Jail sentence in past 5 years				
Mean (s.d.)	0.5 (1.7)	0.5 (2.2)	4.2 (6.1)	<0.001
Median (Min, Max)	0 (0, 66)	0 (0, 48)	5 (2, 95)	
Probation sentence in past 5 years				
Mean (s.d.)	0.7 (1.7)	0.6 (1.6)	4.4 (3.9)	<0.001
Median (Min, Max)	0 (0, 48)	0 (0, 48)	3 (0, 37)	
Any offence in past 5 years				
Mean (s.d.)	0.9 (2.7)	0.9 (2.5)	6.6 (6.7)	<0.001
Median (Min, Max)	0 (0, 70)	0 (0, 54)	4 (0, 70)	
Property offence in past 5 years				
Mean (s.d.)	0.3 (1.3)	0.3 (1.3)	2.4 (3.7)	<0.001
Median (Min, Max)	0 (0, 48)	0 (0, 48)	1 (0, 41)	
Violent offence in past 5 years				
Mean (s.d.)	0.2 (0.7)	0.2 (0.7)	1.2 (1.7)	<0.001
Median (Min, Max)	0 (0, 22)	0 (0, 22)	1 (0, 18)	
Acute hospital admission in past 5 years				
Mean (s.d.)	0.6 (1.7)	0.5 (1.6)	3.2 (4.0)	<0.001
Median (Min, Max)	0 (0, 64)	0 (0, 64)	3 (1, 58)	
Psychiatric ^d hospital admission in past 5 years				
Mean (s.d.)	0.2 (1.0)	0.1 (0.7)	4.9 (5.3)	<0.001
Median (Min, Max)	0 (0, 61)	0 (0, 61)	2 (1, 44)	
Hospital days in past 5 years				
Mean (s.d.)	4.2 (20.9)	3.9 (20.0)	32.7 (53.3)	<0.001
Median (Min, Max)	0 (0, 970)	0 (0, 970)	13 (1, 755)	

Continued

Table 1. Continued

Variables ^a	All participants (<i>n</i> = 188 625) Mean (s.d.) or <i>n</i> (%)	Non-CCD participants (<i>n</i> = 186 423) Mean (s.d.) or <i>n</i> (%)	CCD participants (<i>n</i> = 2202) Mean (s.d.) or <i>n</i> (%)	<i>P</i> value
MSP costs in past 5 years (\$CAD)				
Mean (s.d.)	2798 (4522)	2709 (4381)	10 357 (8331)	<0.001
Social assistance in past 5 years (\$CAD)				
Mean (s.d.)	9119 (18 603)	8798 (18 365)	36 258 (18 652)	<0.001
Shelter payments in past 5 years (\$CAD)				
Mean (s.d.)	5135 (10 034)	4968 (9930)	19 155 (8724)	<0.001

^aVariables with * was presented in terms of counts (N) and proportions (%). All other variables were presented in terms of mean with standard deviation (s.d.) and median with minimum (Min) and maximum (Max).

^bAge was calculated at April 1st of 2007.

^cSpecific mental disorders were not mutually exclusive.

^dRelated to non substance-related or substance-related mental disorders.

as well as those with adult populations five times as large.

HSDA

HSDAs (see Appendix 2) are comprised between one and ten LHAs, based largely on relative remoteness and population density. Table 3 presents HSDAs alongside the number of individuals meeting inclusion criteria and the rate per 100 000 adults. The city of Vancouver had the highest absolute number of people who met the CCD criteria. Note that we present two samples corresponding to the City of Vancouver, one based on those individuals with a known LHA (*n* = 388) and a second that includes people whose address was unknown (*n* = 588). Individuals who are homeless (and thus lack a fixed address) are included in the second sample. Although higher absolute numbers of CCD individuals were identified in regions with higher overall populations, the highest rates per 100 000 were observed in the less urbanised Northern Interior and Northwest of the Province.

Regional HAs

BC is divided into five regional HAs (see Appendix 3). The total number and rate of people with CCD in each HA is shown in Table 4. As was seen with the results from HSDAs, the greatest numbers of individuals meeting CCD criteria were located in the most populous HAs. However, as in the preceding analyses the highest prevalence rate of CCD was observed in the comparatively rural Northern HA, which is the HA with the smallest and most dispersed total population.

Discussion

This study is one of the first to investigate the prevalence and distribution of people with CCD defined on the basis of diagnosed substance dependence and non-substance-related mental disorders, and psychiatric hospitalisations, and multiple criminal convictions and financial need for housing. We found that the largest absolute numbers of people meeting all of these criteria were concentrated in densely populated regions where the high prevalence of CCD has been reported based on police encounters (Thompson, 2010) as well as academic research (Patterson *et al.* 2012). However, we also found that not all populous regions had commensurately high absolute numbers of CCD individuals. Moreover, we found that the highest per capita rates of CCD were observed in comparatively rural and remote regions. Taken together, these findings suggest the need for service planning and inter-agency collaboration in diverse regions, both urban and rural, and counter the hypothesis that the service requirements of CCD individuals are limited to inner-city settings.

The 5-year provincial rate of CCD was 60 per 100 000 (2202 individuals in an adult population of 3.7 million). Per capita, the rate of CCD in the rural and least populous HA was about two and a half times higher than the rate in the most heavily populated and urbanised HA. Large variations in rates were also observed *within* each HA when comparing the constituent LHAs. In LHAs serving at least 50 000 people the rate of CCD varied more than 20 times, from fewer than 15–330 cases per 100 000. This demonstration of variability is a strong indication that the allocation of specialised resources should be informed by empirical details concerning local populations.

Table 2. Prevalence of CCD by LHA in BC

Local health area (LHA)	<i>n</i>	Total adult population	Rate (<i>n</i> /100 000)
Downtown eastside	210	63 597	330
Vancouver unknown place	170		
Surrey	168	307 678	55
Greater Victoria	122	185 729	66
Prince George	105	74 621	141
Central Okanagan	92	149 766	61
Abbotsford	85	105 277	81
Kamloops	69	88 281	78
City Centre (Vancouver)	65	112 779	58
Maple Ridge	54	73 836	73
Nanaimo	53	85 625	62
Burnaby	47	188 690	25
Chilliwack	45	66 470	68
Coquitlam	45	174 459	26
Vernon	43	52 322	82
Midtown (Vancouver)	36	82 189	44
South Vancouver	36	109 577	33
Cowichan	33	45 291	73
Mission	32	32 359	99
Alberni	30	24 859	121
Langley	30	102 534	29
North Vancouver	30	113 325	26
North East	29	89 965	32
Richmond	29	158 713	18
Penticton	26	34 102	76
Delta	26	78 088	33
New Westminster	24	56 389	43
Unknown LHA	24		
Quesnel	23	18 530	124
Terrace	21	15 412	136
Nelson	20	20 242	99
Campbell River	20	33 182	60
Sunshine Coast	17	25 186	67
Peace River North	17	26 262	65
Vancouver Island North	16	9157	175
Prince Rupert	16	10 559	152
Nechako	16	11 043	145
Courtenay	16	52 170	31
Powell River	15	16 405	91
Peace River South	15	21 699	69
Sooke	15	55 585	27
South Surrey/White Rock	–	72 398	–
Trail	–	15 464	–
Saanich	–	52 715	–
West Side	–	112 678	–
Salmon Arm	–	28 139	–

Table 2. Continued

Local health area (LHA)	<i>n</i>	Total adult population	Rate (<i>n</i> /100 000)
Qualicum	–	38 870	–
Merritt	–	9231	–
Cranbrook	–	20 120	–
Howe Sound	–	29 592	–
Smithers	–	11 983	–
Cariboo – Chilcotin	–	20 592	–
Gulf Islands	–	13 833	–
Upper Skeena	–	3814	–
Castlegar	–	10 860	–
Ladysmith	–	15 647	–
West Vancouver-Bowen Island	–	42 495	–
Burns Lake	–	5906	–
Agassiz – Harrison	–	7053	–
Kitimat	–	7730	–
Queen Charlotte	–	3585	–
Fort Nelson	–	4772	–
South Cariboo	–	5952	–
100 Mile House	–	12 276	–
Southern Okanagan	–	16 440	–
Arrow Lakes	–	4064	–
Keremeos	–	4334	–
Lake Cowichan	–	5217	–
Enderby	–	6053	–
Hope	–	6507	–
Summerland	–	9261	–
Fernie	–	11 786	–
Kimberley	–	6899	–
Armstrong – Spallumcheen	–	7560	–
Snow Country	–	420	–
Central Coast	–	1150	–
Nisga'a	–	1416	–
Vancouver Island West	–	1852	–
Lillooet	–	3666	–
Princeton	–	4512	–
Golden	–	5779	–
Revelstoke	–	6370	–
Grand Forks	–	7213	–
Windermere	–	8625	–
Telegraph Creek	–	531	–
Stikine	–	784	–
Bella Coola Valley	–	2293	–
Kettle Valley	–	3103	–
Kootenay Lake	–	3252	–
North Thompson	–	3378	–
Creston	–	10 191	–
Overall/total in BC	2202	3 660 314	60

Continued

Table 3. Prevalence of CCD by HSDA in BC

Health service delivery area (HSDA)	<i>n</i>	Total adult population	Rate (<i>n</i> /100 000)
Vancouver	388	570 785	68
Fraser South	237	560 698	42
Okanagan	177	284 350	62
Fraser East	170	217 666	78
Fraser North	170	493 374	34
South Vancouver Island	156	307 862	51
Northern Interior	149	110 100	135
Central Vancouver Island	136	215 509	63
Thompson Cariboo Shuswap	108	177 885	61
North Shore/Coast Garibaldi	78	230 446	34
Northwest	62	56 234	110
North Vancouver Island	53	96 361	55
Kootenay Boundary	42	64 198	65
Northeast	36	52 733	68
Richmond	29	158 713	18
East Kootenay	17	63 400	27
Vancouver including Vancouver unknown place	388	570 785	98

These findings confirm the need for coordinated inter-agency resources involving health, justice and social services for the large numbers of individuals with CCD who are concentrated in urban settings. But they also demonstrate the need to implement similar collaborative approaches in less populated environments. Several empirically supported programmes for sub-populations with complex psychiatric needs have been adapted for both urban and rural contexts, including housing first (Stefancic *et al.* 2013), assertive community treatment (Aagard & Müller-Nielsen, 2011) and specialised courts (Hiday & Ray, 2010). However, the implementation of specialised services is more common in urban settings, due to a number of factors such as popular support, the

Table 4. Prevalence of CCD by HA in BC

Health authority (HA)	<i>N</i>	Total adult population	Rate (<i>n</i> /100 000)
Interior HA	344	589 833	58
Fraser HA	577	1 271 738	45
Vancouver Coastal HA	495	959 944	52
Vancouver Island HA	345	619 732	56
Northern HA	247	219 067	113
Vancouver Coastal HA including Vancouver unknown place	665	959 944	69

availability of relevant experts and their proximity to institutional resources, champions for reform, including police and front-line service providers (e.g., Szkopek-Szkopowski *et al.* 2013) and the sheer visibility of problems related to CCD. Moreover, it is unclear whether the concentration of inter-agency resources in urban areas contributes to relocation of individuals with CCD from other locations (Lix *et al.* 2006).

The characteristics of people who met our CCD criteria confirm the seriousness and severity of needs within the sample. During a 5-year period members of the sample had an average of nine convictions and five psychiatric hospital admissions per person. Personality disorders and Schizophrenia were ten times more common in the CCD sample than among other offenders, and they were six times more likely to have been diagnosed with alcohol dependence and drug dependence. The rate of violent offences was six times higher in the CCD sample compared with other convicted offenders. Payments for shelter, other social assistance and physician visits were also significantly higher in the CCD sample. Compared with other offenders, the CCD group was significantly younger, more likely to be female and of aboriginal ethnicity and less well educated. Appropriate therapeutic interventions are urgently needed to divert this relatively youthful cohort from a chaotic and costly revolving door of health and justice services (Baillargeon *et al.* 2009a). Females and aboriginal (or indigenous) people are increasingly prevalent in offender populations (Harrison *et al.* 2005; Kong & Au Coin, 2008; Landry & Sinha, 2008). The overrepresentation of both groups in the CCD subpopulation suggests the need for preventative as well as treatment programmes that are responsive to cultural and gender-based considerations.

The present analysis indicates that the raw number of CCD individuals varies regionally. Further work is required to establish whether the characteristics of CCD offenders in different regions might differ on factors such as diagnostic severity, propensity to violence, psychopathy, chronicity of homelessness, etc. Nevertheless, the present analysis provides an empirically based estimate of the prevalence and distribution of those with CCD. The delivery of services to this population requires a focus on contextual factors so that interventions are maximally responsive to individual risks and needs (Andrews & Dowden, 2007).

This research was made possible by the ability to link population-level data spanning several years for relevant services that are universally provided. Selection criteria for inclusion in this study were chosen in order to identify people who share similar profiles of need regardless of their specific location. Nevertheless our study is subject to a number of

limitations associated with our methodology and approach. The use of administrative data to operationalise CCD inevitably fails to include people who do not come into contact with services. It is therefore likely that our results form an underestimate of the prevalence of CCD. We attempted to avoid criteria that may have biased the sample due to regional variation in access to services. For example, we did not include psychiatric consultations in our criteria due to the grossly uneven distribution of specialists. But despite our efforts, it remains possible that our inclusion criteria may have been biased by regional differences in the provision of services. Community mental health and addiction services are not evenly distributed throughout the large geography of BC. It is therefore possible that individuals in more rural setting may have a higher likelihood of hospitalisation (one of our CCD criteria) due to insufficient community-based care. We used physician diagnoses as the basis for identifying mental and substance use disorders, which may reflect errors of under-diagnosis and/or over-diagnosis. However, the fact that the sample had multiple psychiatric hospitalisations is an indication that if we erred at all, it was towards the inclusion of severe psychiatric cases, rather than people without mental illness who had been wrongly diagnosed. We interpret our results as indicative of regional clusters and nodes of CCD throughout a large and variably populated landscape. Further research is necessary to investigate the distribution of CCD in other settings in Canada and internationally. Our results demonstrate that administrative data may be a useful asset to help direct the implementation of specialised offender services to locations with relatively greater need. Finally, our analyses represent a step towards better understanding a sub-population with concurrent disorders and socio-legal needs. Further research will undoubtedly lead to refinements in the criteria that best identify relevant forms of 'complexity' among people with substance use and mental disorders.

The confluence of mental illness, substance use, crime and poverty has been identified as an extremely costly revolving door, measurable in financial terms (Gilmer *et al.* 2010) and in greatly premature mortality (Nielsen *et al.* 2011; Nusselder *et al.* 2013). The implementation of effective interventions can be defended on the basis of the best interests of individual offenders, fiscal prudence and community safety. Our findings suggest that it is important to provide those employed in health, justice and social services with the education and support to assist people with CCD, knowing that such individuals are likely to present in all regions, and understanding that the costs of inadequate care are unsustainable.

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Conflict of interest

The authors have no conflicts of interest or other disclosures.

Ethics standard

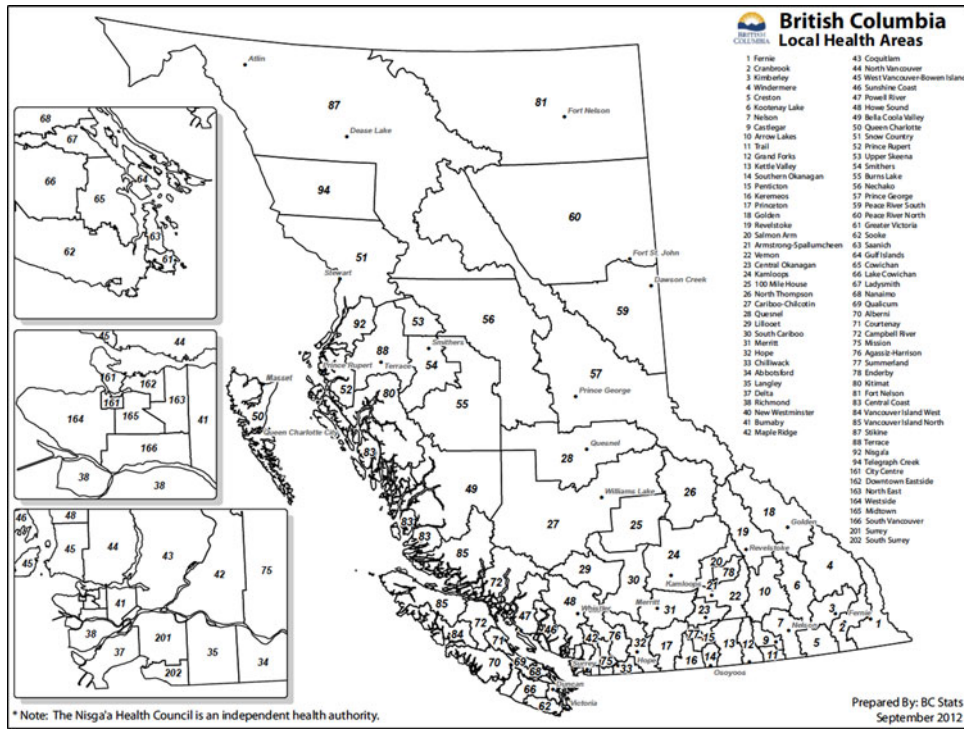
This study was approved by the Research Ethics Board of Simon Fraser University.

References

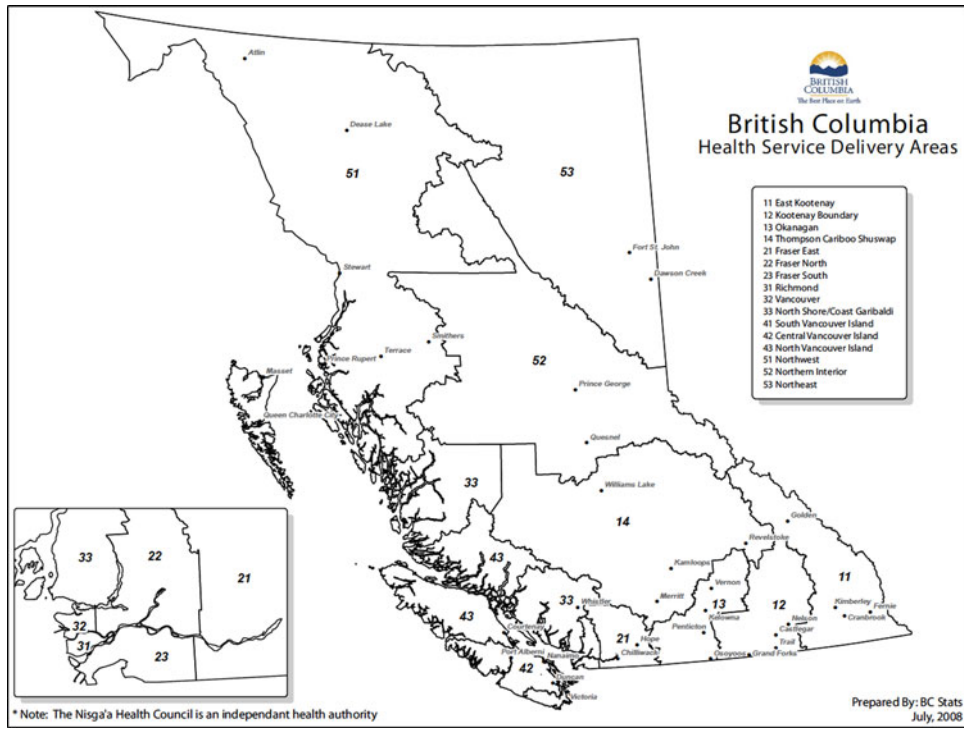
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Appendix 1: British Columbia Local Health Areas



Appendix 2: British Columbia Health Service Delivery Areas



Appendix 3: British Columbia Health Authorities

