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Assessment of beliefs and attitudes towards benzodiazepines using machine learning based on social media posts: an observational study

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Abstract

Background Benzodiazepines are frequently prescribed drugs; however, their prolonged use can lead to tolerance, dependence, and other adverse effects. Despite these risks, long-term use remains common, presenting a public health concern. This study aims to explore the beliefs and opinions held by the public regarding benzodiazepines, as understanding these perspectives may provide insights into their usage patterns.

Methods We collected public tweets published in English between January 1, 2019, and October 31, 2020, that mentioned benzodiazepines. The content of each tweet and the characteristics of the users were analyzed using a mixed-method approach, including manual analysis and semi-supervised machine learning.

Results Over half of the Twitter users highlighted the efficacy of benzodiazepines, with minimal discussion of their side effects. The most active participants in these conversations were patients and their families, with health professionals and institutions being notably absent. Additionally, the drugs most frequently mentioned corresponded with those most commonly prescribed by healthcare professionals.

Conclusions Social media platforms offer valuable insights into users' experiences and opinions regarding medications. Notably, the sentiment towards benzodiazepines is predominantly positive, with users viewing them as effective while rarely mentioning side effects. This analysis underscores the need to educate physicians, patients, and their families about the potential risks associated with benzodiazepine use and to promote clinical guidelines that support the proper management of these medications.

Clinical trial number Not applicable.

Significant outcomes

• Most Twitter users consider benzodiazepines effective, with only 5% mentioning side effects.

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• A significant percentage of users reported combining benzodiazepines with other psychopharmacological drugs, or even with alcohol and other addictive substances.
• Our results indicate an alarming minimization of the risks associated with benzodiazepine use.

Keywords Benzodiazepines, Psychopharmacology, Twitter, social media, public opinion

Introduction

Benzodiazepines are among the most prescribed drugs [1]. Its efficacy has been demonstrated for a number of anxiety disorders and insomnia [2–4]. Despite this efficacy, antidepressants are the first-line treatment for anxiety due to the side effect profile of benzodiazepine [5–8]. Nonbenzodiazepine hypnotics, known as Z-drugs, are also widely used, sharing similar efficacy and side effect profiles [9].

According to guidelines from the World Health Organization, the European Medicines Agency, and other regulatory agencies, benzodiazepines should only be used in short-term regimens [10–12]. However, long term uses, defined as two months or longer, is very common [13–16]. This has become a worldwide problem, leading to substantial and longstanding controversy [17]. Indeed, these drugs are often publicly perceived as innocuous, although prolonged use can lead to serious side effects such as tolerance and dependence [18, 19]. Other notable side effects include potential cognitive and psychomotor impairment, which are related to adverse events such as falls, bone fractures, motor vehicle accidents, and other medical emergencies [20–24]. The increasing mortality rate due to benzodiazepine overdose is also a significant concern [25–27]. These risks have gained such relevance that in 2016, the Centers for Disease Control and Prevention and the Food and Drug Administration of the United States issued warnings to make prescribers and patients aware of them, although the problem persists [28, 29].

We believe it is crucial to gather more knowledge about the views held by people with lived experiences and the general public regarding these medications and their effects in order to address this global public health challenge. While some previous studies have investigated the attitudes of professionals regarding benzodiazepine prescription, use rates, and patterns, there is little research concerning broader social views on benzodiazepines [1, 30]. It is well known that public perspectives on pharmacological treatments influence attitudes towards them, which justifies studying such perspectives [31, 32].

The use of social media as a proxy to understand public perceptions is broadly supported by statistical data. In 2020, 3.80 billion of people were using social media, particularly Facebook, Youtube and WhatsApp [33]. Twitter (now rebranded as X), though not the largest platform, is renowned for its real-time information sharing, with more than 330 million monthly active users worldwide [34]. The most commonly discussed topics on this platform include festivals or religious events, followed by media events, politics, human interest, and sports [35]. In this context, past studies have suggested that Twitter may be better suited for capturing more sincere and spontaneous disclosures and opinions than traditional methods (e.g., surveys), as has been shown for some health conditions and treatments [36, 37]. Artificial intelligence (AI) facilitates the analysis of large datasets, with Machine Learning (ML) being a key focus within AI for deriving insights from data through computational models [38]. There are various ML models, including supervised learning (SL) and semi-supervised learning (SSL). The latter offers significant advantages over SL and other methods, such as achieving competitive results with minimal labeled data and providing a cost-effective alternative by reducing the need for extensive labeling efforts [39]. The use of ML techniques has led to significant applications in diverse areas related to drug research on different platforms like Twitter, including the detection of abuse patterns [40] and associated risks [41], as well as examining public perceptions and attitudes towards drugs [42]. Initial studies using AI and ML techniques on social media have helped understand social perceptions related to some benzodiazepines [43], and detect the emergence of illicit benzodiazepine sale [44]; however, a deeper characterization of and perspectives on different areas of interest related to benzodiazepines in social media are still needed. Therefore, we anticipated that by applying these methods, our study would provide novel insights into public views and attitudes regarding benzodiazepines and Z-drugs (for simplicity, we will generally refer to both as benzodiazepines).

The specific aims of this study were to: (1) identify social media content on Twitter related to benzodiazepines; (2) characterize the types of users and content involved in those posts; and (3) analyze public interest and sentiment regarding such content, as related to the types of users and topics covered.

Materials and methods

Tweet search and collection

This mixed-method quantitative and qualitative analysis focused on individual Twitter posts (tweets) related to benzodiazepines and Z-drugs. Our inclusion criteria were: (1) public tweets (i.e., not protected by users); (2) containing readable text in English; (3) using any of the keywords identifying the generic and commercial names of some of the most commonly used benzodiazepines

internationally: alprazolam (Trankimazin, Xanax), clonazepam (Rivotril, Klonopin), clorazepate (Tranxilium, Tranxene), diazepam (Valium), lorazepam (Orfidal, Idalprem, Ativan), clobazam (Onfi), flurazepam, midazolam, oxazepam, lormetazepam (Noctamid), temazepam (Restoril), triazolam (Halcion), zolpidem (Stilnox, Ambien), zopiclone (Limovan), and zaleplon (Sonata); and (4) posted between January 1, 2019, and October 31, 2020.

We used Tweet Binder to find and extract tweets and their metadata, a tool we have extensively employed in past research, which can access 100% of public tweets within a given search query framed by keywords and publication date [45, 46]. In addition to tweet texts, this tool provides retweet and like counts for each tweet, as well as their publication time and date, permanent link, and user description. The search query led to the collection of a total of 63,098 tweets.

Content analysis: general procedure

Content analysis focused on the text of individual collected tweets and employed a semi-supervised machine learning approach with three phases: first, a filter was applied to remove tweets that did not match all inclusion criteria (42,831 were excluded); second, some of the remaining 20,267 tweets were subjected to manual, qualitative content classification ($n=1,800$) by investigators; and third, an automated computerized classification of the entire, larger set of tweets ($n=20,267$, including those manually classified to train the machine) was performed, based on the topical categories created in the first phase, with the addition of sentiment analysis software. During the machine learning analysis, 8,637 tweets were removed, resulting in a final number of 11,630 tweets classified into content categories and included in the subsequent statistical analysis, as described in Fig. 1.

Content analysis: exploration of data and identification of topical categories

We used a mixed inductive-deductive approach to develop a codebook to classify tweet contents based on key topical categories (that is, codes). Deductively, we brought categories from previous Twitter research from our team [47, 48]. Inductively, we explored an initial subset of 300 tweets (from the small, manual classification subset) to identify potential new topics and refine the codebook. Two investigators (LAT and MA) separately coded these 300 tweets, discussed discrepancies, and reached a final consensus on coding with the mediation of the senior supervisor (MAAM). Once the final codebook was agreed upon, the two investigators coded the remaining 1,500 tweets from the first subset, adding the agreed-upon codes to the initial 300 tweets they had used for training.

The content analysis first distinguished between 'classifiable' and 'unclassifiable' tweets. Classifiable tweets were further analyzed. The main categorical distinction among these was between 'medical' and 'nonmedical' tweets. Among the medical tweets, we coded for the presence of areas of medical interest ('cognitive complaints/anxiety,'

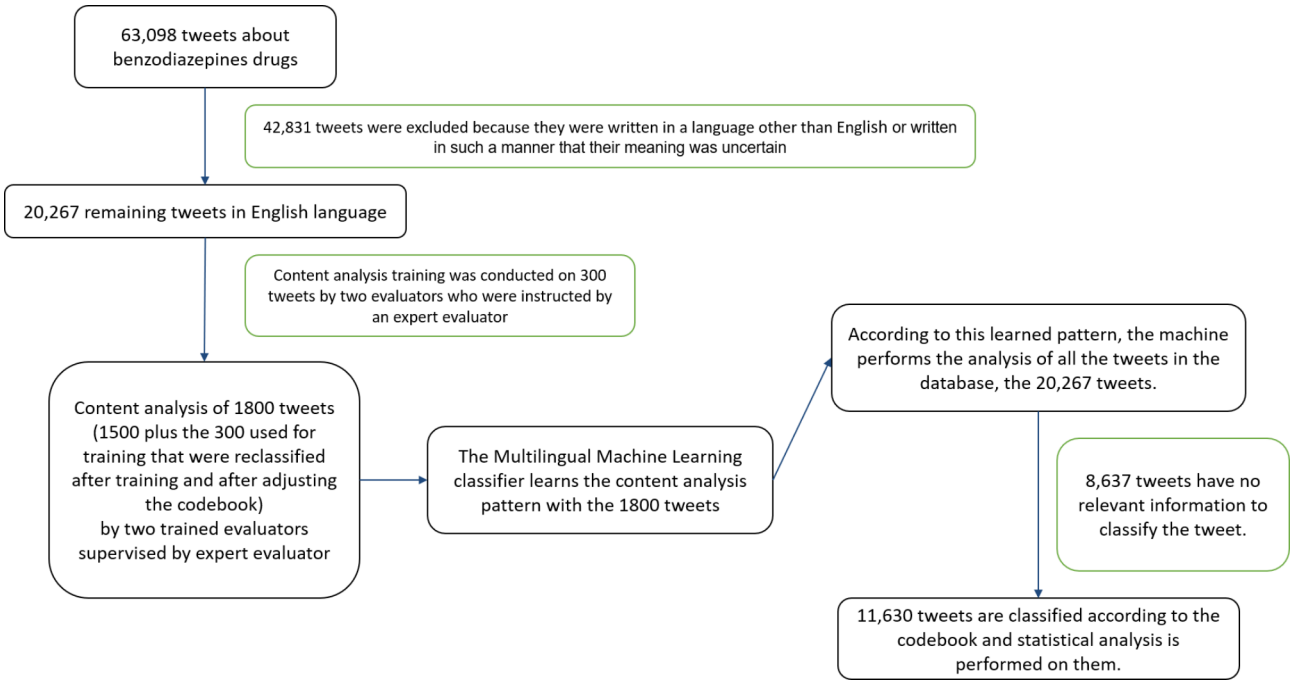

Fig. 1 Tweet analysis flowchart

'sleep,' 'other'), the presence and content of information related to efficacy and side effects (or lack thereof), the type of diagnosis related to benzodiazepine use, if stated ('no psychiatric diagnosis,' 'psychiatric diagnosis,' 'epileptic disorder diagnosis'), the presence and type of external references/sources provided through hyperlinks, if available, and whether the content aligned with current scientific evidence-based knowledge, if other psychopharmacological medications were used alongside benzodiazepines, and whether there was compliance with medical prescription instructions. On the other hand, 'nonmedical' tweets were classified into the following categories: 'commercial activities & dissemination' (related to educational and scientific events such as conferences, webinars, etc.), 'request, offer, or thanksgiving,' 'trivializing' (jokes, stigmatizing content, vulgarity, etc.), and 'other.' For each tweet, we also identified whether or not a 'personal opinion' was provided and analyzed the sentiment to distinguish 'positive' and 'negative' opinions. Topic categories were not mutually exclusive, and tweets could be multiply coded if they contained information related to more than one specific type of content.

In addition to the tweet content, tweets were also classified according to the types of users publishing them. Based on our previous Twitter research, we divided users into the following categories: 'patients and relatives' (including people with lived experience, family members, and close friends or acquaintances), 'healthcare professionals' (including healthcare personnel and institutions), and 'other.' Classification criteria and examples of tweets are shown in Supplementary Material.

Machine learning classifier

The dataset, composed of 20,267 tweets, was classified into codebook categories through semi-supervised machine learning to enable automated analysis of this large volume of data. First, we preprocessed the tweets by removing special characters such as emojis, hashtags, mentions, and long blank spaces. We then divided the 1,800 manually classified tweets into three partitions: training, validation, and test sets. The training set comprised 65% of the tweets, the validation set 15%, and the test set 20%.

Next, we fine-tuned a model for each category using the training set. For fine-tuning, we used the XLM-RoBERTa transformer, a multilingual version of RoBERTa pretrained on 2.5 TB of filtered CommonCrawl data containing 100 languages [49]. For each fine-tuned model, we selected the optimal values for two hyperparameters: learning rate and batch size. We fine-tuned using various hyperparameter values and evaluated the models on the validation set. The tested learning rates were [1e-5, 1e-4, 1e-3, 1e-2], and the batch sizes were [20, 30, 50, 69]. Lastly, we used the test set to evaluate the performance of the models in each selected category. We measured performance using the F1 score [50]. The classifiers achieved F1 scores between 0.6 and 0.90 across all categories. The categories with the best results were Link to source/reference, Areas of medical interest, and Types of content, all scoring above 0.85. Conversely, Compliance with medical prescription instructions and Concomitant use of other psychopharmacological medications achieved the lowest performance, with an F1 score of 0.6. This methodology has been extensively used in the literature [51, 52].

Statistical analysis

We estimated the frequency distribution (percentages) of tweets according to different categories based on tweet characteristics. Statistical comparisons of the proportion of tweets between categories were carried out using Pearson's chi-square test, from which the p-value of statistical significance is reported. We also used multivariable linear regression models to evaluate the associations between tweet characteristics and the interest generated, measured by likes and retweets. Individual beta coefficients were mutually adjusted for other tweet characteristics and reported with 95% confidence intervals. All p-values presented were two-tailed, with <0.05 considered statistically significant. Analyses were performed using STATA version 16.0 (Stata Corp, College Station, TX).

Ethical considerations

This study was approved by the Research Ethics Committee of Universidad de Alcalá and is compliant with the ethical principles from the World Medical Association Declaration of Helsinki (7th revision, 2013).

Results

'Patients and relatives' were the types of users contributing most on Twitter contents regarding benzodiazepines and 'Medical' were the most frequent types of contents

We firstly examined the types of users authoring the tweets. More than half of total tweets (56.72%) were posted by 'patients and relatives', whereas 'healthcare professionals' had authored less than 1% of tweets, and the remaining 42.56% were published by 'other' users. Another specific type of users that we expected to find, namely the 'media', were actually absent from these Twitter conversations (Table 1).

Among the total set of tweets, we found that the vast majority ($n=9586$, 82,4%) had 'medical' content, while 2044 tweets (17.6%) had exclusive 'nonmedical' content (Table 1). 'Patients and relatives' had authored 62.5% of 'medical' tweets, while 'other' users had published more than 30%. Among 'nonmedical' tweets, 'other' users were the most frequent authors, while 'patients and relatives' published the remaining 29.6%, and 'healthcare professionals' were absent among those tweets.

Table 1 General tweet distribution among users and contents. Percentages are relative to the total sample of tweets

	Freq.	Percent
Types of users		
Patients and relatives	6597	56.72%
Healthcare professionals	83	0.71%
Other	4950	42.56%
Types of content		
Medical	9586	82.42%
Nonmedical	2044	17.58%
Efficacy		
Positive	5524	47.50%
Negative/unstated	6105	52.50%
Side effects		
Present	675	5.80%
Absent/unstated	10,955	94.20%
Areas of medical interest		
Cognitive complaints/anxiety	985	8.47%
Sleep	1617	13.90%
Other	9028	77.63%
Compliance with medical prescription instructions		
Good compliance	3171	27.27%
Not using the prescribed dose	809	6.96%
Taking medication alongside toxic substances	2689	23.12%
Noncompliance due to other reasons/unstated	4961	42.66%
Mentions psychiatric diagnosis		
No psychiatric diagnosis	9592	82.48%
Psychiatric diagnosis	928	7.98%
Epileptic disorder diagnosis	1110	9.54%
Contents follow scientific evidence		
Does not follow scientific evidence	8481	72.92%
Follows scientific evidence	3149	27.08%
Link to source/reference		
Scientific reference	230	1.98%
Non-scientific reference	473	4.07%
No links provided	10,927	93.96%
Concomitant use of other psychopharmacological medications		
Present	1251	10.76%
Absent	4463	38.37%
Unknown	5916	50.87%
Personal opinion		
Positive	1734	14.91%
Negative	146	1.26%
Not a personal opinion	9750	83.83%
Nonmedical content		
Commercial activities & divulgation	924	7.94%
Request, offer, or thanksgiving	949	8.16%
Trivialization	3540	30.44%

Almost half of 'medical' tweets referred to efficacy, while just 5.8% indicated side effects, and nearly one quarter indicated concomitant use of toxic substances (Table 1)

Further content analysis of 'medical' tweets revealed that almost half (47,50%) of total tweets of those reported good efficacy, while only 5.8% referred to side effects of benzodiazepines. The area of medical interest most covered was 'sleep' (13.9% of total tweets). Regarding compliance with prescription, 7% total tweets disclosed lack of compliance with prescription due to not using the prescribed dose (including higher or lower doses, or higher or lower frequency of medication intake), and 23.12% reported lack of compliance with prescription due to taking medications alongside toxic substances.

Analysis of 'nonmedical' contents revealed a predominance of 'trivializing' tweets (30.44% of total tweets), while 'commercial activities & divulgation', and 'request, offer, or thanksgiving' had similar, lower percentages (around 8%).

Finally, a 'personal opinion' about benzodiazepines was present in 16.17% of total tweets, and the vast majority of those were positive (14.91% of total tweets, versus 1.26% of negative opinions).

Negative contents related to benzodiazepines receive the greatest number of retweets

We investigated public interest in contents as measured by retweets and likes. Regarding types of contents, tweets related to prescription compliance had higher chances of being liked, while tweets with positive 'personal opinion' and the 'medical' areas of interest of 'sleep' and 'cognitive complaints/anxiety' had less chances. On the other hand, contents of negative 'personal opinion' and prescription noncompliance related to the use alongside toxic substances had higher chances of receiving retweets (Fig. 2).

In relation to specific drugs, we first observed that, among all the benzodiazepines and Z-drugs included in our study, only seven were mentioned in at least 5% ($n=581$) of the total tweets. Their prevalence is graphically displayed in Fig. 3, and the drugs were clonazepam (20.79%), lorazepam (18.48%), zolpidem (18.01%), diazepam (13.89%), alprazolam (11.24%), clobazam (11.06%), and midazolam (7.11%). None of those was associated to relatively higher or lower retweet and likes counts (Fig. 4). Flurazepam y Oxacepam did not generate any tweet.

Discussion

Main findings

Contents related to medical aspects were the most frequently found in our study. Almost half of the tweets positively mentioned the efficacy of these drugs, while only 5% mentioned side effects. A significant portion of the content discussed real-life patterns of benzodiazepine use, including the simultaneous use of other psychopharmacological and illegal drugs. Over half of the users were identified as people with lived experience, their relatives, or acquaintances, while healthcare professionals and institutions were largely absent from these conversations.

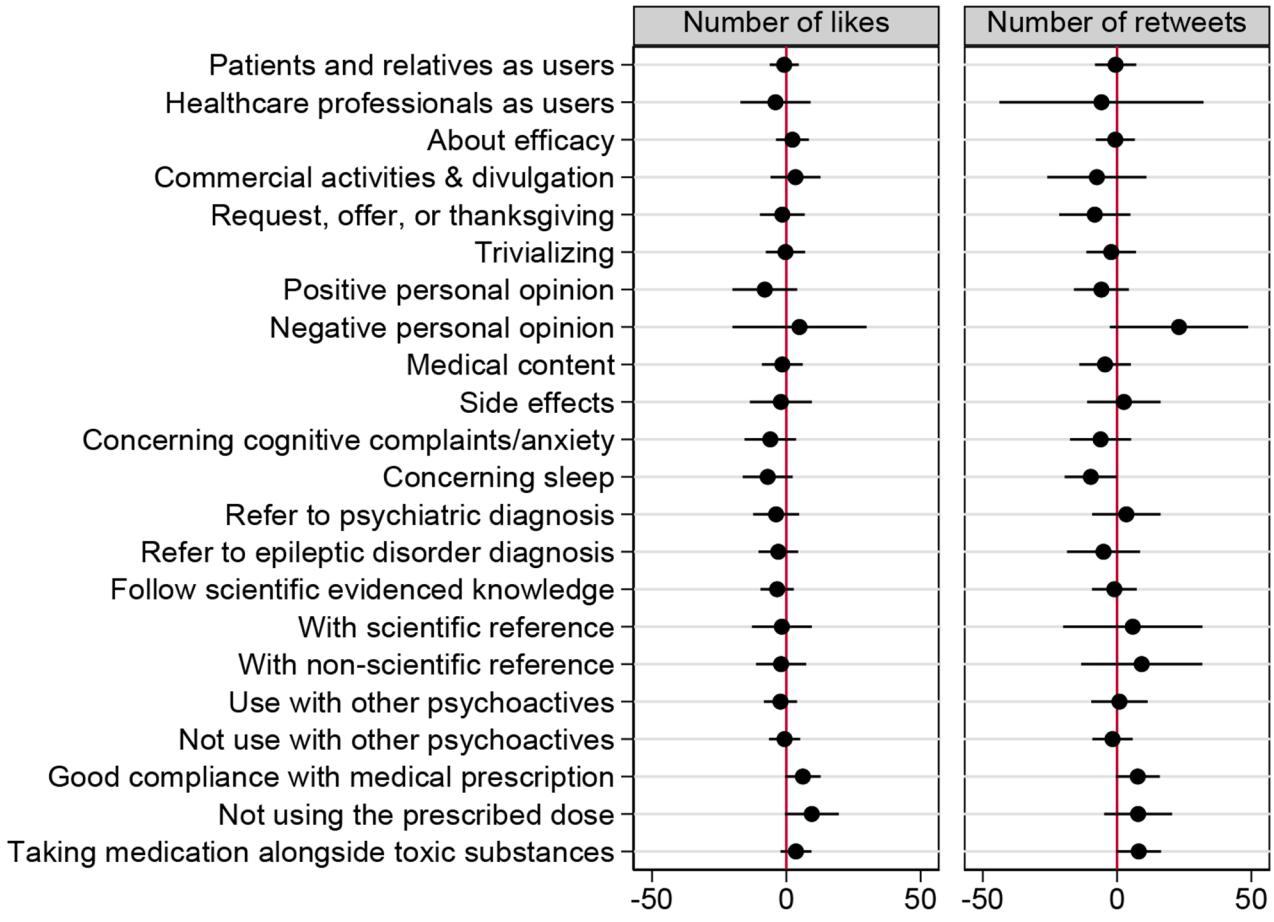

Fig. 2 Association between the different characteristics of the tweet and public interest measured in likes and retweets. The β coefficient and the confidence intervals at 95% are presented, obtained from a multivariate linear regression. Each coefficient is adjusted for all other variables

The majority of comments on Twitter focused on the medical aspects of these drugs, contrasting with findings from previous studies on other mental health treatments, where non-medical content often predominated, including a high percentage of negative and stigmatizing content [48, 53]. In our study, almost half of the 'medical' content about benzodiazepines referred to them as effective. This social perception aligns with medical literature on the efficacy of these drugs [2, 3, 54]. However, this contrasts with findings from other research on drug discussions on Twitter, where efficacy is rarely mentioned. Instead, users often focus on specific symptoms or side effects [37, 53, 55]. This suggests that Twitter users discussing benzodiazepines are particularly interested in expressing their perceived effectiveness of these drugs.

In contrast to the high number of tweets about efficacy, very few tweets discussed benzodiazepine side effects in our research. This is concerning given the significant and growing risks associated with prolonged benzodiazepine use. Long-term use can lead to decreased efficacy in treating anxiety and the emergence of severe side effects [56]. After a few weeks of use, there is an increased risk of side effects such as daytime sleepiness, impaired cognitive functioning, memory problems, reduced mobility, increased risk of falls and fractures in older patients, and reduced driving skills, which increases the risk of traffic accidents and fatalities [23, 24, 57–60]. Other side effects are related to dependence [18, 61–65]. The importance of the above risks cannot be overlooked, since they represent a public health concern to be addressed [66].

The predominance of positive mentions about benzodiazepines' efficacy on Twitter could be due to several factors. Users may share personal experiences that highlight immediate relief from anxiety and insomnia, which are the primary benefits of these medications [67]. This focus on short-term effectiveness may occur because individuals seek validation and support for their experiences or advice on similar issues, thus emphasizing positive outcomes. Moreover, social media discussions tend to be brief, often omitting detailed medical information, including side effects. This could be due to a lack of awareness or a preference for prioritizing immediate benefits over potential long-term risks. Another possible explanation is that the subset of users discussing

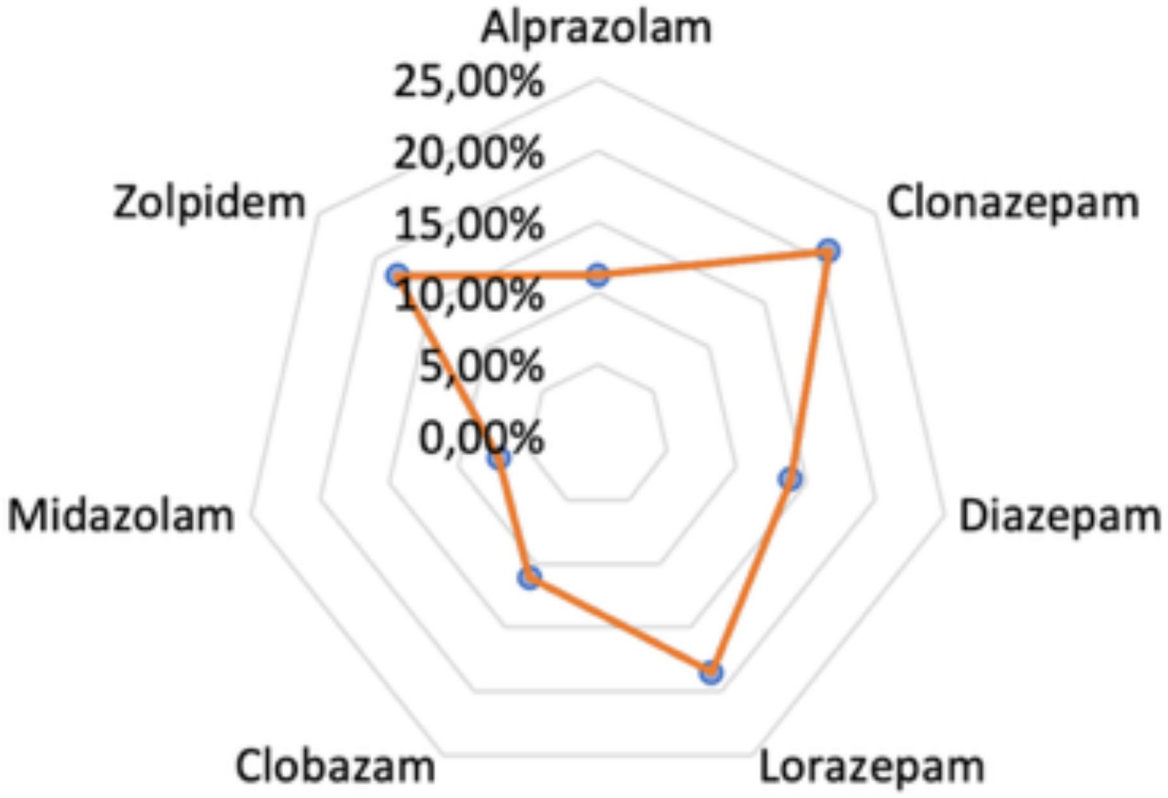

Fig. 3 Benzodiazepines and Z-drugs most frequently found in our sample of tweets

psychiatric drugs on Twitter may differ from the broader population of psychiatric medication users. It is possible that individuals experiencing negative side effects from benzodiazepines did not see the benefit of sharing their negative experiences on Twitter. Additionally, previous studies suggest that Twitter is a platform where individuals may feel more comfortable sharing experiences publicly without fear of judgment or stigma, finding social networks conducive to such discussions [36, 68]. As a result, the social nature of Twitter, driven by peer influence and the desire to conform to positive narratives, further amplifies this trend, overshadowing more balanced or critical perspectives on benzodiazepines.

The withdrawal syndrome that appears with drug dose reduction or cessation may be particularly important when considering the efficacy data and side effects found in our study [69]. The emergence of these symptoms upon reducing or discontinuing benzodiazepines, along with their disappearance upon resuming treatment, may lead to the misconception that benzodiazepines are not associated with long-term withdrawal symptoms [70]. This misunderstanding could be reflected in the Twitter content we analyzed.

The hypothesis that Twitter users are not identifying certain symptoms as side effects of benzodiazepines might extend to other complications of prolonged use, which are difficult to correlate directly with benzodiazepine intake, such as the risk of traffic accidents or falls [71, 72]. Notably, the increasing emergence of other adverse effects of benzodiazepine use, such as overdoses, is not reflected in Twitter content. From 2019 to 2020, visits to the emergency department for benzodiazepine overdoses, as well as deaths from such overdoses, increased [73, 74]. Another study published in 2018 showed that deaths attributed to benzodiazepine overdose had multiplied sevenfold over the last two decades [75].

Despite this, numerous studies report that benzodiazepine use can extend over months, years, or even decades [13]. Additionally, it has been reported that up to 15% of benzodiazepine prescriptions do not comply with regulations regarding the duration of treatment [19]. Moreover, the prolonged use of benzodiazepines occurs under medical prescription, as shown by studies conducted in various countries [15, 76–78]. In Australia, 15–42% of older adults use benzodiazepines chronically [79, 80]. The low presence of healthcare professionals on social media platforms (less than 1% in our study) suggests that this group may not be fully aware of the major problem we face [75]. Given the results of clinical trials where deprescribing

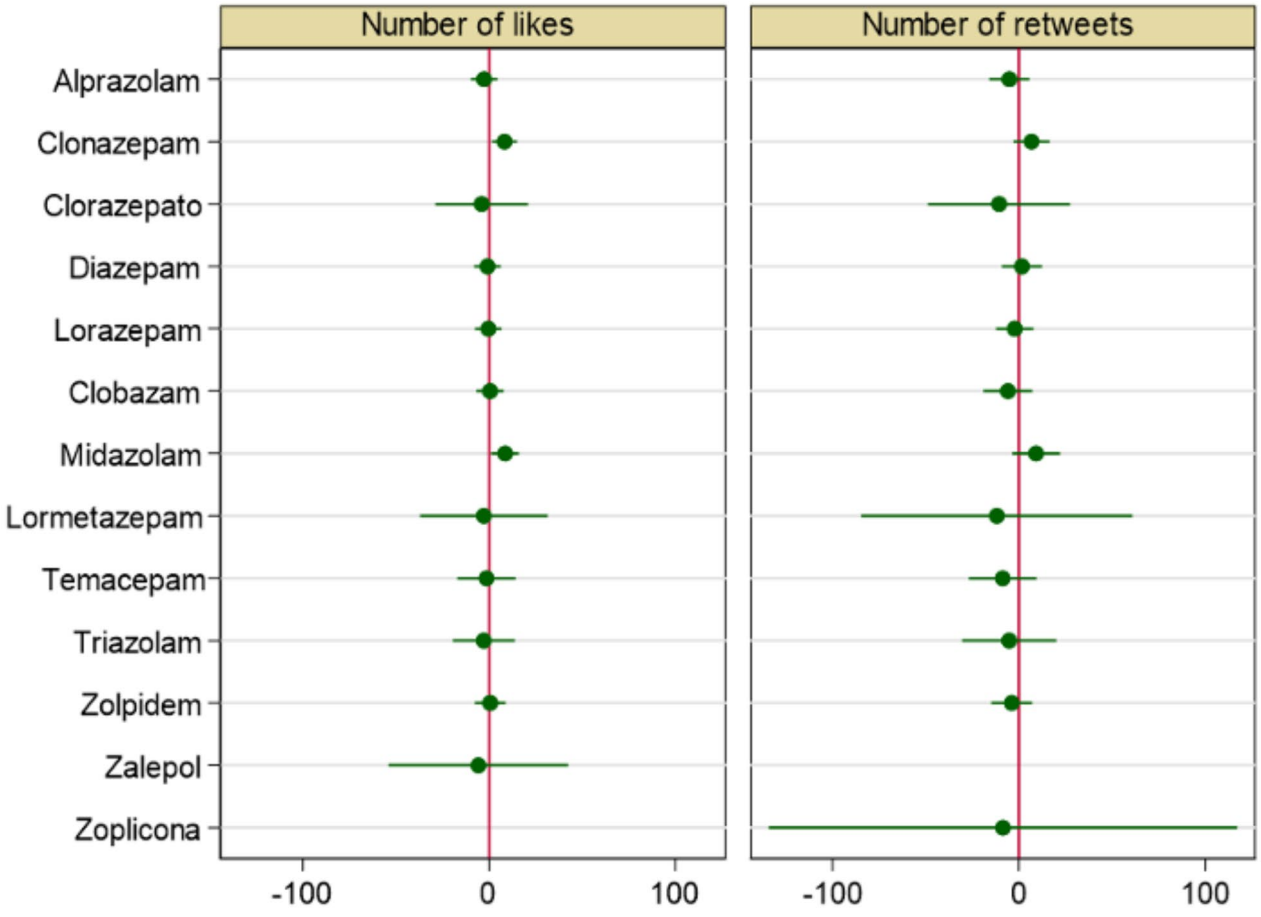

Fig. 4 Association between specific drugs and the public interest measured in likes and retweets. The β coefficient and the confidence intervals at 95% are presented, obtained from a multivariate linear regression

in elderly patients has been evaluated using patient education, progressive dose reduction, and shared decision-making, it seems crucial to provide patients with evidence-based information [81]. Accurate and adequate information could promote deprescribing by addressing patients' concerns and fears [82, 83]. Therefore, increasing the presence of healthcare professionals and institutions on social media platforms is essential.

Another significant clinical and public health issue in our findings is the apparent minimization of the risks associated with benzodiazepine use. Users reported the concurrent use of benzodiazepines with other psychotropic drugs in 10.76% of tweets, a percentage well below findings from previous studies using more objective methods [84, 85]. Up to 64% of oxycodone users are also dependent on benzodiazepines [86]. As for the combined use with illegal substances, our research found that 23.12% of tweets acknowledged this type of consumption, which is lower than findings elsewhere, including a study where 64% of heroin users also abused benzodiazepines [87]. Although benzodiazepines received less public health attention than opioids until recently, it is known that combining both is dangerous because benzodiazepines potentiate the depressant effects of opioids [29]. This concurrent use is associated with a higher risk of requiring emergency services, being treated for complications related to these substances, or even a higher risk of death due to overdose [25, 88]. This is also the case with illicit opioid use [89]. The Centers for Disease Control and Prevention (CDC) reported that in 2020, 16% of opioid-related overdose deaths also involved benzodiazepines [90]. Earlier studies showed even higher percentages of fatal opioid overdoses involving benzodiazepines, likely because they focused on particularly vulnerable populations, such as veterans [91, 92].

Zolpidem, lorazepam, and clonazepam were the most frequently mentioned medications in our sample of tweets, which aligns with their being the most commonly prescribed by healthcare professionals. This supports the view that much of this Twitter content reflects personal or close proxy experiences with these drugs. The United States National Institute on Drug Abuse reported that diazepam, alprazolam, and clonazepam [90] were the most used benzodiazepines in November 2022, while

the Spanish Agency of Medicines and Medical Devices reported that zolpidem was the most frequently prescribed hypnotic and lorazepam was the most frequently prescribed benzodiazepine [93]. Indeed, in the United States, clonazepam and lorazepam are among the ten most frequently used psychotropic medications [75].

Limitations

Our study has several important limitations that should be considered. For instance, Twitter users may not reflect the general population, which could limit the generalizability of our results. Including studies analyzing benzodiazepines on other platforms like Facebook or TikTok would help create a more precise understanding of public perceptions of these drugs on social media and in the general population. Additionally, the qualitative analysis of tweets has an inherent degree of subjectivity, making absolute objectivity unattainable.

Moreover, some methodological limitations should be highlighted. For example, the omission of emojis during data processing may have significantly influenced our results, as emojis provide crucial emotional context and nuance that text alone often lacks, impacting the accuracy of sentiment analysis. Another important limitation could be the search terms used, which may not include all benzodiazepines on the market. Additionally, we did not use generic terms such as "benzodiazepines," so it is possible that we missed potential tweets. Although we included the main commercial names and active ingredients in Europe and the USA, some additional market names of benzodiazepines may have been omitted from our analysis, limiting our results. Furthermore, we were unable to explore differences across countries and regions using techniques such as geolocation. Future studies should analyze global variations in the perception of benzodiazepines.

Conclusion

Our study of public views on social media platforms shows that the low number of mentions of adverse effects and negative consequences of benzodiazepine use may reflect a minimization or lack of understanding of the risks associated with benzodiazepines. In fact, a majority of users view these drugs as effective, with little mention of their potentially serious side effects. However, these results could also be attributed to privacy concerns, possible stigma, the personal nature of these experiences, or the lack of perceived benefit in sharing such experiences publicly. Healthcare professionals and institutions are largely absent from these social media conversations. We call on them to be more active on these platforms to better understand views from patients, families, and the public regarding benzodiazepines and other medical treatments and conditions, and to disseminate and promote scientifically accurate information.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12888-024-06111-5.

Supplementary Material 1

Author contributions

Conceptualization, L.A., M.A.A.-M., V.P-S, C.G-M, O.F-M, M.A.O. and M.A.-M.; methodology, L.A. C.D.-V., F.J.L-A; software, C.D.-V and FJLA; formal analysis, L.A., M.A., M.M-T.; data curation, L.A.; writing—original draft preparation, L.A., M.A.A.-M., V.P-S, F.M., J.Q.; writing—review and editing, CGM, OFM, MAO.; supervision, FM, JQ.; funding acquisition, M.A.A.-M. and M.A.-M. All authors have read and agreed to the published version of the manuscript.

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Data availability

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Declarations

Ethics approval and consent to participate

This study was approved by the Research Ethics Committee of Universidad de Alcalá and is compliant with the ethical principles from the World Medical Association Declaration of Helsinki (7th revision, 2013). The data used was of public domain and in any case we have ensured confidentiality of the users.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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