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Temporal trends of the utilization patterns of sedative-hypnotic medications in children, adolescents and young adults: a 21-year population-based study with joinpoint regression analysis

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Abstract

Background There is limited research on real-world utilization patterns of benzodiazepines and Z-drugs (collectively-termed benzodiazepine-receptor agonists [BZRAs]) in children and adolescents, particularly in non-western countries. We aimed to examine temporal trends of BZRA prescribing-practice among children, adolescents and young adults in Hong Kong over a 21-year period.

Methods This population-based study identified 60,660 individuals aged 4–24 years who had redeemed ≥ 1 BZRA prescription within 2000–2020, using data from medical-record database of Hong Kong public-healthcare-services. We calculated annual prescription prevalence (per 1,000 persons per year) for any BZRA, BZRA-subtypes (short- and long-acting benzodiazepines, Z-drugs) and individual BZRAs. Joinpoint-regression analyses were performed to assess temporal BZRA prescription trends, quantified by average annual-percent-change (AAPC), with 95% confidence-intervals (CIs).

Results Overall BZRA prescription prevalence significantly increased (AAPC: 5.70% [95%CI: 5.31-6.54%]), from 1.88 in 2000 to 5.69 in 2020, uniformly across both sexes. Young adults (18–24 years-old) displayed the highest prescription prevalence, followed by adolescents (12–17 years-old) and children (4–11 years-old). Young adults and adolescents

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exhibited more pronounced increased BZRA use than children. Use of all BZRA subtypes consistently increased over time for all age-groups, except decline in Z-drug prescriptions in children. Lorazepam and diazepam represented the two most frequently-prescribed individual BZRAs, whereas alprazolam use showed the steepest increase. Anxiety and depression emerged as the most commonly-assigned diagnoses for BZRA-users.

Conclusion This first Asian population-based study indicates a significant rising trend of BZRA prescriptions, especially among adolescents and young adults. Judicious prescribing-practices and further investigation clarifying factors contributing to increased BZRA use are warranted.

Keywords Benzodiazepines, Z-drugs, Prescribing trends, Children & adolescents, Pharmacoepidemiology, Population-based

Introduction

The utilization of psychotropic medications among children, adolescents and young adults is on the rise globally [1]. However, little is known about the utilization patterns of benzodiazepines and Z-drugs, collectively-termed benzodiazepine-receptor agonists (BZRAs) [2], in this population. The prevalence of BZRA use in young persons increased over time [1], yet BZRAs are not approved for pediatric anxiolytic use. Clinical guidelines predominantly recommend psychological interventions over pharmacological approaches [3, 4]. These guidelines restrict BZRA use in young persons mainly to acute situations such as pre-surgical anxiety and specific sleep disorders [3], underscoring the importance of cautious, short-term prescribing due to risks of dependence [5] and cognitive impairment [6]. In Hong Kong (HK), BZRAs are classified as controlled substances, and their prescription is strictly regulated under the Dangerous Drugs Ordinance in HK since January 1992 [7]. The use of BZRAs in children and adolescents is considered off-label, and healthcare providers generally limit BZRA prescriptions to a short duration to mitigate their potential risks and align with international regulatory guidelines. Hence, investigating BZRA usage patterns in this vulnerable population is imperative for optimizing clinical practices and policy formulation.

Existing data on BZRA utilization in this young cohort remains sparse [1, 8]. Among those few studies, they often failed to comprehensively compare the utilization of benzodiazepines with Z-drugs [9–14], assess individual BZRAs [8, 10, 14] or explore diagnostic distribution of BZRA prescriptions [9, 11, 12, 16]. The majority of these studies focused solely on the pediatric population [10–12, 15–17] and did not examine the transitional age from adolescence to young adulthood, a critical period for the risk of drug misuse [14]. Additionally, existing research was primarily derived from Western countries [1] and their findings may not be generalizable to other areas of the world due to substantial cross-regional variations in healthcare systems, prescribing practices and socio-cultural contexts. It is widely recognized that health-record databases are a useful source of data to capture real-world prescribing patterns over a long observational period with a large sample size [8]. Until now, there has been one Asian study (conducted in Taiwan) investigating the prescription prevalence of BZRA in children and adolescents based only on one single psychiatric centre [17]. There is a paucity of research in Asia in this respect, and no population-based cohort has been conducted to assess more recent prescribing trends of BZRAs in this vulnerable population.

To this end, we conducted a population-based study to comprehensively examine temporal utilization patterns of BZRAs in children, adolescents, and young adults in HK, a metropolitan city located at the southeastern tip of China with a population of approximately 7.5 million people. Specifically, we assessed the annual prescription patterns of BZRAs between 2000 and 2020, including BZRA subtype and individual BZRA medications. Furthermore, we applied joinpoint regression analyses to evaluate the temporal prescribing patterns, and identify prescription patterns according to the age, sex, and diagnoses over a 21-year period.

Methods

Data source

This population-based study examined annual prescribing patterns of BZRAs among children, adolescents, and young adults in HK from 1 January 2000 to 31 December 2020. The study data was obtained from the Clinical Data Analysis and Reporting System (CDARS) [18], a territory-wide electronic health-record database developed by the Hospital Authority (HA), which is a statutory body that provides government-subsidized, universal health coverage to all HK residents (approximately 92% being Chinese) by managing all public hospitals, specialist and general outpatient clinics in the region. CDARS stores integrated longitudinal patient electronic records from all healthcare settings within HA facilities [19]. Clinical data is entered into the computerized clinical management system by treating clinicians and other healthcare professionals and subsequently transferred to CDARS for audit and research purposes. The database contains patient demographics, clinical information such as

diagnoses, outpatient clinic and emergency department attendances, hospital admissions, as well as prescription and dispensing records. CDARS utilizes unique, anonymized patient identifiers to protect privacy and link all medical records. This database has been previously used for high-quality population-based studies on mental disorders [20–23] and pharmaco-epidemiological investigations in psychotropics [24–27].

Study population and BZRA use

All individuals aged 4–24 years who had ever redeemed at least one prescription of BZRA (benzodiazepine or Z-drugs) in HK public healthcare services between 1 January 2000 and 31 December 2020 were identified based on their prescription records in CDARS. In this study, only single-agent BZRAs were included, and combination BZRA agents were excluded. Individuals with multiple prescriptions of the same BZRA within the same year would only be counted once. Those with prescriptions of multiple BZRAs within the same year would contribute to each of the BZRAs of that year. Follow-up of the study population began on the date of their first BZRA prescription within the study period. For individuals who had been recorded with BZRA prescription before the study period, their start date was defined as January 1 2000. The study population was followed forward till the age became 25 years, death, or the end of the study period, whichever came first. Following previous research [5], benzodiazepines were classified into short-acting and long-acting formations based on their pharmacodynamics (Supplementary Table S1). A principal diagnosis of participants during the study period were ascertained using the ICD-9-CM codes for four selected medical conditions based on prior studies in this respect [10, 28], comprising anxiety and depression, back and chronic pain, insomnia, and neurological conditions (Supplementary Table S2). The study was performed in accordance with the Declaration of Helsinki, and was approved by the Institutional Review Board of the University of Hong Kong/Hospital Authority HK-West Cluster (UW22-625) (clinical trial number: not applicable). All study data were anonymized, and individual patient records were entirely unidentifiable during the analysis. As the study was based on a medical-record database, the requirement for informed consent was waived.

Statistical analysis

Annual prescription prevalence of BZRAs, defined as prescriptions per 1,000 persons per year, were calculated by dividing the number of individuals prescribed BZRAs by the total population of the targeted age group per year, based on the statistics from the HK Government Census and Statistics Department. The annual prescription prevalence was stratified by BZRA subtype (long-acting benzodiazepines, short-acting benzodiazepine, Z-drugs); each individual BZRA (e.g., alprazolam, clonazepam, diazepam); and age-sex categories: children (4–11 years old), adolescents (12–17 years old), and young adults (18–24 years old).

Trend analyses employed joinpoint regression models, based on an algorithm that examined whether the trends in the annual-percentage-change (APC) of BZRA use aligned with a series of joined straight lines on a logarithmic scale. The line segments converge at specific points, known as joinpoints, which denoted a statistically significant change in the trend and define the trends between these joinpoints. The permutation test was applied to identify the number of significant joinpoints, with each test estimation conducted using the Monte Carlo method [29]. Using the calendar year as a regression variable, the joinpoint regression analysis estimated the APC in rates between each change point, and average-annual-percent-change (AAPC) as a summary measure of the trend over a fixed interval, with a 95% confidence interval (CI) generated. Analysis used Joinpoint software version 5.0.2.

Results

Characteristics of the sample

The study population comprised 60,660 individuals (female: 53.9%), of which 42.1% ($n = 25,528$) had a recorded medical diagnosis (Supplementary Figure S1). In 2000, the most commonly-assigned diagnosis was neurologic conditions (19.7%), followed by anxiety and depression (8.6%). By 2020, the most commonly-assigned diagnosis was replaced by anxiety and depression (24.8%), and neurologic conditions decreased to 13.2%. Smaller proportions of individuals prescribed with BZRAs received a diagnosis of back and chronic pain (2.7% in 2000; 2.3% in 2020), and insomnia (1.2% in 2000; 1.8% in 2020). For medical-diagnosis distributions in the specified age groups, children (29.2%) exhibited a higher rate of neurologic conditions than adolescents (16.2%) and young adults (11.4%). Similarly, insomnia was more commonly-reported in children (4.3%) than adolescents (2.9%) and young adults (1.6%). On the contrary, adolescents (25.9%) and young adults (26.1%) showed a much higher anxiety and depression rate than children (1.2%). Back and chronic pain was more frequently-reported in adolescents (4.8%) and young adults (5.1%) relative to children (3.2%) (Supplementary Figure S2).

Time trends and prevalence of BZRA prescriptions

Table 1; Fig. 1 depict the time trends with joinpoint analysis in utilization of BZRA subtypes (Fig. 1A) and individual BZRA medications (Fig. 1B and C). In 2000, the prescription prevalence for any BZRA was 1.88 per 1,000 persons per year. It had a threefold increase to 5.69 per 1,000 persons per year in 2020 (AAPC, 5.70%

Table 1 Joinpoint regression analyses on BZRA prescription prevalence between 2000 and 2020 in children, adolescents and young adults

	Prescription prevalence (per 1,000 persons)		**AAPC (95% CI)**	**APC and joinpoint segments**	
BZRA subtypes	2000	2020	2000–2020	Trend years	APC (95% CI)
Any BZRA	1.880	5.694	5.70 (5.31–6.54)	2000–2005	8.97 (6.60–15.88)
				2005–2011	1.91 (-2.90–3.96)
				2011–2020	6.48 (5.40–10.43)
Any BZD	1.643	4.979	5.76 (5.42–6.44)	2000–2005	7.96 (5.95–13.72)
				2005–2011	2.51 (-1.73–4.33)
				2011–2020	6.76 (5.84–9.64)
Short-acting BZD	0.966	3.261	6.14 (5.44–6.75)	2000–2015	4.97 (2.40–5.81)
				2015–2020	9.73 (6.54–17.65)
Long-acting BZD	0.870	2.183	5.06 (4.56–5.84)	2000–2002	17.69 (8.17–27.59)
				2002–2010	2.42 (-1.83–3.54)
				2010–2020	4.82 (3.98–8.73)
Z drug	0.422	1.431	5.92 (5.42–6.72)	2000–2004	20.73 (16.59–27.81)
				2004–2007	-1.72 (-4.10–3.10)
				2007–2020	3.52 (2.81–6.61)
Children (4 to 11 years)					
Any BZRA	0.990	2.974	6.41 (5.77–7.19)	2000–2020	6.41 (5.77–7.19)
Any BZD	0.988	2.974	6.44 (5.79–7.24)	2000–2020	6.44 (5.79–7.24)
Short-acting BZD	0.348	0.731	4.17 (2.75–5.73)	2000–2020	4.17 (2.75–5.73)
Long-acting BZD	0.729	2.477	7.09 (6.31–8.08)	2000–2020	7.09 (6.31–8.08)
Z drug	0.002	0.004	-4.65 (-9.94 to -1.06)	2000–2020	-4.65 (-9.94 to -1.06)
Adolescents (12 to 17 years)					
Any BZRA	1.236	4.460	7.19 (6.52–8.49)	2000–2006	8.84 (5.58–21.10)
				2006–2011	2.22 (-3.64-8.37)
				2011–2020	8.94 (6.96–14.82)
Any BZD	1.109	4.210	7.13 (6.27–7.96)	2000–2014	5.76 (1.06–6.99)
				2014–2020	10.39 (7.33–19.61)
Short-acting BZD	0.590	2.788	8.52 (7.86–9.56)	2000–2005	10.82 (7.23–21.59)
				2005–2014	4.49 (-1.29-5.95)
				2014–2018	18.03 (12.09–24.50)
				2018–2020	3.26 (-3.06-11.32)
Long-acting BZD	0.674	1.771	5.12 (4.53–5.73)	2000–2020	5.12 (4.53–5.73)
Z drug	0.240	0.573	4.90 (3.76–6.85)	2000–2004	15.96 (7.68–37.20)
				2004–2020	2.31 (0.79–3.21)
Young adults (18 to 24 years)					
Any BZRA	3.233	11.687	6.61 (6.06–7.53)	2000–2004	9.69 (5.83–18.84)
				2004–2011	0.32 (-4.93-2.07)
				2011–2016	5.35 (1.70-12.79)
				2016–2020	16.97 (12.95–25.06)
Any BZD	2.680	9.559	6.69 (5.99–7.46)	2000–2002	12.59 (3.03–21.15)
				2002–2015	2.33 (-0.20-4.51)
				2015–2020	16.38 (13.51–21.03)
Short-acting BZD	1.620	7.404	7.11 (6.55–7.72)	2000–2015	3.73 (2.77–4.63)
				2015–2020	17.91 (14.53–23.11)
Long-acting BZD	1.380	3.001	4.05 (3.29–4.94)	2000–2002	12.99 (2.12–23.63)
				2002–2014	0.19 (-4.42-1.12)
				2014–2020	9.17 (6.33–14.59)
Z drug	0.975	4.051	7.25 (6.74–7.91)	2000–2004	19.18 (15.80-24.62)
				2004–2007	-4.49 (-6.81-0.61)
				2007–2017	3.25 (2.33–5.22)
				2017–2020	18.80 (14.06–27.04)
Most commonly prescribed BZRA					

Table 1 (continued)

	Prescription prevalence (per 1,000 persons)		AAPC (95% CI)	APC and joinpoint segments	
Alprazolam	0.107	0.816	10.72 (10.24–11.62)	2000–2003	24.84 (17.81–34.04)
				2003–2015	5.55 (4.60–6.25)
				2015–2020	15.55 (13.44–18.88)
Clonazepam	0.224	0.745	6.24 (5.89–6.68)	2000–2005	9.63 (7.53–14.07)
				2005–2020	5.13 (4.68–5.49)
Diazepam	0.791	1.624	3.83 (3.49–4.30)	2000–2005	6.70 (4.73–11.63)
				2005–2010	0.34 (-3.03–2.30)
				2010–2020	4.18 (3.53–5.89)
Lorazepam	0.328	1.913	9.24 (8.61–10.26)	2000–2004	22.59 (16.61–31.49)
				2004–2013	2.34 (-0.72–3.86)
				2013–2020	11.24 (9.30–14.43)
Zopiclone	0.346	0.971	5.02 (4.50–5.64)	2000–2004	21.21 (18.27–25.99)
				2004–2007	-3.10 (-6.04–2.27)
				2007–2012	4.60 (2.50–9.53)
				2012–2020	1.01 (-1.78–1.97)
Other commonly prescribed BZRA					
Bromazepam	0.017	0.146	9.23 (8.36–10.34)	2000–2011	14.03 (12.15–17.03)
				2011–2020	3.63 (1.24–5.39)
Chlordiazepoxide	0.102	0.423	7.55 (6.19–8.72)	2000–2011	4.03 (-1.10–6.84)
				2011–2014	26.63 (12.51–35.07)
				2014–2020	5.34 (-4.08–9.09)
Clobazam	0.151	0.384	4.92 (4.60–5.38)	2000–2002	13.37 (8.46–18.77)
				2002–2013	5.05 (4.51–5.53)
				2013–2020	2.42 (1.03–3.16)
Midazolam	0.104	0.140	3.72 (0.60–6.45)	2000–2015	0.34 (-17.61–22.1)
				2015–2020	14.54 (1.25–55.7)
Zolpidem	0.102	0.551	8.53 (7.68–9.67)	2000–2003	24.88 (15.11–44.61)
				2003–2016	3.12 (1.71–4.06)
				2016–2020	15.37 (10.82–23.75)

AAPC = Average annual percentage change; APC = Annual percentage change; BZD = Benzodiazepines; BZRA = Benzodiazepine-receptor agonist drugs; CI = Confidence intervals

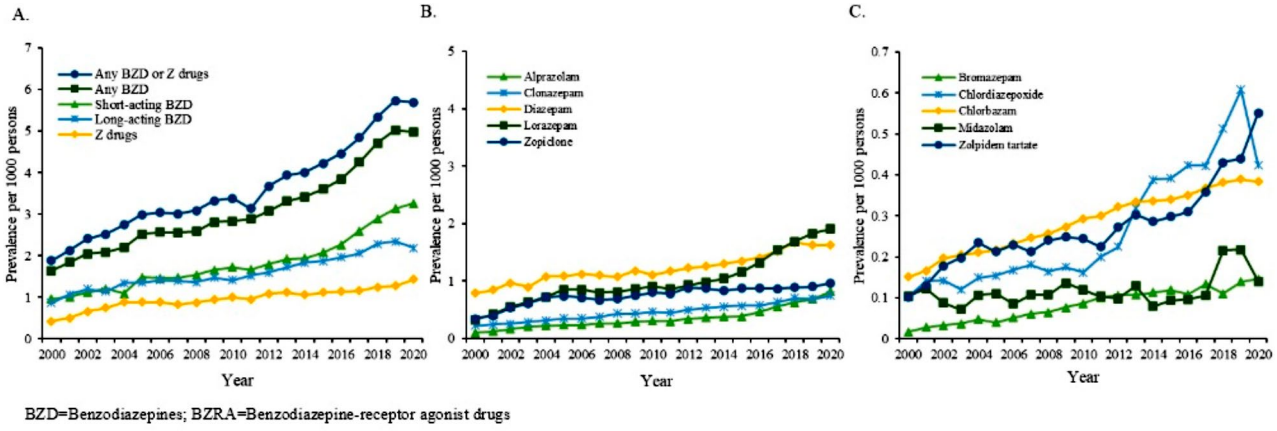

Fig. 1 Annual prescription prevalence of BZRAs per 1,000 persons between year 2000 and 2020 in children, adolescents and young adults. (**A**) any BZRA and subtypes of BZRAs, (**B**) five most commonly-prescribed BZRAs, and (**C**) other commonly-prescribed BZRAs

[95%CI: 5.31-6.54%]). This increase was observed across both sexes, with young males showing an AAPC of 5.67% (95%CI: 5.27-6.45%) and females demonstrating an AAPC of 5.81% (95%CI: 5.49-6.31%), as further detailed in Supplementary Table S3. When examining prescription prevalence by age-group, young adults had the highest prescription prevalence at 11.69 per 1,000 persons per year, followed by adolescents at 4.46 per 1,000 persons per year, and children at 2.97 per 1,000 persons per year. Among these, young adults and adolescents experienced more pronounced increase, with AAPCs of 6.61% (95%CI: 6.06-7.53%) and 7.19% (95%CI: 6.52-8.49%), respectively, compared to children who had an AAPC of 6.41% (95%CI:5.77-7.19%). The use of most BZRA subtypes and individual BZRA medications consistently increased over time, except Z-drug prescriptions among children showing a decline (AAPC, -4.65% [95%CI: -9.94%- -1.06%]). Specifically, the five most frequently-prescribed individual BZRAs throughout the study period were lorazepam (1.91 per 1,000 persons per year), diazepam (1.62 per 1,000 persons per year), zopiclone (0.97 per 1,000 persons per year), alprazolam (0.82 per 1,000 persons per year), and clonazepam (0.75 per 1,000 persons per year) (Table 1; Fig. 1). Alprazolam, in particular, exhibited the most significant increase in prescription prevalence with an AAPC of 10.72% (95%CI: 10.24-11.62%). Lorazepam also presented a substantial rise with an AAPC of 9.24% (95%CI: 8.61-10.26%), followed by clonazepam at 6.24% (95%CI: 5.89-6.68%), zopiclone at 5.02% (95%CI: 4.50-5.64%), and diazepam at 3.83% (95%CI: 3.49-4.30%).

Discussion

To our knowledge, this is the first population-based study examining the real-world temporal utilization patterns and annual prescription rates of BZRAs, encompassing different BZRA subtypes and individual BZRA medications, among children, adolescents, and young adults in Asia. Three major findings emerged: First, the overall annual prevalence of BZRA use increased, with the highest prescription prevalence observed in the 18–24 age-group, marking a more pronounced increase compared to younger age-groups.; Second, the use of all BZRA subtypes and individual BZRA medications consistently increased over time, except that Z-drug prescription prevalence among children declined; Third, among individual BZRA medications, lorazepam and diazepam were most frequently-prescribed, while alprazolam displayed the steepest increase in prescription.

Our finding highlighted a threefold increase in BZRA utilization. Limited research on BZRA prescribing in younger populations and methodological variations between studies preclude direct cross-study comparison with our findings. Nonetheless, the prescription prevalence of BZRA in our study largely corroborated the results of Taiwan [17], though lower than those reported in Western countries [1, 8, 12, 13, 16]. Likewise, our findings of increasing trends of BZRA prescriptions over time were generally consistent with data in many European countries [1, 13], but contrasted with the declining trend observed in Ireland [12], Australia [16], and Taiwan [17], and the stable trends in Iceland [30] and Denmark [8]. The growth of BZRA utilization adds to the concerns about BZRA use in young persons [5], including the depressant effect on central nervous system, potential drug misuse [14], and cognitive deficits [6]. It is worth noting that, over the study period, the number of children and adolescents with mental-disorder diagnoses in HK increased significantly. For instance, the caseload of child and adolescent psychiatric clinics in HK markedly increased from 18,974 cases to 36,400 cases over the past decade [31], with anxiety and depression being the leading diagnoses. The off-label BZRA prescription (i.e., outside of approved indication or age category) may have become increasingly common locally and globally in recent years. As the risk-benefit ratio of BZRA use has not yet been fully clarified for children and adolescents, it is important to guide clinicians for cautious use of BZRAs in their prescribing practices. Close clinical monitoring of the young population receiving BZRAs is warranted until further research establishing their safety and effectiveness in this population.

Young adults had doubled the prescription prevalence of adolescents and quadrupled those of children over the study period, along with a slightly more pronounced increase. This trend might indicate enhanced recognition and diagnosis of anxiety disorders among young adults, who are clinically eligible for BZRA prescription treating acute anxiety [3, 4]. However, research on the effectiveness and long-term safety of BZRAs in this young population remains insufficient [5]. Additionally, the transitional age from adolescence to young adulthood is at heightened risk of drug misuse. Further efforts are needed to ensure judicious and evidence-based prescribing of BZRAs in this transitional age group [14].

We found that all BZRA subtypes and individual BZRA medications consistently increased over time, aligning with previous studies [13, 17]. Notably, Z-drug use exhibited an overall increasing trend over time, but with a decline in use in children. This is, however, generally consistent with findings of studies conducted in the Western countries indicating more controlled usage patterns of Z-drugs in children and adolescents [11, 16]. The decrease in Z-drug use in children might partly be attributable to an introduction of melatonin for insomnia in children in recent years [32]. The lack of approval and limited treatment guidelines for pediatric use of Z-drugs also restrict their utilization in children [33]. The

familiarity of clinical use for and availability of benzodiazepines, along with a better understanding of their pharmacokinetics in children, may contribute to clinicians' preference in using benzodiazepines to Z-drugs in pediatric cases [34]. Furthermore, a wider range of treatment indications beyond insomnia, including anxiety and epilepsy, for benzodiazepines in children, might account for their higher overall utilization rates relative to Z-drugs, which are primarily indicated for insomnia [35]. Regarding individual BZRA medications, diazepam was among the most commonly-prescribed, consistent with Western studies [12, 16]. It was explained by the clinical guidelines that diazepam has FDA-approved dosing for generalized anxiety disorder and neurological conditions in children and adolescents [3]. Consistent with prior research [10, 17], lorazepam, a short-acting BZRA, was prescribed as frequently as diazepam in our sample. For adults, but not in children and adolescents, lorazepam is indicated for generalized anxiety disorder, while depression and anxiety represented the most commonly-assigned diagnosis for BZRA-users in our sample. Moreover, our study data covered participants from both inpatient and outpatient settings, including specialised centres where lorazepam is commonly administered for acute conditions. Alprazolam demonstrated the sharpest increase in utilization, possibly due to recent findings suggesting its effectiveness in reducing anxiety in younger age groups [15].

Owing to the limited existing data, further research is warranted to get insight into the mechanisms as well as the risk and protective factors that shape the current prescribing patterns. Our findings underscore the necessity to develop strategies to avoid potentially harmful prescribing practices of BZRAs. Effective interventions should involve prescribing clinicians, including but not limited to primary and specialised care in paediatrics, internal medicine, and psychiatry, focusing on education, feedback, and peer support [5]. International guidelines recommend prioritizing non-pharmacological treatment for depression, anxiety, and insomnia in young persons [3, 4]. Research should explore the integration of BZRA with various modalities of psychotherapy to facilitate development of effective interventions and psychiatric service delivery for this age-groups. Moreover, more well-designed clinical studies are warranted to investigate the safety and efficacy of these BZRA for young persons.

This study has several limitations. First, our data did not contain information about the prescribing duration, precluding us from further evaluating the utilization patterns of short-term versus long-term BZRA use. Second, similar to other pharmaco-epidemiological studies, patients' adherence to prescribed BZRAs could not be assessed, hence actual drug use of our study population may be overestimated. Third, although we obtained data on patients' recorded diagnoses (which, albeit is limited by a proportion of missing data), we were not able to ascertain the precise indication for initiating BZRA treatment on an individual basis, thereby precluding us from examining the prevalence of off-label BZRA use. Fourth, we did not have data regarding the BZRA prescribing specialties, therefore the potential differential relationships between prescribing specialities and specific age categories of the study population could not be explored. Fifth, data of other psychotropic medications was not available. Hence, we were not able to investigate the patterns and extent of polypharmacy with different psychotropics in our sample. Sixth, as our dataset only obtained prescription data till 2020, the current study was not able to cover a more extensive period of the COVID-19 pandemic and therefore precluded us from comprehensively assessing the changes in BZRA utilization patterns across the pandemic era.

In conclusion, this first population-based study on the BZRA prescribing patterns in Asia adds to the growing concerns about BZRA use among young populations. It is critical to improve prescribing practices through close monitoring of BZRA utilisation in young persons, strengthening the adherence to BZRA prescribing guidelines among psychiatrists, primary care practitioners, and other non-psychiatric specialists, as well as improving communications between non-specialised care and psychiatric services in the management of anxiety and depression in children and youths.

Abbreviations

AAPC	Average Annual-Percent-Change
APC	Annual-Percentage-Change
BZRA	Benzodiazepine-Receptor Agonists
CDARS	Clinical Data Analysis and Reporting System
CI	Confidence Intervals
HA	Hospital Authority
HK	Hong Kong
ICD	International Classification of Diseases

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12888-025-06515-x.

Supplementary Material 1

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Author contributions

W.C.C, J.K.N.C. and E.H.M.L. designed and conceptualized the study. J.C.Y.C. retrieved the study data. C.C.T.K. and J.K.N.C. conducted statistical analysis. C.C.T.K., H.K.Y.L., E.H.M.L. and W.C.C. interpreted the study data. C.C.T.K. wrote the first draft of the manuscript. H.K.Y.L. and E.H.M.L. revised the manuscript. H.K.Y.L. and W.C.C. finalized the manuscript. All authors provided critical feedback to the manuscript and have approved the final manuscript.

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Data availability

Data collected for this study are proprietary of the Hospital Authority of Hong Kong, which granted researchers permission and access to data. The data that support the findings of this study are available from this authority, but restrictions apply to the availability to these data (information on the cost is available from the corresponding author). The analytic codes are available from the corresponding author on request.

Declarations

Ethics approval and consent to participate

The study was performed in accordance with the Declaration of Helsinki, and was approved by Institutional Review Board of the University of Hong Kong/Hospital Authority Hong Kong West Cluster (HKU/HA HKW) (reference number: UW22-625). All study data were anonymized, and individual patient records were entirely unidentifiable during the analysis. As the study was based on a medical-record database, the requirement for informed consent was waived. This is not a clinical trial study and clinical trial number is not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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