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Research

Long-term sedative use among community-dwelling adults: a population-based analysis

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Abstract

Background: Chronic use of benzodiazepines and benzodiazepine-like sedatives (z-drugs) presents substantial risks to people of all ages. We sought to assess trends in long-term sedative use among community-dwelling adults in British Columbia.

Methods: Using population-based linked administrative databases, we examined longitudinal trends in age-standardized rates of sedative use among different age groups of community-dwelling adults (age ≥ 18 yr), from 2004 to 2013. For each calendar year, we classified adults as nonusers, short-term users, or long-term users of sedatives based on their patterns of sedative dispensation. For calendar year 2013, we applied cross-sectional analysis and estimated logistic regression models to identify health and socioeconomic risk factors associated with long-term sedative use.

Results: More than half (53.4%) of long-term users of sedatives in British Columbia are between ages 18 and 64 years (young and middle-aged adults). From 2004 to 2013, long-term sedative use remained stable among adults more than 65 years of age (older adults) and increased slightly among young and middle-aged adults. Although the use of benzodiazepines decreased during the study period, the trend was offset by equal or greater increases in long-term use of z-drugs. Being an older adult, sick, poor and single were associated with increased odds of long-term sedative use.

Interpretation: Despite efforts to stem such patterns of medication use, long-term use of sedatives increased in British Columbia between 2004 and 2013. This increase was driven largely by increased use among middle-aged adults. Future deprescribing efforts that target adults of all ages may help curb this trend.

Benzodiazepines and benzodiazepine-like sedatives (zopiclone, zolpidem and zaleplon, termed z-drugs) are commonly prescribed to treat anxiety and insomnia, but are contraindicated for long-term use.[1,2] Chronic use of sedatives presents serious risks, including dependence, abuse, and cognitive and psychomotor impairment.[3–6] Numerous efforts have aimed to curb long-term sedative use, particularly among older adults (age ≥ 65 yr), yet these policies have not had substantial effects.[7–10] Most efforts to curb chronic sedative prescribing have focused on benzodiazepines and ignored z-drugs despite indications that recent prescribing trends favour z-drugs over benzodiazepines.[11–13] Stable trends in long-term sedative dispensing may mask underlying variation in benzodiazepine and z-drug dispensing. Indeed, decreases in benzodiazepine dispensing accompanied by concurrent increases in z-drug dispensing are documented in Europe.[14–16] Little is known about long-term sedative use in North America. Furthermore, existing studies of long-term sedative use primarily focus on older adults.[17–20] Yet, long-term sedative use among younger adults is also contraindicated and is worthy of examination.

We sought to assess trends in benzodiazepine and z-drug dispensations among all community-dwelling adults in British Columbia from 2004 to 2013. We wished to determine the extent to which patterns of sedative use vary by age and sex and to identify medical and socioeconomic risk factors associated with long-term sedative use for all adults (age ≥ 18 yr). Given that past research shows women are more likely to receive prescriptions for sedatives than men,[7,8,14,21] we sex-stratified our analyses where appropriate.

Competing interests: None declared.

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Methods

Data

We based our retrospective analysis on deidentified linked health data sets provided by Population Data BC with the approval of relevant data stewards.[22–24] Data sets included information on all adult (age ≥ 18 yr) residents of British Columbia, with the exception of those whose prescription drug coverage fell under federal jurisdiction (military veterans, registered First Nations and Inuit and inmates in federal penitentiaries — all of whom make up ~4% of BC's population). To ensure complete pharmaceutical data capture, we only included people living in BC for at least 275 days in any year from 2004 to 2013. Similar to past studies,[19,21] we focused our analysis on community-dwelling adults and excluded residents of long-term care facilities (0.7% of the population and 3% of sedative users).

Data on pharmaceutical dispensations came from PharmaNet, an information system into which pharmacists must, by law, enter records of every prescription dispensed outside of acute care hospitals.[25] We grouped prescription drugs according to the World Health Organization's Anatomic Therapeutic Chemical drug classification system.[26] We identified benzodiazepine and z-drug prescriptions using level 5 codes (Appendix 1, available at www.cmajopen.ca/content/5/1/E52/suppl/DC1).

We linked prescription history to hospital discharge data containing up to 25 diagnostic codes (International Classification of Diseases, 10th revision [ICD-10]) per hospital admission and to medical services data from the BC Medical Services Plan Payment File, which included 1 primary diagnosis code (International Classification of Diseases, 9th revision, [ICD-9]) for every fee-for-service medical visit. Hospital services data came from the Discharge Abstract Database, which tracks inpatient separations from all hospitals in BC. We did not have access to medical services data for care funded by alternative payments (e.g., capitation-funded health clinics). We therefore excluded a small number of geographic areas (e.g., northern and inner-city communities) that receive 25% or more of their medical care from non–fee-for-service providers. This exclusion affected an additional 4% of the study population.

Derived variables

We used the John Hopkins Adjusted Clinical Group (version 10.0) case-mix adjustment system to adjust for health status.[27] Specifically, we constructed a count of the number of major and minor Aggregated Diagnostic Groups. Counts of Aggregated Diagnostic Groups are predictive of mortality and health services use.[28,29]

We estimated household income based on a combination of household-specific and area-based income data.[30] For 52% of the population, we had validated, household-specific income information from registration files for BC's income-based public drug plan (Fair PharmaCare). For the remaining 48% of the population, we estimated household income based on median household income for the Census Dissemination Area in which people lived. People with missing household and area-based income data were excluded from the analysis (~2%).

Previous research suggests that there may be ethnic differences in use of medications as a result of cultural, environmental and biologic factors.[31–34] We sought to identify whether the likelihood of long-term sedative use varies according to ethnicity. Since there are no population-based sources of information on ethnicity that could be linked to our data sets, we estimated ethnicity using a validated algorithm developed to identify surnames of South Asian and Chinese origin.[35]

Definitions

For each calendar year, we classified adults as nonusers, short-term users or long-terms users of sedatives based on their dispensation history. We classified people as long-term sedative users if they filled prescriptions totaling more than a 90-day supply of benzodiazepines or z-drugs in the calendar year. We identified short-term sedative users as those who filled at least 1 sedative prescription and had 90 or fewer days of medication dispensed.

Most guidelines recommend limiting sedative use to less than 28 days.[36,37] Our definition of long-term use is a conservative estimate, consistent with other studies,[7,38] and ensures that most people classified as long-term users have filled more than 3 sedative prescriptions in the year, given that BC's public drug plan restricts dispensations of sedatives to 30 days' worth of medication.[39]

Statistical analysis

When reporting prevalence rates for the adult population, we age-standardized annual statistics using the 2013 population in 4 age categories (18–44, 45–64, 65–84 and ≥ 85 yr). We termed participants between the ages 18 and 44 years "young adults," those between ages 45 and 64 years "middle-aged adults" and those 65 years of age and older "older adults." We based these definitions on past studies that examined benzodiazepine use in different age groups.[40]

We studied medical and socioeconomic risk factors associated with different levels of benzodiazepine use in 2013. We estimated age- and sex-stratified and sex-pooled logistic regression models, incorporating explanatory variables based on well-established models of health services use.[41,42] We included measures of sex, age, health status, income, marital status, ethnicity and neighbourhood urbanization in our models. All analysis was conducted in Stata 13.[43]

Ethics approval

The University of British Columbia's Behavioural Research Ethics Board approved this study.

Results

The population of community-dwelling adults meeting our study inclusion criteria grew from 2.94 million in 2004 to 3.22 million in 2013. These adults represented about 75% of the total population of the province. The characteristics of community-dwelling British Columbians who met our inclusion criteria in 2013 are summarized in Table 1. Long-term

Table 1: Characteristics of community-dwelling adults aged 18 years and older, British Columbia, 2013, by sedative use

Variable	Sedative use, no. (%)		
	Nonuse *n* = 2 837 834	Short-term use *n* = 206 059	Long-term use* *n* = 172 276
Using benzodiazepines†	0 (0.0)	142 061 (68.9)	98 107 (57.0)
Using z-drugs†	0 (0.0)	79 053 (38.4)	87 840 (51.0)
Sex			
Female	1 411 861 (49.8)	132 318 (64.2)	109 264 (63.4)
Male	1 425 973 (50.3)	73 741 (35.8)	63 012 (36.6)
Age, yr			
18–44	1 246 832 (43.9)	66 602 (32.3)	22 459 (13.0)
45–64	1 028 052 (36.2)	86 474 (42.0)	71 086 (41.3)
65–84	487 515 (17.2)	47 057 (22.8)	65 313 (37.9)
≥ 85	75 435 (2.7)	5926 (2.9)	13 418 (7.8)
Count of major ADGs			
0	1 938 119 (68.3)	94 655 (45.9)	54 917 (31.9)
1–2	809 027 (28.5)	90 995 (44.2)	88 901 (51.6)
≥ 3	90 688 (3.2)	20 409 (9.9)	28 458 (16.5)
Count of minor ADGs			
0–1	996 680 (35.1)	16 131 (7.8)	8700 (5.1)
2–3	866 290 (30.5)	51 610 (25.1)	34 445 (20.0)
4–5	578 867 (20.4)	60 936 (29.6)	48 277 (28.0)
≥ 6	395 997 (14.0)	77 382 (37.6)	80 854 (46.9)
Income quintile			
1 (lowest)	564 644 (19.9)	49 035 (23.8)	55 597 (32.3)
2	589 608 (20.8)	38 898 (18.9)	36 131 (21.0)
3	545 222 (19.2)	33 156 (16.1)	25 568 (14.8)
4	574 352 (20.2)	37 345 (18.1)	25 379 (14.7)
5 (highest)	564 008 (19.9)	47 625 (23.1)	29 601 (17.2)
Relationship status			
Marriage-like relationship§	1 553 729 (54.8)	114 960 (55.8)	88 367 (51.3)
Single	1 284 105 (45.3)	91 099 (44.2)	83 909 (48.7)
Ethnicity			
Other	2 357 019 (83.1)	185 958 (90.3)	161 502 (93.8)
Chinese	346 159 (12.2)	11 033 (5.4)	6733 (3.9)
South Asian	134 656 (4.8)	9068 (4.4)	4041 (2.4)
Neighbourhood urbanization			
Urban	2 682 538 (94.5)	194 214 (94.3)	161 061 (93.5)
Rural	155 296 (5.5)	11 845 (5.8)	11 215 (6.5)

Note: ADG = Aggregated Diagnostic Group.
*Defined by the filling of prescriptions containing a total of 90 or more days' supply of sedative during the calendar year.
†Drugs included as benzodiazepines and z-drugs are provided in Appendix 1.
‡ADGs map International Classification of Disease, 9th and 10th revisions, codes into 32 mutually exclusive groups based on similar levels of severity, persistence and health resource requirements. Of these groups, 8 have very high expected resource use and are labelled as major ADGs. Remaining ADGs are considered minor.
§Marriage-like relationships include common-law and married relationships between 2 same-sex or opposite-sex adults.

users of sedatives were most likely to be women, to be older, to have low incomes and to have relatively poor health status. Nonusers were most likely to have surnames of Chinese origin.

Among young and middle-aged adults, long-term use of sedatives was most common among people aged 45–64 years; among older adults, long-term use was most common among people aged 65–84 years (Appendix 2, available at www.cmajopen.ca/content/5/1/E52/suppl/DC1). Despite differences in population prevalence of long-term sedative use, more young and middle-aged adults were exposed to long-term sedative prescriptions in 2013 relative to older adults.

Trends in sedative use among community-dwelling adults, 2004 to 2013

Figure 1 shows age-standardized trends in prevalence of overall (short- and long-term) sedative use among community-dwelling women and men aged 18 years and older. All changes in prevalence of overall use were statistically significant at $p < 0.05$. The age-standardized proportion of community-dwelling adult women who filled at least 1 sedative prescription increased from 14.2% in 2004 to 14.6% in 2013, representing a 3% increase in the age-standardized prevalence rate. Similarly, the age-standardized proportion of community-dwelling adult men who filled sedative prescriptions increased from 8.2% to 8.8% over the study period, a 6% increase in the age-standardized prevalence rate.

Stable age-standardized prevalence of overall use of sedatives masked changes in the composition of sedatives prescribed. From 2004 to 2013, the age-standardized proportion of participants who were dispensed a benzodiazepine declined from 11.2% to 10.0% for women and from 6.4% to 5.6% for men. Conversely, the age-standardized proportion of participants who were dispensed z-drugs increased from 4.6% to 6.6% for women and from 2.7% to 4.1% for men. Note that the sum of benzodiazepine users and z-drug users does not equal the total number of sedative users, because 1% of adults filled prescriptions for both benzodiazepines and z-drugs.

Figure 2 shows age-standardized trends in the prevalence of overall sedative use among community-dwelling adults. From 2004 to 2013, increases in z-drug use offset decreases in benzodiazepine use among community-dwelling adults more than aged 65 years and older; consequently, age-standardized prevalence of sedative use remained stable, at about 23% among women and about 15% among men. Among adults younger than 65 years of age, age-standardized increases in z-drug use slightly exceeded age-standardized decreases in use of benzodiazepines. Thus, age-standardized prevalence of using sedatives of any type increased among adults younger than 65 years of age, from 11.6% to 12.2% among women and from 6.6% to 7.2% among men.

Figure 3 shows age-standardized trends in prevalence of long-term sedative use among community dwelling adults. All changes in prevalence of long-term benzodiazepine and z-drug use were statistically significant ($p < 0.05$). The age-standardized prevalence of long-term sedative use among adults aged 65 years and older was relatively stable, at about 14% for women and about 8% for men. As with trends in overall sedative use among adults aged 65 years and older, the relatively stable prevalence of long-term use masked a considerable shift from benzodiazepines to z-drugs.

Community-dwelling adults younger than 65 years of age showed similar trends in age-standardized prevalence of long-term sedative use to those of adults aged 65 years and older,

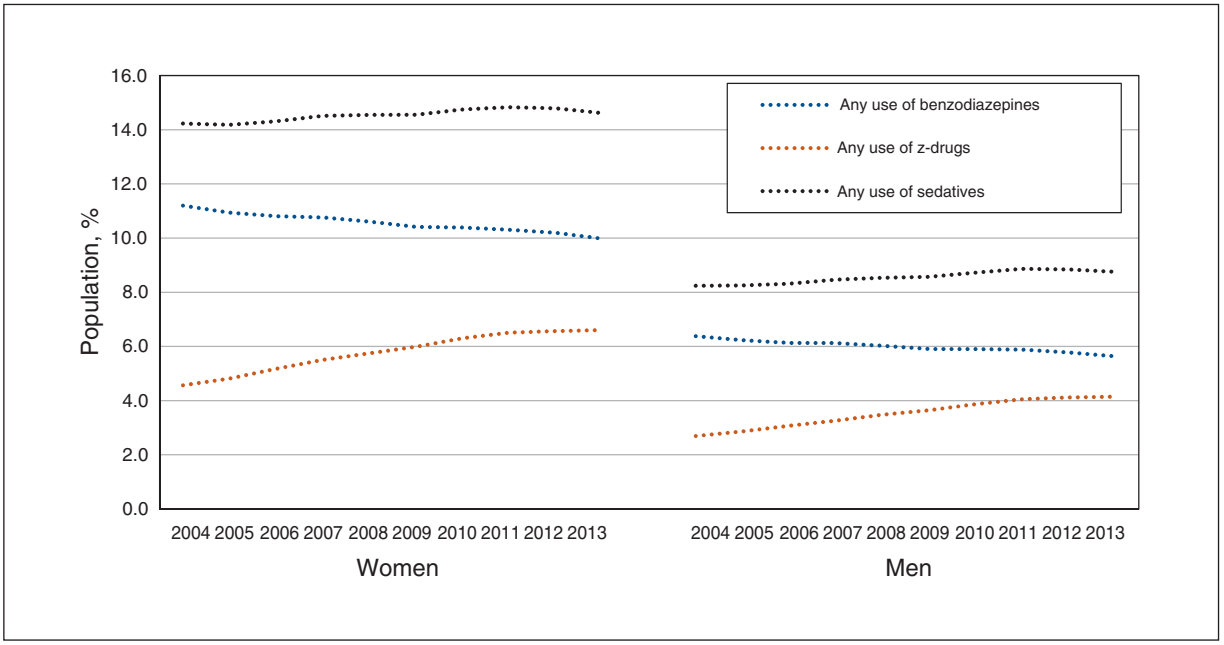

Figure 1: Age-standardized prevalence of overall (short- and long-term) sedative use among community-dwelling adults aged 18 years and older in British Columbia, 2004–2013. Sedative use was defined as the filling of 1 or more sedative prescription during the calendar year. Age-standardization was performed using the 2013 population in 4 age categories (18–44, 45–64, 65–84 and ≥ 85 yr).

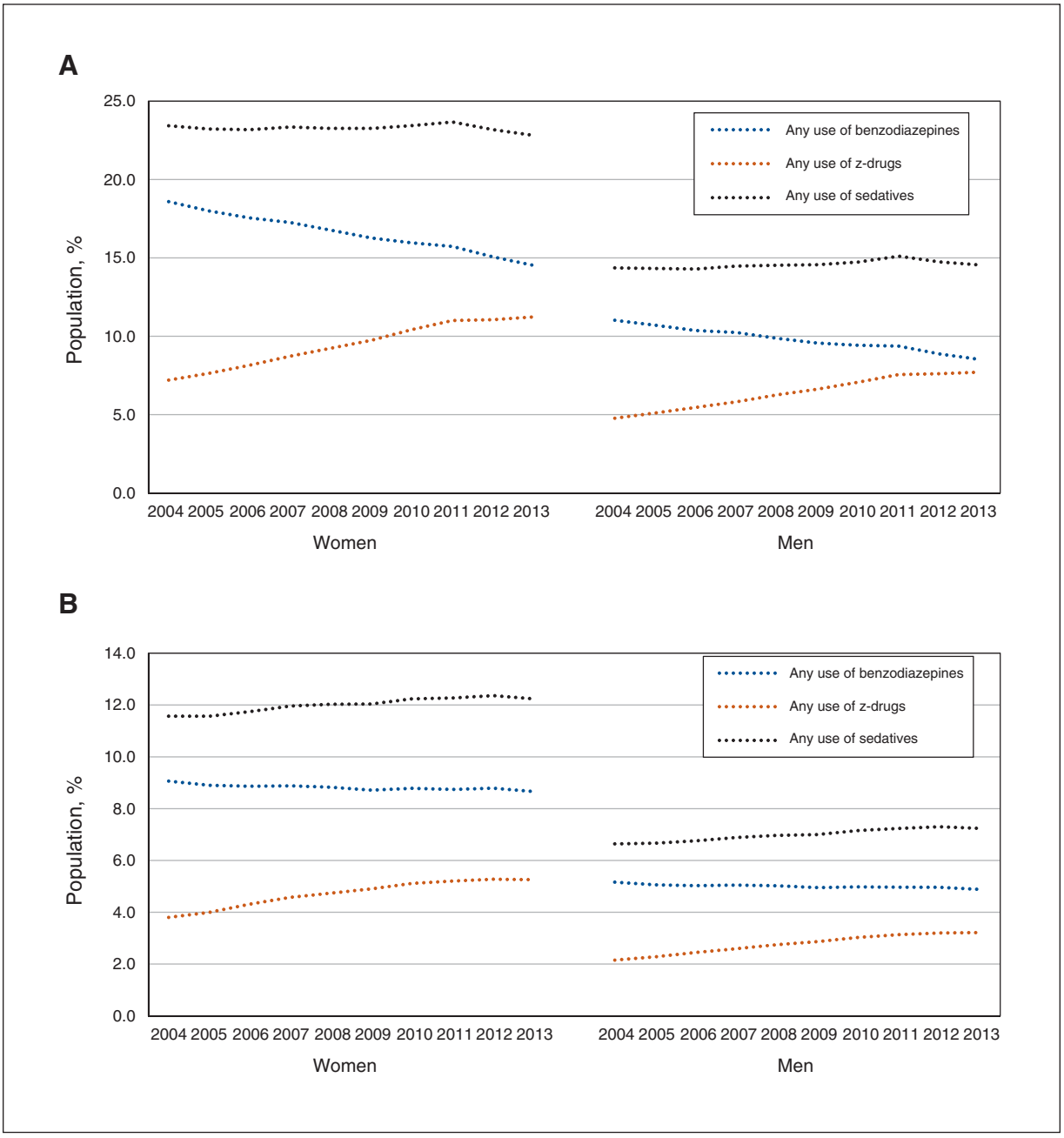

Figure 2: Age-standardized prevalence of overall sedative use among community-dwelling adults aged 65 years and older (A) and among community-dwelling adults aged 18–64 years (B) in British Columbia, 2004–2013. Sedative use was defined as the filling of 1 or more sedative prescription during the calendar year. Age-standardization was performed using the 2013 population in 4 age categories (18–44, 45–64, 65–84 and ≥ 85 yr).

albeit at lower levels of use (Figure 3). The age-standardized proportion of women younger than 65 years of age who filled a long-term sedative prescription increased from 4.1% to 4.5% over the study period, an increase of about 10% in the age-standardized prevalence rate. Similarly, the age-standardized proportion of men younger than 65 years of age who filled a long-term sedative prescription also increased from 2.5% to 2.9% over the period, representing an increase of about 14% in the age-standardized prevalence rate. Across the study period, the proportion of sedative users younger than 65 years of age who used 90 or more days of sedative medications in the given year grew from about 36% to 38%.

Variations in sedative use among community-dwelling adults in 2013

Table 2 shows the results of age- and sex-stratified and sex-pooled logistic regression analyses for the population stratified at age 65 years. In all regression models, being older, having poorer health status, having lower income and being single were all significantly associated with increased odds of long-

term use of sedatives. Conversely, having a surname of Chinese or South Asian origin was associated with lower odds of long-term sedative use in all regression models. Some effects varied across older and young and middle-aged men and women. For example, living in a rural area was associated with increased odds of long-term use of sedatives among younger and middle-aged adult women (adjusted odds ratio [OR] 1.08, 95% confidence interval [CI] 1.04–1.12), but decreased odds among older adult women (adjusted OR 0.95, 95% CI 0.91–0.98). Furthermore, living in a rural area had no significant effect on odds of long-term use among either young and middle-aged or older adult men.

After adjusting for other demographic factors and health status, sex had a significant effect on the odds of long-term sedative use among older adults and among young and middle-aged adults. Young and middle-aged women were associated with 22% higher odds of long-term use of sedatives than men (adjusted OR 1.22, 95% CI = 1.20–1.24), and older adult women had 59% higher odds than men (OR = 1.59, 95% CI = 1.57–1.62).

Interpretation

Despite numerous safety concerns and guidelines targeting overprescribing of sedatives,[36,44–48] our study shows age-standardized prevalence of long-term use of these medications

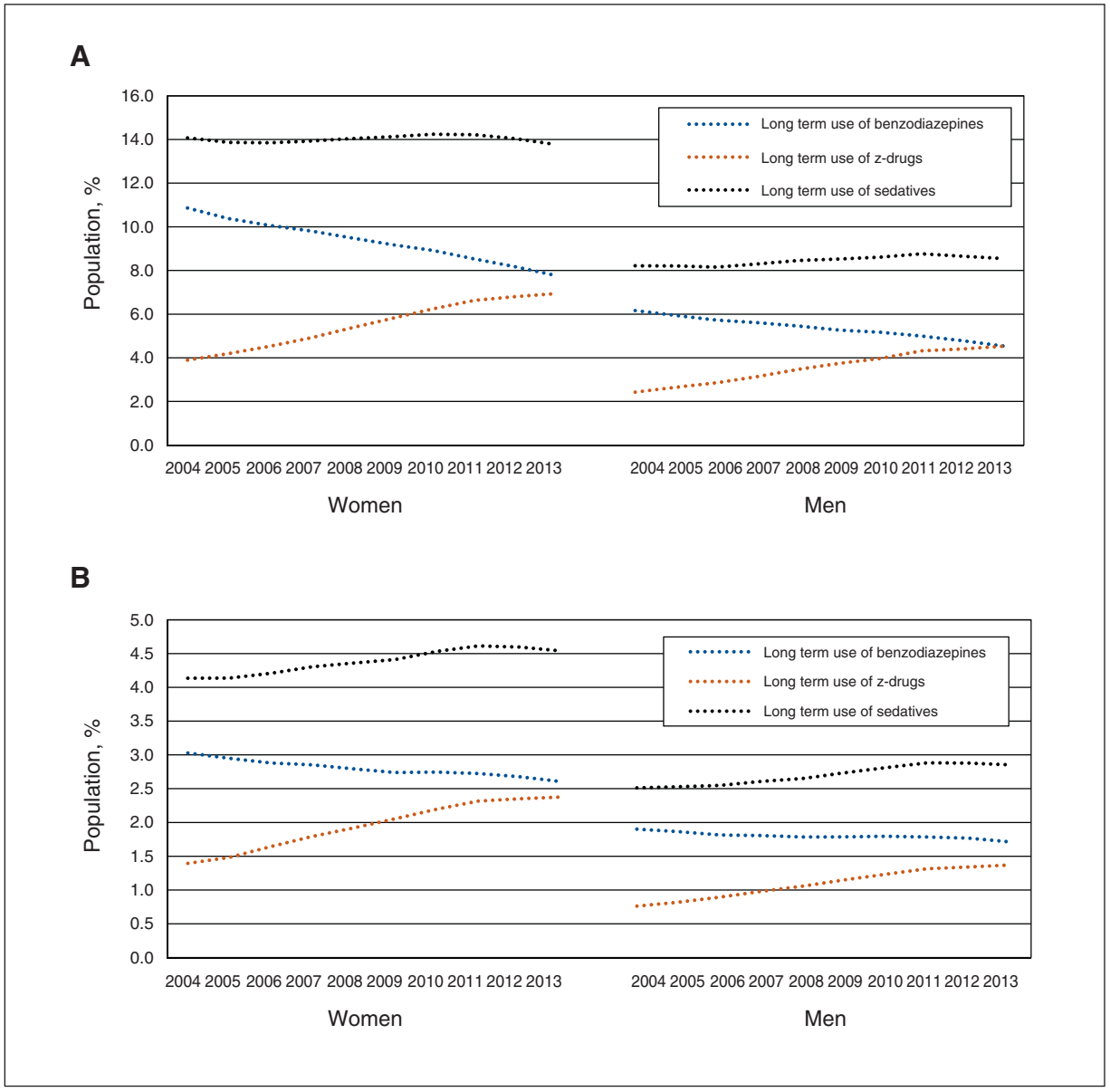

Figure 3: Age-standardized prevalence of long-term sedative use among community-dwelling adults aged 65 years and older (A) and among community-dwelling adults aged 18–64 years (B) in British Columbia, 2004–2013. Sedative use was defined as the filling of 1 or more sedative prescription during the calendar year. Age-standardization was performed using the 2013 population in 4 age categories (18–44, 45–64, 65–84 and ≥ 85 yr).

remained stable among older adults and increased slightly among young and middle-aged adults in BC from 2004 to 2013. Consistent with other studies,[8,15,49] our findings show evolving prescribing practices that favour z-drugs over benzodiazepines. Although many physicians believe z-drugs are a safer, more effective alternative to traditional benzodiazepines,[49]

Table 2: Adjusted odds ratios for likelihood of long-term sedative use* among community-dwelling British Columbians, stratified by age and sex and pooled by sex

	Women		Men			
Variable	Age 18–64 yr OR (95% CI)†	Age ≥ 65 yr OR (95% CI)†	Age 18–64 yr OR (95% CI)†	Age ≥ 65 yr OR (95% CI)†	Age 18–64 yr OR (95% CI)†	Age ≥ 65 yr OR (95% CI)†
Sex						
Male (reference)	–	–	–	–	1.00	1.00
Female	–	–	–	–	**1.22** (1.20–1.24)	**1.59** (1.57–1.62)
Age, yr						
18–44 (reference)	1.00	–	1.00	–	1.00	–
45–64	**3.53** (3.46–3.60)	–	**2.57** (2.50–2.64)	–	**3.14** (3.09–3.19)	–
65–84 (reference)	–	1.00	–	1.00	–	1.00
≥ 85	–	**1.10** (1.07–1.13)	–	**1.10** (1.06–1.14)	–	**1.09** (1.07–1.12)
Count of major ADGs‡						
0 (reference)	1.00	1.00	1.00	1.00	1.00	1.00
1–2	**1.86** (1.82–1.89)	**1.39** (1.36–1.42)	**2.02** (1.97–2.07)	**1.53** (1.48–1.59)	**1.92** (1.90–1.95)	**1.43** (1.41–1.46)
≥ 3	**3.76** (3.64–3.89)	**1.83** (1.77–1.89)	**3.26** (3.13–3.39)	**2.04** (1.96–2.13)	**3.54** (3.45–3.63)	**1.90** (1.85–1.94)
Count of minor ADGs‡						
0–1	1.00	1.00	1.00	1.00	1.00	1.00
2–3	**3.11** (2.98–3.25)	**2.84** (2.69–3.00)	**3.59** (3.45–3.74)	**2.64** (2.47–2.83)	**3.35** (3.25–3.45)	**2.77** (2.65–2.88)
4–5	**5.21** (4.99–5.43)	**4.15** (3.94–4.38)	**6.34** (6.08–6.61)	**3.94** (3.68–4.21)	**5.70** (5.53–5.87)	**4.08** (3.91–4.25)
≥ 6	**9.42** (9.04–9.83)	**6.96** (6.61–7.33)	**11.70** (11.2–12.21)	**6.59** (6.16–7.04)	**10.29** (9.99–10.6)	**6.83** (6.56–7.12)
Income quintile						
Lowest	**1.33** (1.29–1.36)	**1.23** (1.18–1.27)	**1.57** (1.52–1.63)	**1.14** (1.10–1.19)	**1.41** (1.38–1.44)	**1.19** (1.16–1.22)
Second	**1.08** (1.05–1.11)	**1.13** (1.09–1.17)	**1.19** (1.15–1.23)	**1.08** (1.03–1.12)	**1.12** (1.10–1.15)	**1.11** (1.08–1.14)
Third	0.97 (0.95–1.00)	1.01 (0.97–1.05)	**1.05** (1.01–1.09)	0.98 (0.94–1.02)	1.01 (0.98–1.03)	1.00 (0.97–1.03)
Fourth	0.99 (0.96–1.02)	0.98 (0.94–1.02)	1.00 (0.97–1.04)	**0.93** (0.89–0.97)	0.99 (0.97–1.02)	0.96 (0.93–0.98)
Fifth (reference)	1.00	1.00	1.00	1.00	1.00	1.00
Relationship status						
Marriage-like relationship§ (reference)	1.00	1.00	1.00	1.00	1.00	1.00
Single	**1.40** (1.37–1.43)	**1.10** (1.08–1.13)	**1.61** (1.57–1.65)	**1.29** (1.25–1.33)	**1.48** (1.46–1.50)	**1.16** (1.14–1.19)
Ethnicity						
Other (reference)	1.00	1.00	1.00	1.00	1.00	1.00
Chinese	**0.29** (0.28–0.31)	**0.47** (0.45–0.49)	**0.34** (0.32–0.36)	**0.55** (0.52–0.59)	**0.31** (0.30–0.32)	**0.50** (0.48–0.52)
South Asian	**0.35** (0.33–0.37)	**0.44** (0.41–0.47)	**0.53** (0.50–0.57)	**0.60** (0.55–0.65)	**0.42** (0.40–0.43)	**0.49** (0.47–0.52)
Neighbourhood urbanization						
Urban (reference)	1.00	1.00	1.00	1.00	1.00	1.00
Rural	**1.08** (1.04–1.12)	**0.95** (0.91–0.98)	0.98 (0.93–1.02)	0.98 (0.94–1.03)	**1.04** (1.01–1.07)	**0.96** (0.93–0.99)

Note: Bold values indicate significance at $p < 0.05$. ADG = Aggregated Diagnostic Group, CI = confidence interval, OR = odds ratio.
*Long-term sedative use defined as the filling of prescriptions containing a total of 90 or more days' supply of sedative during the calendar year. Drugs included as benzodiazepines and z-drugs are provided in Appendix 1.
†Odds ratios are adjusted for all listed variables.
‡ADGs map International Classification of Diseases, 9th and 10th revisions, codes into 32 mutually exclusive groups based on similar levels of severity, persistence, and health resource requirements. Of these groups, 8 have very high expected resource use and are labelled as major ADGs. Remaining ADGs are considered minor.
§Marriage-like relationships include common-law and married relationships between 2 same-sex or opposite-sex adults.

z-drugs are shown to have similar risk profiles to benzodiazepines, even in younger adults.[3,50]

Similar to previous studies,[7,8,14,20,51] we found adults had increased odds of long-term sedative use if they were women, if they had low incomes and if they had relatively poor health status. We also found that having a surname of Chinese or South Asian origin was associated with a protective effect on the odds of long-term sedative use. This finding coincides with other studies documenting ethnic variations in prescription drug use.[52,53] In addition, being in a marriage-like relationship was associated with a significant reduction in odds of long-term use. Although some previous literature suggests that marriage may have a protective effect on risk of chronic use and abuse of prescription drugs,[54,55] the opposite has also been true.[17]

Long-term sedative use seems to be as much a problem among middle-aged adults as it is among older adults. Although there is a steep age gradient in terms of population prevalence of long-term sedative use, there were actually a higher number of long-term sedative users younger than 65 years of age than older than 65 years of age. Young and middle-aged chronic sedative users are subject to many of the same risks associated with sedative use as older users; thus their high levels of long-term use should not be ignored. Past efforts to limit chronic sedative use have focused on discontinuing sedative use in older adult populations; future efforts should also consider interventions to limit sedative use in young and middle-aged adult populations. Ultimately, interventions that target adults of all ages might result in the most substantial gains to patient health.

Limitations

We were unable to determine whether participants consumed all of the prescription drugs dispensed to them; however, people who invest the time and out-of-pocket costs to fill prescriptions likely do so with the intent to consume them. Moreover, because some prescriptions will be written but not filled, this measure is arguably an understatement of the extent of long-term sedative prescribing in BC. Although our findings mirror recent trends in total benzodiazepine and z-drug dispensations from another Canadian province,[8] it is important to note that they are based on BC's population and may not be generalizable to other jurisdictions with different prescription monitoring programs and deprescribing strategies in place.

Conclusion

Long-term benzodiazepine and z-drug dispensing continues to be a considerable problem in BC, as shown by the stable dispensations among older adults and increasing dispensations among younger and middle-aged adults from 2004 to 2013. Our results suggest that numerous warnings and policies to reduce long-term prescribing of sedatives to older adults may have only resulted in the substitution of benzodiazepines with z-drugs, a harmful alternative. In addition, we found that most long-term sedative users are younger than 65 years of age. Long-term sedative use appears to be common and increasing slightly among middle-aged adults. Future deprescribing efforts might best achieve their goals by targeting the middle-aged adults who fill a substantial proportion of total long-term sedative prescriptions.

References

1. Donoghue J, Lader M. Usage of benzodiazepines: a review. *Int J Psychiatry Clin Pract* 2010;14:78-87.
2. Kurko TA, Saastamoinen LK, Tähkäpää S, et al. Long-term use of benzodiazepines: definitions, prevalence and usage patterns — a systematic review of register-based studies. *Eur Psychiatry* 2015;30:1037-47.
3. Gustavsen I, Bramness JG, Skurtveit S, et al. Road traffic accident risk related to prescriptions of the hypnotics zopiclone, zolpidem, flunitrazepam and nitrazepam. *Sleep Med* 2008;9:818-22.
4. Leipzig RM, Cumming RG, Tinetti ME. Drugs and falls in older people: a systematic review and meta-analysis: I. Psychotropic drugs. *J Am Geriatr Soc* 1999;47:30-9.
5. Kripke DF. Chronic hypnotic use: deadly risks, doubtful benefit: review article. *Sleep Med Rev* 2000;4:5-20.
6. Rapoport MJ, Lanctôt KL, Streiner DL, et al. Benzodiazepine use and driving: a meta-analysis. *J Clin Psychiatry* 2009;70:663-73.
7. Cunningham CM, Hanley GE, Morgan S. Patterns in the use of benzodiazepines in British Columbia: examining the impact of increasing research and guideline cautions against long-term use. *Health Policy* 2010;97:122-9.
8. Alessi-Severini S, Bolton JM, Enns MW, et al. Use of benzodiazepines and related drugs in Manitoba: a population-based study. *CMAJ Open* 2014;2:E208-16.
9. Morgan S, Smolina K, Mooney D, et al. The Canadian Rx Atlas. 3rd edition. Vancouver: UBC Centre for Health Services and Policy Research; 2013.
10. Sonnenberg CM, Bierman EJ, Deeg DJ, et al. Ten-year trends in benzodiazepine use in the Dutch population. *Soc Psychiatry Psychiatr Epidemiol* 2012;47:293-301.
11. Dündar Y, Boland A, Strobl J, et al. Newer hypnotic drugs for the short-term management of insomnia: a systematic review and economic evaluation. *Health Technol Assess* 2004;8:iii-x, 1-125.
12. Lader M. Benzodiazepines revisited — will we ever learn? *Addiction* 2011;106:2086-109.
13. Lader M. Benzodiazepine harm: how can it be reduced? *Br J Clin Pharmacol* 2014;77:295-301.
14. Johnell K, Fastbom J. The use of benzodiazpines and related drugs amongst older people in Sweden: associated factors and concomitant use of other psychotropics. *Int J Geriatr Psychiatry* 2009;24:731-8.
15. Hoffmann F, Hies M, Glaeske G. Regional variations of private prescriptions for the non-benzodiazepine hypnotics zolpidem and zopiclone in Germany. *Pharmacoepidemiol Drug Saf* 2010;19:1071-7.
16. Hausken AM, Furu K, Skurtveit S, et al. Starting insomnia treatment: the use of benzodiazepines versus z-hypnotics. A prescription database study of predictors. *Eur J Clin Pharmacol* 2009;65:295-301.
17. Luijendijk HJ, Tiemeier H, Hofman A, et al. Determinants of chronic benzodiazepine use in the elderly: a longitudinal study. *Br J Clin Pharmacol* 2008;65:593-9.
18. Fortin D, Préville M, Ducharme C, et al. Factors associated with long-term benzodiazepine use among elderly women and men in Quebec. *J Women Aging* 2007;19:37-52.
19. Fourrier A, Letenneur L, Dartigues J, et al. Benzodiazepine use in an elderly community-dwelling population. *Eur J Clin Pharmacol* 2001;57:419-25.
20. Tu K, Mamdani MM, Hux JE, et al. Progressive trends in the prevalence of benzodiazepine prescribing in older people in Ontario, Canada. *J Am Geriatr Soc* 2001;49:1341-5.
21. Egan M, Moride Y, Wolfson C, et al. Long-term continuous use of benzodiazepines by older adults in Quebec: prevalence, incidence and risk factors. *J Am Geriatr Soc* 2000;48:811-6.
22. BC Ministry of Health. Medical services plan (MSP) payment information file. Population Data BC. Data Extract. MOH; 2015. Available: www.popdata.bc.ca/data (accessed 2017 Jan. 16).
23. BC Ministry of Health. PharmaNet. BC Ministry of Health. Data Extract. Data Stewardship Committee; 2015. Available: www.popdata.bc.ca/data (accessed 2017 Jan. 16).
24. Canadian Institute for Health Information. Discharge Abstract Database (Hospital Separations file). Population Data BC. Data Extract. MOH; 2015.
25. What Is PharmaNet? Victoria: Pharmacare, BC Ministry of Health; 2014. Available: www.health.gov.bc.ca/pharmacare/pharmanet/netindex.html (accessed 2014 July 7).
26. Anatomical Therapeutic Chemical Code Classification Index with Defined Daily Doses. Oslo (Norway): World Health Organization Collaborating Centre for Drug Statistics Methodology; 2014. Available: www.whocc.no/atcddd/ (accessed 2014 Feb. 4).
27. Weiner J, Abrams C. *The Johns Hopkins ACG System technical reference guide*. Version 9.0. Baltimore: The Perl Foundation; 2009;5:762-5.

28. Hanley GE, Morgan S, Reid RJ. Explaining prescription drug use and expenditures using the adjusted clinical groups case-mix system in the population of British Columbia, Canada. *Med Care* 2010;48:402-8.
29. Baldwin L-M, Klabunde CN, Green P, et al. In search of the perfect comorbidity measure for use with administrative claims data: does it exist? *Med Care* 2006;44:745-53.
30. Hanley GE, Morgan S. On the validity of area-based income measures to proxy household income. *BMC Health Serv Res* 2008;8:79.
31. Gaskin DJ, Briesacher BA, Limcangco R, et al. Exploring racial and ethnic disparities in prescription drug spending and use among Medicare beneficiaries. *Am J Geriatr Pharmacother* 2006;4:96-111.
32. Morgan S, Hanley G, Cunningham C, et al. Ethnic differences in the use of prescription drugs: a cross-sectional analysis of linked survey and administrative data. *Open Med* 2011;5:e87-93.
33. Salerno E. Race, culture, and medications. *J Emerg Nurs* 1995;21:560-2.
34. Burroughs VJ, Maxey RW, Levy RA. Racial and ethnic differences in response to medicines: towards individualized pharmaceutical treatment. *J Natl Med Assoc* 2002;94(Suppl):1-26.
35. Shah BR, Chiu M, Amin S, et al. Surname lists to identify South Asian and Chinese ethnicity from secondary data in Ontario, Canada: a validation study. *BMC Med Res Methodol* 2010;10:42.
36. McIntosh B, Clark M, Spry C. Benzodiazepines in older adults: a review of clinical effectiveness, cost-effectiveness, and guidelines. Ottawa: Canadian Agency for Drugs and Technologies in Health; 2011.
37. Benzodiazepines and newer hypnotics. Liverpool (UK): National Prescribing Centre; 2005; Vol 15:17-20. Available: http://filesdown.esecure.co.uk/NorthLancsPCT/MeRec_Bull_15_5_.pdf_07012011-1137-24.pdf (accessed 2015 Nov. 3).
38. Neutel CI. The epidemiology of long-term benzodiazepine use. *Int Rev Psychiatry* 2005;17:189-97.
39. General coverage policies. British Columbia Ministry of Health. Available: http://www2.gov.bc.ca/gov/content/health/health-drug-coverage/pharmacare-for-bc-residents/what-we-cover/general-coverage-policies (accessed 2015 Nov. 5).
40. Olfson M, King M, Schoenbaum M. Benzodiazepine use in the United States. *JAMA Psychiatry* 2015;72:136-42.
41. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter. *J Health Soc Behav* 1995;36:1-10.
42. Phillips KA, Morrison KR, Andersen R, et al. Understanding the context of healthcare utilization: assessing environmental and provider-related variables in the behavioral model of utilization. *Health Serv Res* 1998;33:571-96.
43. Stata Statistical Software. Release 13. College Station (TX): StataCorp LP; 2014.
44. Use of benzodiazepines in BC — Is it consistent with recommendations? Vancouver: Therapeutics Initiative, University of British Columbia; 2004.
45. Nelson J, Chouinard G. Guidelines for the clinical use of benzodiazepines: pharmacokinetics, dependency, rebound and withdrawal. *Can J Clin Pharmacol* 1999;6:69-83.
46. el-Guebaly N, Sareen J, Stein MB. Are there guidelines for the responsible prescription of benzodiazepines? *Can J Psychiatry* 2010;55:709-14.
47. American Geriatrics Society Beers Criteria Update Expert Panel. American Geriatrics Society 2015 updated beers criteria for potentially inappropriate medication use in older adults. *J Am Geriatr Soc* 2015;63:2227-46.
48. Smith N, Quansah K, Chelak K, et al. *Narcotics, benzodiazepines, stimulants, and gabapentin: policies, initiatives, and practices across Canada, 2014 — Environmental scan*. Ottawa: Canadian Agency for Drugs and Technologies in Health; 2014. Issue 45.
49. Siriwardena AN, Qureshi Z, Gibson S, et al. GPs' attitudes to benzodiazepine and 'Z-drug'prescribing: a barrier to implementation of evidence and guidance on hypnotics. *Br J Gen Pract* 2006;56:964-7.
50. Orriols L, Philip P, Moore N, et al. CESIR Research Group Benzodiazepine-like hypnotics and the associated risk of road traffic accidents. *Clin Pharmacol Ther* 2011;89:595-601.
51. Rosman S, Le Vaillant M, Pelletier-Fleury N. Gaining insight into benzodiazepine prescribing in general practice in France: a data-based study. *BMC Fam Pract* 2011;12:28.
52. Puyat JH, Hanley GE, Cunningham CM, et al. Ethnic disparities in antipsychotic drug use in British Columbia: a cross-sectional retrospective study. *Psychiatr Serv* 2011;62:1026-31.
53. Valenstein M, Taylor KK, Austin K, et al. Benzodiazepine use among depressed patients treated in mental health settings. *Am J Psychiatry* 2004;161:654-61.
54. Edlund MJ, Steffick D, Hudson T, et al. Risk factors for clinically recognized opioid abuse and dependence among veterans using opioids for chronic noncancer pain. *Pain* 2007;129:355-62.
55. Jorm AF, Grayson D, Creasey H, et al. Long-term benzodiazepine use by elderly people living in the community. *Aust N Z J Public Health* 2000;24:7-10.

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