BMJ Open

Patterns of benzodiazepine prescription among older adults in Switzerland: a cross-sectional analysis of claims data

Xhyljeta Luta [1], Christophe Bagnoud,[2] Mark Lambiris,[3] Anne Decollogny,[1] Yves Eggli,[1] Marie-Annick Le Pogam [1], Pedro Marques-Vidal,[4] Joachim Marti [1]

To cite: Luta X, Bagnoud C, Lambiris M, *et al*. Patterns of benzodiazepine prescription among older adults in Switzerland: a cross-sectional analysis of claims data. *BMJ Open* 2020;**10**:e031156. doi:10.1136/bmjopen-2019-031156

► Prepublication history and additional material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2019-031156).

Received 22 April 2019
Revised 04 November 2019
Accepted 06 November 2019

[1]Centre for Primary Care and Public Health (Unisanté), University of Lausanne, Lausanne, Switzerland
[2]Groupe Mutuel, Martigny, Switzerland
[3]Swiss Tropical and Public Health Institute, Basel, Switzerland
[4]Department of Internal Medicine, Lausanne University Hospital, Lausanne, Vaud, Switzerland

Correspondence to
Professor Joachim Marti;
joachim.marti@unisante.ch

ABSTRACT

Objective This study aimed to examine the prevalence and determinants of benzodiazepine prescription among older adults in Switzerland, and analyse association with hospitalisation and costs.

Design Retrospective analysis of claims data.

Setting The study was conducted in nine cantons in Switzerland.

Participants Older adults aged 65 years and older enrolled with a large Swiss health insurance company participated in the study.

Primary and secondary outcome measures The primary outcome was prevalence of benzodiazepine prescription. The secondary outcomes were (1) determinants of any benzodiazepine prescription; (2) the association between any prescription and the probability of hospitalisation for trauma and (3) the association between any prescription and total healthcare expenditures.

Results Overall, 69 005 individuals were included in the study. Approximately 20% of participants had at least one benzodiazepine prescription in 2017. Prescription prevalence increased with age (65–69: 15.9%; 70–74: 18.4%; 75–80: 22.5%; >80: 25.8%) and was higher in women (25.1%) compared with men (14.6%). Enrollees with the highest deductible of Swiss Francs (CHF) 2500 were 70% less likely to receive a prescription than enrollees with the lowest deductible of CHF 300 (adjusted OR=0.29, 95% CI 0.24 to 0.35).

Individuals with at least one prescription had a higher probability of hospitalisation for trauma (OR=1.31, 95% CI 1. 20 to 1.1.44), and 70% higher health care expenditures (β=0.72, 95% CI 0. 67 to 0.77). Enrollees in canton Valais were three times more likely to receive a prescription compared to enrollees from canton Aargau (OR=2.84, 95% 2.51 to 3.21).

Conclusions The proportion of older adults with at least one benzodiazepine prescription is high, as found in the data of one large Swiss health insurance company. These enrollees are more likely to be hospitalised for trauma and have higher healthcare expenditures. Important differences in prescription prevalence across cantons were observed, suggesting potential overuse. Further research is needed to understand the drivers of variation, prescription patterns across providers, and trends over time.

Strengths and limitations of this study

- ► We analysed a large administrative dataset with detailed patient-level information to provide recent evidence on benzodiazepine prescription in older adults in Switzerland.
- ► The Swiss context with its decentralised system but homogeneous benefit package offers an opportunity to study regional variation that can shed light on cultural differences in healthcare use.
- ► We restricted our analysis to the cantons in which direct dispensing by physicians is not allowed; our sample is therefore not representative of all Switzerland.
- ► By relying on claims data, we have only limited diagnostic information at the individual level and we were therefore unable to identify the reason for benzodiazepine prescriptions.
- ► We only investigate association between prescription, hospitalisations and costs, and are not able to make any causal claim.

INTRODUCTION

Benzodiazepines are among the most prescribed psychotropic drugs in high-income countries, widely used for treating anxiety and sleep disorders. Estimates of adult benzodiazepine consumption (≥18 years) range from 5% in the USA to over 16% in some European countries.[1 2] There are growing concerns about the potentially inappropriate use of benzodiazepines, particularly when used for a long period of time.[3 4] Studies have found an increase in benzodiazepine prescription with age in both men and women and a positive association with health-related factors such as depression and chronic disease.[1 5 6] Benzodiazepines have been ranked among the most misused drugs, particularly for dependence.[7] Moreover, guidelines discourage prolonged use of benzodiazepines especially among older people due to severity of adverse effects, particularly those associated with the central nervous system.[8 9] Indeed, when used for long

periods, benzodiazepines may lead to dependency, traumatic falls and fracture,[10 11] hospitalisation and death,[12–14] leading to increased healthcare costs.[8 15 16]

In 2019, the American Geriatrics Society[9] published an update of the Beers Criteria to guide prescription in the elderly population.[17] It recommends avoiding the use of benzodiazepines in elderly patients due to increased sensitivity to these drugs and decreased metabolic rate of long-acting agents. Moreover, use for longer than 4 weeks may be potentially problematic.[18]Despite the lack of evidence supporting their use beyond short periods, benzodiazepines are often prescribed for longer periods than recommended, particularly among those aged ≥65.[19]

In Switzerland, the Choosing Wisely Switzerland ('smarter medicine') top-5 list of low-value interventions for geriatrics includes benzodiazepines (https://www.smartermedicine.ch) and makes the following recommendation: "Don't use benzodiazepines or other sedative-hypnotics in older adults as first choice for insomnia, agitation or delirium and avoid prescription at discharge".[20] Use of benzodiazepines is, however, recommended for alcohol withdrawal symptoms/delirium tremens or severe generalised anxiety disorder unresponsive to other therapies. Although concern exists regarding potential overuse, limited information is available regarding patterns of use and its impact in older adults. For instance, a study conducted in 2007 including 520 000 participants from the general adult population found that 9.1% received at least one benzodiazepine prescription within a period of 6 months.[21]

In this study, we use routine health insurance claims data to measure the prevalence of benzodiazepine prescription among individuals aged ≥65 in Switzerland. We further assess patterns of benzodiazepine prescription (eg, number of prescriptions, defined daily dose (DDD)), determinants of prescription, association with hospitalisation and healthcare costs. In addition, we study differences in the prevalence of prescription across cantons to assess potential unwarranted variation and identify regions in need of concerted deprescribing efforts.

METHODS

Setting

Switzerland is a confederation of 26 cantons (states) with a total population of 8.4 million inhabitants. There are four official languages: German (63%), French (22.7%), Italian (8.1%) and Romansch (0.5%). While the Swiss healthcare system performs well in international comparisons,[22 23] it is also one of the most expensive in the world. The regulation and organisation of healthcare takes place at the three main political levels, that is, central government, cantons and municipalities, with cantons playing a central role in delivery and financing of healthcare services.[24] This gives rise to disparate cantonal health systems under the umbrella of a common central regulation. Health insurance is mandatory and covers illness, maternity and accidents for all insured individuals who are free to choose among registered health insurance companies that offer the same benefit package. The standard plan offers freedom of provider choice and direct access to secondary care. Enrollees can choose their deductible level (options range from CHF 300 to 2500) and, in return for a lower premium, they can choose alternative healthcare plans (HCPs), with either a general practitioner (GP) or a medical call centre as the first point of contact.[25] Gatekeeping plans require enrollees to see a GP for referral to specialists, and managed care plans typically restrict access to a list of providers. Premiums are not risk-rated but can vary significantly across regions. Participation of households to healthcare expenditures is important and includes deductibles, co-payments and out-of-pocket expenses, giving rise to a particularly regressive financing system.[26]

Study design and participants

We conducted a cross-sectional analysis of claims data to study benzodiazepine prescriptions in enrollees aged ≥65 in 2017. We restricted our analysis to the nine Swiss cantons (ie, Aargau, Basel, Freiburg, Geneva, Jura, Neuchatel, Ticino, Vaud and Valais) in which direct medication dispensing by physicians is not allowed, as such prescriptions may not be captured with enough accuracy in the data.

Data sources

We obtained data from Groupe Mutuel, which is one of the largest health insurance companies in Switzerland, covering some 981 160 individuals with mandatory health insurance in 2019. The database provides information on demographic characteristics of enrollees including age, sex and canton of residence, as well as information on insurance plan (deductible level and type of contract (types of contract include basic option, gatekeeping, telephone-based gatekeeping, as well as managed care (HMO))). In addition, the data include information on hospitalisations with the associated diagnosis-related group (DRG), total costs covered by mandatory health insurance, comorbidities[i] derived from medication use,[27] drug prescription information including anonymous prescriber identifier, Anatomical Therapeutic Chemical (ATC) classification system codes and a more detailed Swiss classification code (ie, Pharmacode), number of packs and prescription date. The following ATC codes were used to identify benzodiazepine prescriptions : N05BA and N05CD. We identified two types of hospitalisations using Swiss DRG codes: (1) those potentially related

[i]Attention deficit hyperactivity disorder (ADHD), asthma, autoimmune diseases, cystic fibrosis/pancreatic enzyme, high cholesterol, chronic obstructive pulmonary disease (COPD)/severe asthma, Crohn's disease/ulcerative colitis, depression, diabetes, type 2 diabetes, epilepsy, glaucoma, heart disease, HIV/AIDS, hormone-sensitive cancer, hypertension, cancer, kidney disease, brain or spinal cord diseases, neuropathic pain, Parkinson's disease, psychosis, Alzheimer, and addiction, rheumatism, thyroid disease, transplantation

to benzodiazepine use, that is, trauma-related (online supplementary file 1), and (2) all other hospitalisations.

Statistical analysis

We first described participants' characteristics including demographics (ie, age categorised into four main groups: 65–69, 70–74, 75–80 and >80 years, sex, canton of residence) and insurance details (deductible and plan type), and analysed differences in characteristics between those with and without any benzodiazepine prescription. We also analysed how the prevalence of prescription vary by age and canton. Intensity of potential benzodiazepine use among individuals with at least one prescription was captured using number of benzodiazepine prescriptions and total number of DDD. We also produced an estimate of the treatment duration, and computed mean daily dose by combining information on prescription dates and DDDs.[28] Finally, we analysed (1) the determinants of any benzodiazepine prescription and (2) the association between any prescription and the probability of trauma-related hospitalisations using logistic regression, as well as (3) the association between any prescription and total healthcare expenditures using a linear regression with log-transformed costs.[29] This specification was preferred to two-part or zero-inflated models as we have a highly skewed distribution of costs, but only a small proportion of enrollees with zero cost. Control variables included age, canton of residence, deductible level, type of contract, total number of non-trauma hospitalisations as a proxy for health status and comorbidities. In addition to ORs and regression coefficients, we report predicted outcomes (ie, hospitalisation rate and healthcare expenditures) to reflect the contribution of each value of each covariate to the outcomes of interest, all else being equal.

Data management and analysis were conducted using Stata V.15.1 (StataCorp LP, College Station, Texas, USA).

Patient and public involvement

Patients and the public were not involved in the design or planning of the study.
[30]

RESULTS

Descriptive statistics

Our study population consisted of 69 005 individuals aged 65 and older (table 1). The mean age for all enrollees was 75.1 years and over half were women (55%). The majority of participants (57%) had a basic health insurance plan without a specific model and chose the lowest deductible level of CHF 300 (55%). Among all included individuals, 20.4% had at least one benzodiazepine prescription during the study period.

The prevalence of any benzodiazepine prescription increased with age and was highest (25.8%) among age group 80 and older. Women had higher (25.1%) prevalence compared with men (14.6%). Study participants with a basic health insurance (22.1%) and those with the lowest deductible level (23.6%) had higher prevalence of benzodiazepine prescription. Overall, over half of the study participants (55.7%) had no comorbidity and about a third had one comorbidity (32%). The highest prevalence of benzodiazepine prescription was observed among those with five or more comorbidities (44%).

Figure 1 shows variation of prescription prevalence by age and canton of residence. In all cantons, except in canton of Fribourg where prevalence dropped among older enrollees, prevalence increased steadily with age to reach about 30% for the oldest age group in some cantons. We also observe important variation between cantons, with prevalence varying by a factor of 2 between the highest and the lowest prescribing cantons. Of note, the two lowest prescribing cantons are in the German-speaking part of the country, whereas the other cantons are in the French-speaking or Italian-speaking regions.

A total of 75 130 benzodiazepine prescriptions were filled in 2017. The most commonly prescribed products were lorazepam (39.9%), oxazepam (16.4%) and bromazepam (13.1%) (table 2). The majority of individuals with at least one prescription received intermediate-acting benzodiazepine agents (67.7%), followed by long-acting benzodiazepines (25%) and only a small proportion (7.4%) received short-acting benzodiazepines.

The mean number of prescriptions among those with at least one prescription was 4.9 (SD 5.4, median 4), and the mean DDD was 111.23 (SD 145.4, median 60). About one-third of users received at least five prescriptions during the year and 40% were prescribed the equivalent of 90 DDD or more. More importantly, the estimated treatment duration is above 15 days for 80% of users, suggesting high prevalence of long-term use. By combining information on prescription dates and DDD, we calculated a mean daily dose of 0.85 (SD 1.65, median 0.70).

Determinants of benzodiazepine prescription

Logistic regression results are presented in table 1. The probability of any benzodiazepine prescription increased with age. For example, the adjusted OR was 1.29 (95% CI 1.22 to 1.36) for enrollees aged 75–80 and 1.41 (95% CI 1.34 to 1.49) for those aged 80 and older (ref: 65–69). Men were 50% less likely to be prescribed benzodiazepines as women (adjusted OR=0.53, 95% CI 0.51 to 0.55). The model also revealed significant differences in prescribing patterns between cantons, with for instance prevalence of prescription being nearly three times higher in canton Valais than in the reference canton of Aargau (OR=2.84, 95% CI 2.51 to 3.21).

We observed an association between deductible level and benzodiazepine prescription. Enrollees with higher deductibles were less likely to receive a prescription. For instance, enrollees with the highest deductible level of CHF 2500 were 70% less likely to receive a prescription than enrollees with a deductible of CHF 300 (OR=0.29, 95% CI 0.24 to 0.35). Having chronic conditions was associated with benzodiazepine prescription. For example, among individuals with one chronic condition, the OR

Table 1 Sample characteristics, 2017 (n=69 005)

	N (%)	% with any benzodiazepine prescription	Adjusted % with any benzodiazepine prescription*	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age groups					
65–69	19 553 (28.3)	15.9	20.4	–	–
70–74	17 773 (25.8)	18.4	21.4	1.18 (1.12 to 1.25)	1.08 (1.02 to 1.15)
75–80	14 820 (21.5)	22.5	23.6	1.53 (1.45 to 1.62)	1.29 (1.22 to 1.36)
80+	16 859 (24.4)	25.8	24.5	1.83 (1.74 to 1.93)	1.41 (1.34 to 1.49)
Sex					
Female	38 259 (55.4)	25.1	24.5	–	–
Male	30 746 (44.6)	14.6	15.1	0.51 (0.49 to 0.53)	0.53 (0.51 to 0.55)
Canton					
NE	3594 (5.2)	24.9	23.2	3.53 (3.09 to 4.05)	2.72 (2.37 to 3.12)
VS	12 159 (17.6)	24	23.9	3.37 (2.99 to 3.79)	2.84 (2.51 to 3.21)
GE	12 753 (18.5)	23.1	21.8	3.21 (2.85 to 3.61)	2.50 (2.21 to 2.83)
JU	1672 (2.4)	22	21.7	3.00 (2.56 to 3.53)	2.49 (2.11 to 2.93)
TI	3591 (5.2)	21.6	22.8	2.94 (2.56 to 3.37)	2.65 (2.31 to 3.05)
VD	23 363 (33.9)	19.4	19.2	2.57 (2.29 to 2.88)	2.11 (1.88 to 2.39)
FR	5742 (8.3)	18.2	19.4	2.38 (2.09 to 2.70)	2.15 (1.88 to 2.46)
BS	2145 (3.1)	12.5	12.9	1.52 (1.28 to 1.80)	1.29 (1.09 to 1.54)
AG	3986 (5.8)	8.6	10.4	–	–
Insurance plan					
Basic plan	39 310 (57.0)	22.1	21.1	–	–
Gatekeeping	14 706 (21.3)	19.6	20.4	0.86 (0.82 to 0.90)	0.96 (0.91 to 1.01)
Phone-based gatekeeping	8776 (12.7)	14.9	17.6	0.61 (0.58 to 0.65)	0.79 (0.74 to 0.85)
Managed care (HMO)	6213 (9.0)	19.3	19.4	0.84 (0.79 to 0.90)	0.89 (0.83 to 0.96)
Deductible (CHF)					
300	38 037 (55.1)	23.6	22.3	–	–
500	22 415 (32.5)	19.7	19.5	0.79 (0.76 to 0.83)	0.83 (0.80 to 0.87)
1000	2004 (2.9)	11.9	15	0.44 (0.38 to 0.50)	0.60 (0.52 to 0.69)
1500	3667 (5.3)	8.6	12.4	0.31 (0.27 to 0.34)	0.47 (0.42 to 0.54)
2000	395 (0.6)	6.6	10	0.23 (0.15 to 0.34)	0.37 (0.25 to 0.56)
2500	2487 (3.6)	5.1	8	0.17 (0.15 to 0.21)	0.29 (0.24 to 0.35)
Comorbidities (PCG)					
0	38 430 (55.7)	15.1	15.7	–	–
1	22 231 (32.2)	24.6	24	1.83 (1.76 to 1.91)	1.73 (1.66 to 1.80)
2	6813 (9.9)	32.2	29.8	2.67 (2.52 to 2.83)	2.36 (2.22 to 2.50)
3	1317 (1.9)	38.2	34.3	3.47 (3.09 to 3.89)	2.94 (2.61 to 3.30)
4	189 (0.3)	41.8	37.1	4.03 (3.02 to 5.39)	3.35 (2.49 to 4.51)
5+	25 (0.0)	44	36.6	4.41 (2.00 to 9.72)	3.27 (1.46 to 7.32)
Overall		**20.4**			

Outcomes	Benzodiazepine users (n=14 072)	Non-users (n=54 925)
Healthcare expenditures, mean (SD)	15 573 (19 040)	9111 (14 848)
Hospitalisation (any), N (%)	3841 (27.3)	9298 (16.9)
Hospitalisation (trauma), N (%)	760 (5.4)	1925 (3.5)

*Adjusted for age, sex, canton, insurance plan, deductible (CHF) and comorbidities.
PCG, pharmaceutical cost group.

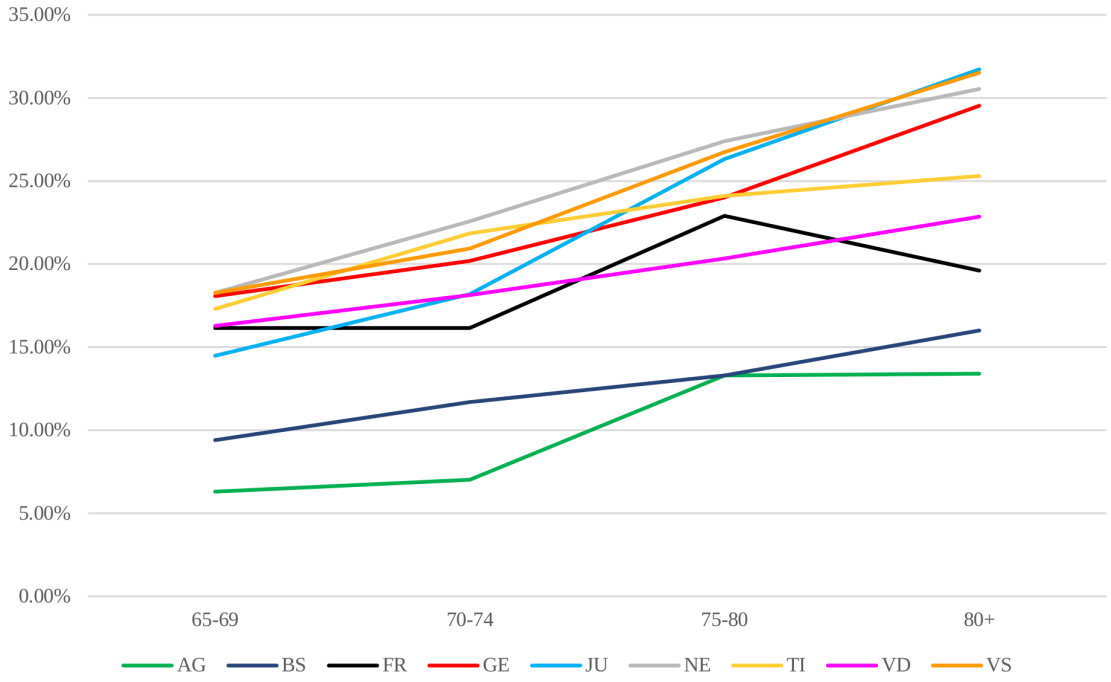

Figure 1 Prescription prevalence by age groups and canton, 2017.

was 1.73 (95% CI 1.66 to 1.80) and increased to 3.27 among those with five or more comorbidities (95% CI 1.46 to 7.32).

Association with hospitalisations and healthcare expenditures

Overall, 19% of individuals had at least one hospital admission during the study period. Individuals with a benzodiazepine prescription were more likely to be hospitalised for any cause (27.3% vs 16.9%) and for trauma (5.4% vs 3.5%) compared to non-users. Total healthcare expenditures were higher for those with a prescription than for non-users (CHF 15573 vs 9111). Table 3 shows the association between benzodiazepine prescription, hospitalisations and healthcare expenditures. Individuals with any benzodiazepine prescription had higher probability of being hospitalised for trauma (OR=1.31, 95% CI 1.20 to 1.44) table 3. As expected, hospitalisation rate increased with age and comorbidities. Our models of total healthcare expenditures showed that those with at least one prescription had 70% higher expenditures compared to non-users (β=0.72, 95% CI 0. 67 to 0.77).

DISCUSSION

In this retrospective analysis of insurance claims data, the proportion of individuals aged 65 years and older with at least one prescription of benzodiazepines in 2017 was about 20%. The prevalence of prescription increased with age and was higher among women. We also found important variation in prescription prevalence across cantons, with prevalence ranging from 16% to 31%. Having more than one comorbidity and having a lower deductible was associated with a higher probability of benzodiazepine prescription. Finally, we found an association between benzodiazepine prescription, hospitalisation for trauma and healthcare expenditures.

This is one of the first studies investigating benzodiazepine prescription in older adults in Switzerland. A study conducted in the general population[21] showed a prevalence of benzodiazepine dependence of 16%–20% with many patients (49.3%) receiving benzodiazepines on a long-term basis and 8.3% receiving benzodiazepines in high doses. A recently published Swiss study using claims data found no association between use and the risk of Alzheimer's disease,[31] contrary to previous evidence.[32] In other countries the prevalence of benzodiazepine use in the elderly population ranged from 15% to 31%.[1 6 33–35] In our study, about 20% of enrollees received at least one benzodiazepine prescription in 2017, with two-thirds of them receiving the equivalent of 30 DDD or more, and 80% with estimated treatment durations longer than 2 weeks. Thus, considering that use is typically not recommended beyond 2–4 weeks of treatment,[17 36] the prevalence of benzodiazepine overuse among older people in Switzerland is likely to be as high as 16%. This proportion might be twice higher in non-German-speaking cantons, among women over 80 years old and in multimorbid people.

High prevalence of benzodiazepine prescription among older adults appears to be common in many parts of the world. For example, a study in the USA found that 5.2% of the adult population were benzodiazepine users.[1] People receiving prescription from a psychiatrist were more likely to be long-term users and this tendency increased with age (33% in younger adults and 53.5% in older adults). In Australia, 16% of the adults aged 65 years and older had at least one benzodiazepine prescription

Table 2 Details on benzodiazepine prescriptions, 2017

	N	% of all benzodiazepine prescriptions
Panel A: prescribed benzodiazepines (n=75 130)		
Anxiolitics (N05BA)		
Intermediate acting		
Lorazepam	29 945	39.9
Oxazepam	12 298	16.4
Alprazolam	5843	7.8
Lorazepam+Diphenhydramine	1557	2.1
Long acting		
Bromazepam	9840	13.1
Clorazepate	3782	5.0
Prazepam	1122	1.5
Others (ie, diazepam, clobazam, kétazolam)	456	0.6
Hypnotics and sedatives (N05CD)		
Short acting		
Midazolam	3524	4.7
Triazolam	2039	2.7
Intermediate acting		
Lormatezepam	755	1.0
Temazepam	366	0.5
Long acting		
Flurazepam	2461	3.3
Flunitrazepam	838	1.1
Nitrazepam	284	0.4

	Mean	SD	Median	IQR
Panel B: prescriptions among users (n=14 072)				
No. of benzodiazepine prescriptions	4.94	5.43	4	6
DDD	111.23	145.40	60	128
Mean daily dose	0.85	1.65	0.70	0.62
No. of different prescribers	1.25	0.57	1	0
No. of different drugs prescribed (any type)*	10.2	7.2	9	9

	N	%
No. of benzodiazepine prescriptions		
1	3839	27.3
2–5	5278	37.5
5–10	3427	24.4
10+	1528	10.9
DDD		
0–30	5046	35.9
30–90	3371	24.0
90–180	3142	22.3
180–360	1713	12.2
360+	800	5.7
Estimated treatment duration (days)		
0–15	2936	20.1
15–90	2095	14.9
90–180	2182	15.5
180–270	2440	17.3
270+	4419	31.4
Mean daily dose		
0–0.5	5317	37.8
0.5–1	6893	50.0
1–2	1429	10.2
2+	433	3.1

*Total number of prescriptions of different therapeutic/pharmacological subgroups (ATC 4-digit).
DDD, defined daily dose.

with higher prevalence in women and those aged 65 and older.[34] A recent German retrospective study including over 32 000 older people showed that the proportion of patients receiving benzodiazepine therapy for over 6 months was approximately 15%–20%. Similar to our findings, use of benzodiazepines was more frequent in older people, patients treated in neuropsychiatric practices, and people diagnosed with dementia, sleep disorders or depression.[6]

The fact that over three quarters of individuals with at least one benzodiazepine prescription are long-term users reflects the challenge of discontinuing such treatment. Research suggests that the main barriers to reducing or stopping prescription of psychotropic drugs in clinical practices are patient perceived difficulty to stop the medication and lack of alternative therapies such as cognitive behavioural therapy.[37] Moreover, healthcare providers may not recommend discontinuing benzodiazepines due to concerns related with withdrawal symptoms, which may occur in up to 50% of patients.[38] Our findings are consistent with previous research[33 39 40] showing higher prevalence of prescription among women. The increase of benzodiazepine prescription with the number of chronic conditions can be partly explained by poorer quality of sleep and more prevalent anxiety in this group. It is also possible that more frequent physician visits increase the risk of initiating hypnotic treatment.

We found higher rates of trauma-related hospital admissions and higher healthcare expenditures in individuals with at least one benzodiazepine prescription than in non-users. Previous research has consistently reported that benzodiazepine use is associated with significant increase in risk of falls.[41–43] A meta-analysis reported up to 50% increase in risk of falls among benzodiazepine users.[44] Fall-related injuries are one of the most expensive medical conditions and may have major economic consequences on healthcare systems.[45] Research from the USA suggests that the average cost for fall injury is over $30 000 and increases with age.[46]

Table 3 Association with hospitalisation and costs

	Outcome: any hospitalisation for trauma Logistic regression			Outcomes: ln(health expenditure) OLS (β reported)*		
Variables	**OR**	**95% CI**	**Predicted % with hospitalisation†**	**β**	**95% CI**	**Predicted health expenditure (in CHF)†**
Any benzodiazepine prescription						
No	–	–	3.6	–	–	6400
Yes	1.31	1.20 to 1.44	4.7	0.72	0.67 to 0.77	13 168
Age						
65–69	–	–	3.9	–	–	8504
70–74	1.15	1.03 to 1.29	4.3	0.37	0.31 to 0.42	11 562
75–80	1.34	1.20 to 1.51	4.8	0.53	0.47 to 0.58	13 013
80+	1.28	1.14 to 1.43	4.6	0.83	0.78 to 0.89	14 494
Sex						
Female	–	–	4.4	–	–	8923
Male	0.74	0.69 to 0.81	3.3	−0.12	−0.16 to −0.07	7952
Canton						
AG	–	–	4.4	–	–	5470
BS	1.06	0.81 to 1.38	4.7	0.46	0.32 to 0.60	8683
FR	1.00	0.81 to 1.25	4.4	0.57	0.46 to 0.68	9657
VD	0.88	0.73 to 1.06	3.9	0.58	0.49 to 0.68	9807
TI	0.69	0.54 to 0.89	3.1	0.21	0.09 to 0.33	6733
JU	0.95	0.71 to 1.27	4.2	0.24	0.09 to 0.39	6230
GE	0.85	0.70 to 1.03	3.8	0.50	0.40 to 0.60	8991
VS	0.80	0.66 to 0.97	3.6	0.17	0.07 to 0.27	6475
NE	0.97	0.77 to 1.22	4.3	0.40	0.28 to 0.52	8124
Insurance plan						
Basic plan	–	–	4.0	–	–	8475
Gatekeeping	0.91	0.82 to 1.00	3.6	0.09	0.03 to 0.14	9245
Phone-based gatekeeping	0.94	0.83 to 1.07	3.8	−0.12	−0.19 to −0.06	7485
Managed care (HMO)	0.95	0.82 to 1.10	3.8	−0.04	−0.12 to 0.03	8090
Deductible (CHF)						
300	–	–	4.1	–	–	9495
500	0.95	0.88 to 1.04	3.9	−0.22	−0.26 to −0.17	7656
1000	0.69	0.52 to 0.92	2.8	−1.01	−1.13 to −0.89	3448
1500	0.85	0.69 to 1.04	3.5	−1.69	−1.78 to −1.60	1748
2000	0.68	0.35 to 1.32	2.8	−2.45	−2.71 to −2.18	823
2500	0.55	0.40 to 0.75	2.3	−3.14	−3.25 to −3.03	409
Comorbidities (PCG)						
0	–	–	3.6	–	–	2977
1	1.19	1.09 to 1.30	4.2	1.35	1.30 to 1.39	11 461
2	1.21	1.07 to 1.37	4.3	1.58	1.51 to 1.65	14 500
3	1.39	1.10 to 1.76	4.9	1.78	1.64 to 1.93	17 675
4	0.22	0.05 to 0.89	0.8	1.94	1.56 to 2.32	20 699
5+	1.46	0.34 to 6.27	5.1	2.00	0.96 to 3.03	21 908

Continued

Table 3 Continued

Variables	Outcome: any hospitalisation for trauma Logistic regression			Outcomes: ln(health expenditure) OLS (β reported)*		
	OR	95% CI	Predicted % with hospitalisation†	β	95% CI	Predicted health expenditure (in CHF)†
Total number of hospital admissions (non-trauma)						
0	–	–	3.4	–	–	3704
1	1.69	1.52 to 1.88	5.7	1.69	1.63 to 1.76	20131
2+	2.03	1.76 to 2.33	6.7	2.22	2.13 to 2.31	34079
N	69005					

*Semielasticity.
†Obtained by predicting the outcome for each value of each covariate, all else being equal.
PCG, pharmaceutical cost group.

Finally, we observed a large variation across cantons in the prevalence of benzodiazepine prescription. The variation could be due to several factors including patient and provider characteristics, as well as factors related to the organisation of healthcare (eg, guidelines, incentives, different local practice patterns). Large differences in healthcare utilisation across the three language regions (French, German and Italian) have been reported in several Swiss studies, which might reflect cultural differences.[47–49] In particular, substantial cantonal variation in prescriptions for other types of drugs has been reported in previous Swiss studies, for example, in Wertli *et al* (2017)[50] who found pronounced geographical differences in prescription of pain medications.

Strengths and limitations

This study has several strengths. First, select data from individuals were available with detailed patient-level information to provide recent evidence on benzodiazepine prescription in older people in Switzerland. Such data are not readily available in the country and previous studies have often relied on survey data.[21 51 52] In addition, the Swiss context with its decentralised system but homogeneous benefit package offers an opportunity to study regional variation that can shed light on cultural differences in healthcare use.

Our study has also several limitations. First, we restricted our analysis to the cantons in which direct dispensing by physicians is not allowed; our sample is therefore not representative of all Switzerland. In addition, as we are relying on claims data, we have only limited diagnostic information at the individual level and we were therefore unable to identify the reason for prescription, and we are only able to analyse prescriptions filled and not actual medication use. Also, our study is likely to underestimate prescription prevalence as a share of prescriptions is likely to be paid out-of-pocket and therefore not recorded in claims data; our findings on the negative association between deductible level and benzodiazepines prescription could partly reflect this. Also, while our data capture information on the number of providers, we were not able to identify the type of prescribing physician which has been previously identified as an important determinant of benzodiazepine prescription.[53] Also, as benzodiazepine misuse at older ages may reflect misuse and consequent habituation at younger ages, focusing on the population aged 65 and older is a limitation. Future studies should examine patterns and initiation of problematic use in different age groups, and persistence of misuse over time. Finally, we only investigate association between prescription, hospitalisation and costs and are not able to make any causal claim.

Implications for clinicians and policy makers

Despite these limitations, our study has important implications for patients, healthcare providers and policy makers. Our results indicate that benzodiazepine overuse among older adults is likely to be a public health issue in Switzerland. It is thus necessary to analyse the causes and the consequences of this phenomenon. Is it driven by patient demand or by physician supply, with a minority of doctors initiating such treatments? Potential explanations of excessive prescription by doctors include inaccurate appreciation of the risk–benefit trade-off of the medication, poor knowledge of alternative treatment options or consultation time constraints while facing complex psychosocial problems.[54 55]

In this context, the development of clearer prescription guidelines, accompanied with improved monitoring of use, might help curb prescription rates. As overuse may be driven by variation in prescribing practice, future interventions could target prescribers in cantons with highest prescribing rates. Results shown in this study could also be used to set a national benchmark. For instance, authorities could aim for a target of use in adults age 65 and older, which would be realistic and reflect what is achievable in some cantons (eg, <10% in use). Future research should also look into why some cantons are able to achieve such low prevalence compared with others. It will also be important to better understand why multimorbid

patients consume benzodiazepines more frequently and whether the observed associations between benzodiazepine prescription, hospitalisation rates and healthcare expenditures reflect causality.

Our findings may be generalised to other developed countries that face similar challenges in their healthcare system (eg, ageing population and increasing healthcare costs).

CONCLUSIONS

We found evidence of high prevalence of prescription in this population, in particular in non-German-speaking cantons, women over 80 years old and in people with comorbidities. Future studies could identify patterns of prescription across provider type and trends over time. The use of benzodiazepines is high and is associated with trauma and healthcare expenditures, with variability across cantons, suggesting regional/prescriber directed interventions could address overuse. Further efforts are also needed to examine causality using longitudinal data.

Twitter Xhyljeta Luta @xluta

Acknowledgements We are grateful to Groupe Mutuel for providing us with the data used in the study and other relevant information. We would also like to thank the reviewers for their helpful comments and suggestions.

Contributors JM was the principal investigator on the project and led the analyses. CB actively collaborated on data preparation, description, analysis and interpretation. ML and CB were involved in data management. XL and JM drafted the manuscript. AD, YE, M-ALP and PM-V provided input in the analysis phase. All authors provided critical feedback and approved the final version of the manuscript.

Funding This work was supported by the Swiss Medical Board (www.medical-board.ch).

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval In our analysis we used routinely collected anonymous data; therefore, ethical approval was not required according to the Swiss law for research on humans.[30]

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement The insurance claims data cannot be made publicly available.

ORCID iDs
Xhyljeta Luta http://orcid.org/0000-0002-5716-4693
Marie-Annick Le Pogam http://orcid.org/0000-0003-1672-3644
Joachim Marti http://orcid.org/0000-0001-5763-3704

REFERENCES

1 Olfson M, King M, Schoenbaum M. Benzodiazepine use in the United States. *JAMA Psychiatry* 2015;72:136–42.
2 Huerta C, Abbing-Karahagopian V, Requena G, *et al*. Exposure to benzodiazepines (anxiolytics, hypnotics and related drugs) in seven European electronic healthcare databases: a cross-national descriptive study from the PROTECT-EU project. *Pharmacoepidemiol Drug Saf* 2016;25(Suppl 1):56–65.
3 Schmitz A. Benzodiazepine use, misuse, and abuse: a review. *Ment Health Clin* 2016;6:120–6.
4 Baldwin DS, Aitchison K, Bateson A, *et al*. Benzodiazepines: risks and benefits. A reconsideration. *J Psychopharmacol* 2013;27:967–71.
5 Mokhar A, Tillenburg N, Dirmaier J, *et al*. Potentially inappropriate use of benzodiazepines and z-drugs in the older population-analysis of associations between long-term use and patient-related factors. *PeerJ* 2018;6:e4614.
6 Jacob L, Rapp MA, Kostev K. Long-Term use of benzodiazepines in older patients in Germany: a retrospective analysis. *Ther Adv Psychopharmacol* 2017;7:191–200.
7 Nutt D, King LA, Saulsbury W, *et al*. Development of a rational scale to assess the harm of drugs of potential misuse. *Lancet* 2007;369:1047–53.
8 Fick DM, Cooper JW, Wade WE, *et al*. Updating the beers criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. *Arch Intern Med* 2003;163:2716–24.
9 By the 2019 American Geriatrics Society Beers Criteria® Update Expert Panel. American geriatrics Society 2019 updated AGS beers Criteria® for potentially inappropriate medication use in older adults. *J Am Geriatr Soc* 2019;67:674–94.
10 van der Hooft CS, Schoofs MWCJ, Ziere G, *et al*. Inappropriate benzodiazepine use in older adults and the risk of fracture. *Br J Clin Pharmacol* 2008;66:276–82.
11 Finkle WD, Der JS, Greenland S, *et al*. Risk of fractures requiring hospitalization after an initial prescription for zolpidem, alprazolam, lorazepam, or diazepam in older adults. *J Am Geriatr Soc* 2011;59:1883–90.
12 Peel NM. Epidemiology of falls in older age. *Can J Aging/ La Revue canadienne du vieillissement* 2011;30:7–19.
13 Ballokova A, Peel NM, Fialová D, *et al*. Use of benzodiazepines and association with falls in older people admitted to hospital: a prospective cohort study. *Drugs Aging* 2014;31:299–310.
14 Hampton LM, Daubresse M, Chang H-Y, *et al*. Emergency department visits by adults for psychiatric medication adverse events. *JAMA Psychiatry* 2014;71:1006–14.
15 Panneman MJM, Goettsch WG, Kramarz P, *et al*. The costs of benzodiazepine-associated hospital-treated fall injuries in the EU: a Pharmo study. *Drugs Aging* 2003;20:833–9.
16 Dionne P-A, Vasiliadis H-M, Latimer E, *et al*. Economic impact of inappropriate benzodiazepine prescribing and related drug interactions among elderly persons. *Psychiatr Serv* 2013;64:331–8.
17 By the American Geriatrics Society 2015 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.
18 Lader M. Benzodiazepines revisited--will we ever learn? *Addiction* 2011;106:2086–109.
19 Gerlach LB, Maust DT, Leong SH, *et al*. Factors associated with long-term benzodiazepine use among older adults. *JAMA Intern Med* 2018;178:1560–2.
20 Hui D. Benzodiazepines for agitation in patients with delirium: selecting the right patient, right time, and right indication. *Curr Opin Support Palliat Care* 2018;12:489–94.
21 Petitjean S, Ladewig D, Meier CR, *et al*. Benzodiazepine prescribing to the Swiss adult population: results from a national survey of community pharmacies. *Int Clin Psychopharmacol* 2007;22:292–8.
22 De Pietro C, Camenzind P, Sturny I, *et al*. Switzerland: health system review. *Health Syst Transit* 2015;17:1–288. xix.
23 OECD, World Health Organization. OECD reviews of health systems: Switzerland 2011.
24 Biller-Andorno N, Zeltner T. Individual responsibility and community solidarity--the Swiss health care system. *N Engl J Med* 2015;373:2193–7.
25 Keizer E, Huibers L, Bondo Christensen M, *et al*. Impact of alternative healthcare plans on out-of-hours help-seeking intentions in Switzerland. *Swiss Med Wkly* 2018;148:w14686.
26 Crivelli L, Salari P. The inequity of the Swiss health care system financing from a federal state perspective. *Int J Equity Health* 2014;13:17.
27 Huber CA, Szucs TD, Rapold R, *et al*. Identifying patients with chronic conditions using pharmacy data in Switzerland: an updated mapping approach to the classification of medications. *BMC Public Health* 2013;13:1030.
28 Manthey L, van Veen T, Giltay EJ, *et al*. Correlates of (inappropriate) benzodiazepine use: the Netherlands study of depression and anxiety (NESDA). *Br J Clin Pharmacol* 2011;71:263–72.
29 Deb P, Norton EC. Modeling health care expenditures and use. *Annu Rev Public Health* 2018;39:489–505.
30 Junod V, Elger B. Retrospective research: what are the ethical and legal requirements? *Swiss Med Wkly* 2010;140:w13041.

31 Biétry FA, Pfeil AM, Reich O, *et al*. Benzodiazepine use and risk of developing Alzheimer's disease: a case-control study based on Swiss claims data. *CNS Drugs* 2017;31:245–51.
32 Billioti de Gage S, Moride Y, Ducruet T, *et al*. Benzodiazepine use and risk of Alzheimer's disease: case-control study. *BMJ* 2014;349:g5205.
33 Davies SJC, Jacob B, Rudoler D, *et al*. Benzodiazepine prescription in Ontario residents aged 65 and over: a population-based study from 1998 to 2013. *Ther Adv Psychopharmacol* 2018;8:99–114.
34 Windle A, Elliot E, Duszynski K, *et al*. Benzodiazepine prescribing in elderly Australian general practice patients. *Aust N Z J Public Health* 2007;31:379–81.
35 Johnson CF, Frei C, Downes N, *et al*. Benzodiazepine and z-hypnotic prescribing for older people in primary care: a cross-sectional population-based study. *Br J Gen Pract* 2016;66:e410–5.
36 Ashton H. The diagnosis and management of benzodiazepine dependence. *Curr Opin Psychiatry* 2005;18:249–55.
37 Lasserre A, Younès N, Blanchon T, *et al*. Psychotropic drug use among older people in general practice: discrepancies between opinion and practice. *Br J Gen Pract* 2010;60:e156–62.
38 Cook JM, Biyanova T, Masci C, *et al*. Older patient perspectives on long-term anxiolytic benzodiazepine use and discontinuation: a qualitative study. *J Gen Intern Med* 2007;22:1094–100.
39 Fulone I, Silva MT, Lopes LC. Long-term benzodiazepine use in patients taking antidepressants in a public health setting in Brazil: a cross-sectional study. *BMJ Open* 2018;8:e018956.
40 Tournier M, Pariente A, Bégaud B, *et al*. [Use and misuse of benzodiazepines out of France]. *Presse Med* 2018;47:882–5.
41 Hill KD, Wee R. Psychotropic drug-induced falls in older people: a review of interventions aimed at reducing the problem. *Drugs Aging* 2012;29:15–30.
42 Markota M, Rummans TA, Bostwick JM, *et al*. Benzodiazepine use in older adults: dangers, management, and alternative therapies. *Mayo Clin Proc* 2016;91:1632–9.
43 Ballokova A, Peel NM, Fialova D, *et al*. Use of benzodiazepines and association with falls in older people admitted to hospital: a prospective cohort study. *Drugs Aging* 2014;31:299–310.
44 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.
45 Carroll NV, Slattum PW, Cox FM. The cost of falls among the community-dwelling elderly. *J Manag Care Pharm* 2005;11:307–16.
46 Florence CS, Bergen G, Atherly A, *et al*. Medical costs of fatal and nonfatal falls in older adults. *J Am Geriatr Soc* 2018;66:693–8.
47 Busato A, Matter P, Künzi B, *et al*. Geographic variation in the cost of ambulatory care in Switzerland. *J Health Serv Res Policy* 2012;17:18–23.
48 Camenzind PA. Explaining regional variations in health care utilization between Swiss cantons using panel econometric models. *BMC Health Serv Res* 2012;12:62.
49 Panczak R, Luta X, Maessen M, *et al*. Regional variation of cost of care in the last 12 months of life in Switzerland: Small-area analysis using insurance claims data. *Med Care* 2017;55:155–63.
50 Wertli MM, Reich O, Signorell A, *et al*. Changes over time in prescription practices of pain medications in Switzerland between 2006 and 2013: an analysis of insurance claims. *BMC Health Serv Res* 2017;17:167.
51 Davies J, Rae TC, Montagu L, *et al*. Long-term benzodiazepine and Z-drugs use in England: a survey of general practice [corrected]. *Br J Gen Pract* 2017;67:e609–13.
52 Maust DT, Kales HC, Wiechers IR, *et al*. No end in sight: benzodiazepine use in older adults in the United States. *J Am Geriatr Soc* 2016;64:2546–53.
53 Agarwal SD, Landon BE. Patterns in outpatient benzodiazepine prescribing in the United States. *JAMA Netw Open* 2019;2:e187399.
54 Sirdifield C, Anthierens S, Creupelandt H, *et al*. General practitioners' experiences and perceptions of benzodiazepine prescribing: systematic review and meta-synthesis. *BMC Fam Pract* 2013;14:191.
55 Anthierens S, Habraken H, Petrovic M, *et al*. The lesser evil? initiating a benzodiazepine prescription in general practice: a qualitative study on GPs' perspectives. *Scand J Prim Health Care* 2007;25:214–9.