Research Square

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Trends in Antidepressant Prescribing Among Children, Adolescents and Young Adults in Croatia (2016–2024): Sex Differences

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Abstract

Purpose

The prevalence of mental health disorders among children and adolescents has increased globally and previous studies show increasing antidepressant prescriptions for young people in several high-income countries. This study examines whether similar trends are present in Croatia, using national prescribing data from the Croatian Institute of Public Health from 2016 to 2024.

Methods

We analyzed all prescriptions for antidepressants (ATC code N06A) issued to individuals aged 10–24, grouped into age categories (10–14, 15–19, 20–24), regardless of diagnosis. Both overall and newly prescribed antidepressants were examined. Data were obtained from the Central Health Information System of Croatia. Joinpoint regression was used to detect significant changes in trends over time.

Results

Antidepressant prescribing increased significantly across all age groups, with consistently steeper increases among females. In the 10–14 age group, prescription rates increased steadily in females, while no significant change was observed in males until 2020. Among individuals aged 15–19 and 20–24 years, prescription rates rose more rapidly in females than males. Newly initiated antidepressant prescriptions remained stable among males but showed a significant upward trend among females.

Conclusion

Antidepressant use among young people in Croatia has increased substantially, particularly among females, reflecting patterns reported in other countries. More research is needed to understand the reasons behind this trend.

Introduction

The increasing prevalence of mental health disorders among children and adolescents has become a critical global public health issue. The third most common cause of disability-adjusted life years (DALYs) lost in teenagers globally is depression, whereas anxiety disorders are the fifth most common cause of DALYs lost in teenage girls [1]. According to a UNICEF report, over 13% of adolescents between the ages of 10 and 19 have a diagnosed mental health disorder, as defined by the World Health Organization (WHO), with depression and anxiety making up to 40% of these cases [2]. For mild depressive episodes, international guidelines generally recommend psychotherapy as the primary treatment for children and adolescents. For moderate to severe episodes, a combination of psychotherapy and antidepressants is

recommended [3–5]. Children and adolescents are most prescribed selective serotonin reuptake inhibitors (SSRIs) for disorders like generalized anxiety disorder (GAD), obsessive-compulsive disorder (OCD), and major depressive disorder (MDD) [6].

Previous research shows that the prescribing of antidepressants to children and adolescents is increasing in many countries. Antidepressant use increased from 1.3% to 1.6% in the United States, from 0.7% to 1.1% in the United Kingdom, from 0.6% to 1.0% in Denmark, from 0.5% to 0.6% in the Netherlands, and from 0.3% to 0.5% in Germany between 2005 and 2012 [7]. Studies have consistently shown a steeper increase in antidepressant prescriptions among adolescent girls. A study conducted in the UK by the National Institute for Health and Care Research (NIHR), which included more than 21,000 adolescents aged 12–17 treated with SSRIs, reported an increasing trend in prescribing between 2005 and 2017 [8]. A large retrospective cohort study by the University of Nottingham based on data from 4.3 million children and adolescents in the UK (1998–2017) confirmed these findings, showing that the rise in prescriptions was significantly more pronounced among girls than boys [9]. Similar patterns have been observed in France, Germany, Denmark, Norway, Sweden, Italy, Israel, Australia, Mexico, Canada, and the United States, where sertraline is most commonly prescribed [10–17].

In Croatia, mental health has recently received considerable attention, with a 2021 UNICEF survey identifying mental health as the top concern among adolescents [2]. While comprehensive data on antidepressant use among children and adolescents are available in many countries, there remains a significant gap in knowledge about these trends in Croatia. This study aims to address this gap by analyzing national prescribing data over eight years from 2016 to 2024. We will evaluate prescribing patterns over time, the number of newly prescribed medications, and related diagnoses. The findings will help determine whether Croatia aligns with global trends in pediatric antidepressant prescriptions and will provide insights to inform future clinical practices and healthcare policies aimed at improving youth mental health.

Methods

For this study, we examined all prescriptions for antidepressants classified under N06A ACT code issued to individuals aged 10 to 24, divided into three age groups (10–14, 15–19, and 20–24), regardless of the diagnosis indicated on the prescription. We analyzed prescription data from 2016 to 2024, distinguishing between overall prescribing patterns and newly prescribed medications during this period.

As the data source for conducting the study, the National Public Health Information System (NAJS) and its data warehouse component (NAJS DWH) were used [18]. Managed by the Croatian Institute of Public Health (CIPH), NAJS DWH integrates data from various public health sources using a personal identification number, enabling data linkage. It operates under strict security standards, with limited access granted only to authorized personnel. The data used in this analysis were real-world data generated in primary healthcare settings, originally recorded for administrative and clinical purposes. The datasets included structured, patient-level information on e-prescriptions and visits to general practitioners (GPs).

Joinpoint analysis was used to identify significant changes in trends over time, allowing for the detection of distinct periods of acceleration, deceleration, or stability in the data. Joinpoint is statistical software for analyzing trends using segmented linear regression models, where several lines are connected at “joinpoints.” The software fits the simplest model supported by the data, starting with no joinpoints (a straight line) and testing whether adding joinpoints significantly improves the fit, up to a user-defined maximum. This enables statistical testing of observed changes in trend direction or magnitude [19].

For the purpose of our analysis, we extracted the number of unique individuals who were prescribed antidepressants in each calendar year. If an individual received multiple prescriptions with the N06A code in one year, they were counted only once, regardless of the diagnosis. Age-adjusted rates were calculated using the 2021 Census data by the Croatian Bureau of Statistics. Joinpoint regression was conducted using permutation tests and Monte Carlo methods with Bonferroni correction to analyze changes in antidepressant prescribing to children, adolescents, and youth. Analysis was performed using Joinpoint Statistical Software with, given the number of time periods, maximum number of joinpoints set at 1. Logarithmic transformation was applied, with statistical significance for average percent changes (APC) set at 0.05 level.

Results

Study population

In our analysis, we examined 343,316 antidepressant prescriptions issued to 33,500 distinct individuals, where the distinct total represents the number of unique people prescribed antidepressants at least once between 2016 and 2024, without double-counting those who received prescriptions in multiple years (Table 1.). The data show that the occurrence of mental disorders varies by age (Table 2.). In children (10–14), childhood-specific emotional disorders (F93) are most common, followed by depressive episodes (F32) and adjustment disorders (F43.2). In adolescents (15–19), depressive episodes (F32) and mixed anxiety-depressive disorders (F41.2) increase, with childhood emotional disorders still present. In young adults (20–24), mixed anxiety-depressive disorders (F41.2) are most frequent, followed by depressive episodes (F32) and other anxiety disorders (F41).

Table 1
Number of children who were prescribed antidepressants, by age group and sex

		2016	2017	2018	2019	2020	2021	2022	2023	2024	Distinct total
10–14	Male	269	263	248	272	217	258	335	327	356	1812
	Female	241	279	303	307	304	532	666	651	659	2853
15–19	Male	767	743	813	823	713	878	984	925	960	5116
	Female	1185	1271	1362	1387	1427	2055	2610	2598	2409	9979
20–24	Male	1465	1509	1546	1581	1559	1681	1686	1652	1663	8878
	Female	1792	1952	2073	2210	2250	2614	2892	2973	2897	13048
	TOTAL	5719	6017	6345	6580	6470	8018	9173	9126	8944	36352

Table 2
Number of children with specific diagnosis on prescription, by age

Age group	ICD 10 diagnosis	Number of children
10–14	F93 - Emotional disorders with onset specific to childhood	644
	F93.8 - Other childhood emotional disorders	569
	F32 - Depressive episode	325
	F43.2 - Adjustment disorders	216
	F92.8 - Other mixed disorders of conduct and emotions	174
15–19	F41.2 - Mixed anxiety and depressive disorder	1771
	F32 - Depressive episode	1460
	F93 - Emotional disorders with onset specific to childhood	1310
	F93.8 - Other childhood emotional disorders	1299
	F43.2 - Adjustment disorders	1061
20–24	F41.2 - Mixed anxiety and depressive disorder	4437
	F41 - Other anxiety disorders	2397
	F32 - Depressive episode	2119
	F43.2 - Adjustment disorders	1662
	F41.0 - Panic disorder [episodic paroxysmal anxiety]	1659

Age-adjusted rates of children, adolescents, and youth who were prescribed antidepressants by gender

In both sexes, age-adjusted prescription rates of antidepressants in children, adolescents, and young adults increased consistently over the study period. Among females, rates rose from 1115.86 to 2069.24 per 100,000, reflecting a statistically significant and steep increase, with an APC of 9.67% (95% CI: 7.43 to 12.32, $p < 0.05$). In males, prescription rates increased from 820.30 to 977.18 per 100,000, accompanied by a statistically significant but more modest rise (APC = 2.49%, 95% CI: 1.26 to 3.79, $p < 0.05$). These findings indicate a consistent upward trend, with a greater relative increase observed in females.

In the 10–14 age group, a joinpoint was detected in 2020 among males. From 2016 to 2020, age-adjusted prescription rates decreased slightly from 14.73 to 11.88 per 100,000, with an APC of -2.76% (95% CI: -12.32 to 2.00, $p > 0.05$), indicating no clear trend. However, from 2020 to 2024, rates rose to 19.49 per 100,000, corresponding to a statistically significant increase (APC = 11.10%, 95% CI: 6.32 to 21.24, $p < 0.05$). Among females, no joinpoint was detected, and prescription rates increased steadily from 13.90 to 38.00 per 100,000 throughout the study period, with a statistically significant APC of 15.77% (95% CI: 10.48 to 23.62, $p < 0.05$), indicating a more pronounced upward trend compared to males.

In the 15–19 age group, no joinpoint was detected, indicating a stable trend throughout the study period. Among females, age-adjusted prescription rates increased from 71.03 to 144.40 per 100,000, corresponding to a statistically significant APC of 12.01% (95% CI: 8.66 to 16.24, $p < 0.05$). In males, rates rose from 43.34 to 54.25 per 100,000, also reflecting a statistically significant increase, though more modest (APC = 3.45%, 95% CI: 1.22 to 5.84, $p < 0.05$). These results indicate a consistent upward trend in both sexes, with a markedly steeper increase among females.

Among youth aged 20–24 years, a joinpoint was detected in 2022 for both males and females, indicating a change in the trend of antidepressant prescriptions toward the end of the study period. For females, age-adjusted prescription rates increased from 104.77 to 169.08 per 100,000 in 2022 and further to 169.37 per 100,000 in 2024, showing a significant upward trend prior to 2022 (APC = 8.16%, 95% CI: 6.79 to 14.20, $p < 0.05$), followed by a modest increase thereafter (APC = 2.01%, 95% CI: -2.69 to 6.75, $p > 0.05$). Among males, rates rose from 81.38 to 93.66 per 100,000 in 2022 and slightly declined to 92.38 per 100,000 in 2024, with a modest but significant increase before 2022 (APC = 2.29%, 95% CI: 1.73 to 4.44, $p < 0.05$) and a slight decrease after the joinpoint (APC = -0.85%, 95% CI: − 2.99 to 1.41, $p > 0.05$). These findings suggest that while antidepressant use increased steadily among both sexes up to 2022, the pattern shifted thereafter, potentially reflecting emerging changes in prescribing practices

Age-adjusted rates of children, adolescents and youth to whom antidepressants were newly prescribed by gender

A new case, i.e. a new prescription of an antidepressant, is any prescription that occurred at least one year after the previous prescription of one of the drugs from the group.

Rates of newly prescribed antidepressants among children, adolescents, and youth showed a significant change in trend. Among females, a joinpoint was detected in 2022, indicating an alteration in the pattern of prescriptions toward the end of the study period. Age-adjusted rates rose from 621.26 to 1,157.65 per 100,000 in 2022 and then declined to 927.62 per 100,000 in 2024, showing a significant upward trend prior to 2022 (APC = 10.59%, 95% CI: 7.58 to 25.13, $p < 0.05$), followed by a non-significant decrease thereafter (APC = -8.60%, 95% CI: -19.72 to 4.30, $p < 0.05$). In males, no joinpoints were detected, and rates remained relatively stable, changing from 470.21 to 505.95 per 100,000 over the study period. The observed APC of 0.99% (95% CI: − 1.05 to 3.16, $p > 0.05$) was not statistically significant.

Among children to whom antidepressants were newly prescribed, a joinpoint was detected for both males and females, indicating a change in trend over the study period. In females, age-adjusted prescription rates increased from 9.23 to 26.93 per 100,000 in 2022 and then declined slightly to 23.47 per 100,000 in 2024, with a significant upward trend before the joinpoint (APC = 20.46%, 95% CI: 15.08 to 52.24, $p < 0.05$), and a slight, non-significant decrease after the joinpoint (APC = -4.27%, 95% CI: -19.40 to 13.60, $p > 0.05$). Among males, rates declined from 9.09 to 6.95 per 100,000 in 2020 and then rose to 12.65 per 100,000 in 2024, showing a modest, non-significant decrease prior to the joinpoint (APC = -1.94%, 95% CI: -17.96 to 8.61 $p > 0.05$) and significant increase thereafter (APC = 11.76%, 95% CI: 2.16 to 31.14, $p < 0.05$).

Among adolescents to whom antidepressants were newly prescribed, a joinpoint was detected among females, indicating a change in trend over the study period, whereas no joinpoint was observed among males. In females, age-adjusted prescription rates increased from 39.56 to 84.40 per 100,000 in 2022 and then declined slightly to 61.38 per 100,000 in 2024, with a significant upward trend before the joinpoint (APC = 12.90%, 95% CI: 8.28 to 35.56, $p < 0.05$), followed by a insignificant decrease after the joinpoint (APC = -12.40%, 95% CI: -26.89 to 5.16, $p > 0.05$). In males, rates increased slightly from 27.41 to 28.37 per 100,000, and no significant change in trend was detected (APC = 0.57%, 95% CI: − 2.59 to 3.90, $p > 0.05$).

Among youth to whom antidepressants were newly prescribed, a joinpoint was detected among females, indicating a change in the trend of prescriptions over the study period, whereas no joinpoint was observed among males. In females, age-adjusted prescription rates increased from 56.83 to 85.47 per 100,000 in 2022 and then declined slightly to 72.85 per 100,000 in 2024, with a significant upward trend before the joinpoint (APC = 6.74%, 95% CI: 4.73 to 16.66, $p < 0.05$), followed by a slower decrease after the joinpoint (APC = -6.92%, 95% CI: -15.79 to 2.23, $p > 0.05$). Among males, rates remained stable, changing slightly from 43.44 to 44.99 per 100,000, with a non-significant APC of 0.40% (95% CI: − 2.29 to 3.21, $p > 0.05$). These findings suggest that while antidepressant use among female youth increased initially and shifted in trend after the identified joinpoint, rates among males remained relatively unchanged throughout the study period.

Discussion

The observed increase in antidepressant prescribing among children, adolescents, and young adults in Croatia is consistent with trends reported across numerous high-income countries. Similar to findings

from the UK, Canada, the United States, and several European countries, our study shows a consistent and steeper rise in antidepressant prescriptions among females across all age groups [7–17]. The APC observed in Croatian females, particularly in the 10–14 (APC = 15.77%) and 15–19 age groups (APC = 12.01%), are comparable to or even exceed rates reported in international studies, where adolescent girls were also disproportionately affected by the overall increase in prescribing.

According to UK research, the prescription of SSRIs increased significantly starting in the early 2000s, with considerably higher rates in adolescent girls compared to boys [8–9]. Similarly, data from Norway and Sweden show that from 2006 to 2016, prescription rates among girls increased by over 50%, while changes among boys were more modest [12–13]. These global trends support the reliability of our findings and indicate an ongoing problem affecting healthcare systems. Among Croatian boys aged 10–14, the absence of a significant increase in prescribing until 2020, followed by a sharp rise (APC = 11.10%), is in line with recent observations elsewhere that point to a growing mental health burden in younger male populations [16].

Our examination of newly prescribed antidepressants showed only a moderate but statistically significant increase among females from 2016 until 2022 (APC = 10.59%) and no significant trend in males. This contrasts with certain countries where the number of new prescriptions has risen more dramatically in recent years [8, 13]. The smaller sample size (n), which lowers statistical power to detect changes, could be one reason why there was not a significant rising trend in the number of newly prescribed antidepressants among Croatian boys. It might also represent variations in the length of treatment, the diagnostic processes, or the availability of care. Across all age groups, a change in trend among females was observed in 2022, with rates of newly prescribed antidepressants beginning to decline slightly after a period of consistent increase. However, the APCs observed after 2022 were not statistically significant and confidence intervals were wide, likely reflecting the short post-joinpoint period, which limits the precision of trend estimates and makes it difficult to draw firm conclusions about the direction or magnitude of recent changes.

Several factors have been proposed to explain this trend, including the increasing use of digital media among adolescents, which has been linked to rising mental health issues such as depression and suicide risk factors. One study found that each additional hour spent on social media is associated with a 0.64-unit increase in depressive symptoms among adolescents [20]. This negative impact generally refers to mechanisms like upward social comparison and reinforcing spirals, in which poor self-esteem and other negative emotions encourage increased usage of social media, worsening mental health issues. Research suggests that girls, who spend more time on social media and communication platforms, may be more vulnerable to these negative effects than boys, who tend to spend more time on video games and other online activities [21].

Another perspective is the prevalence inflation theory, which suggests that initiatives to increase awareness may inadvertently lead to increased reporting of mental illness. While greater awareness helps improve detection of previously underreported conditions, it also raises concerns about medicalizing normal psychological experiences and increasing antidepressant use beyond necessity [22].

It is also important to consider the Croatian healthcare context when interpreting these results. There are just 63 child and adolescent psychiatrists in the entire nation, according to the Croatian Medical Chamber (HLK) Atlas [23], and access to psychiatric therapy is sometimes restricted by long waiting lists, particularly outside of urban centers. According to WHO, approximately 1 in 7 children and adolescents in the WHO European Region live with a mental health condition. Based on this prevalence, it is estimated that over 50,000 children and adolescents in Croatia may struggle with mental health issues [24], suggesting a significant gap between services needs and capacity. In such settings, GPs may be more likely to initiate pharmacological treatment in the absence of timely access to specialist care. Additionally, cultural factors and stigma related to mental illness may have historically limited help-seeking behavior, but recent increases in openness may be contributing to both rising diagnoses and antidepressant prescriptions.

Our study was not designed to determine whether the increased prescribing of antidepressants in children and young people since 2016 is due to rising rates of mental health problems, greater awareness and help-seeking among young people, changes in prescribing behavior, patient preferences, or challenges in accessing psychological therapies. Further research is necessary to better understand the underlying reasons for this increasing trend in antidepressant prescriptions among children and adolescents.

Strengths and limitations

The main strengths of this study are its size, representativeness, and duration. To ensure that the results are representative, we use a nationwide dataset from the CEZIH. The study covers a wide time frame (2016–2024) and involves age stratification into three groups (10–14, 15–19, and 20–24).

One of the main limitations of this study is the lack of insight into the underlying reasons for the increasing number of children, teenagers, and young adults being prescribed antidepressants. It remains unclear whether this trend is driven by a growing recognition and diagnosis of mental health conditions, changes in treatment guidelines, or an actual rise in the prevalence of these disorders.

It is important to acknowledge that antidepressants are not prescribed exclusively for depression and anxiety but also for other medical conditions. Our analysis of diagnosis codes from prescriptions revealed that 5% of all recorded diagnoses did not fall under the Mental and Behavioral Disorders category (F00–F99) according to the ICD-10 classification.

Declarations

Author Contribution

A.J. wrote the Introduction and Discussion; M.Š. performed the Joinpoint analysis and drafted the Results; A.J. and M.Š. jointly contributed to the study and manuscript preparation; P.I. extracted the necessary data; I.P. provided mentorship; all authors reviewed and approved the final manuscript.

Data Availability

The data that support the findings of this study were obtained from the National Public Health Information System (NAJS) and its data warehouse (NAJS DWH), managed by the Croatian Institute of Public Health (CIPH). These real-world patient-level datasets include e-prescriptions and general practitioner visits. Due to privacy regulations, the data are not publicly available but can be accessed upon reasonable request with permission from the CIPH.

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Figures

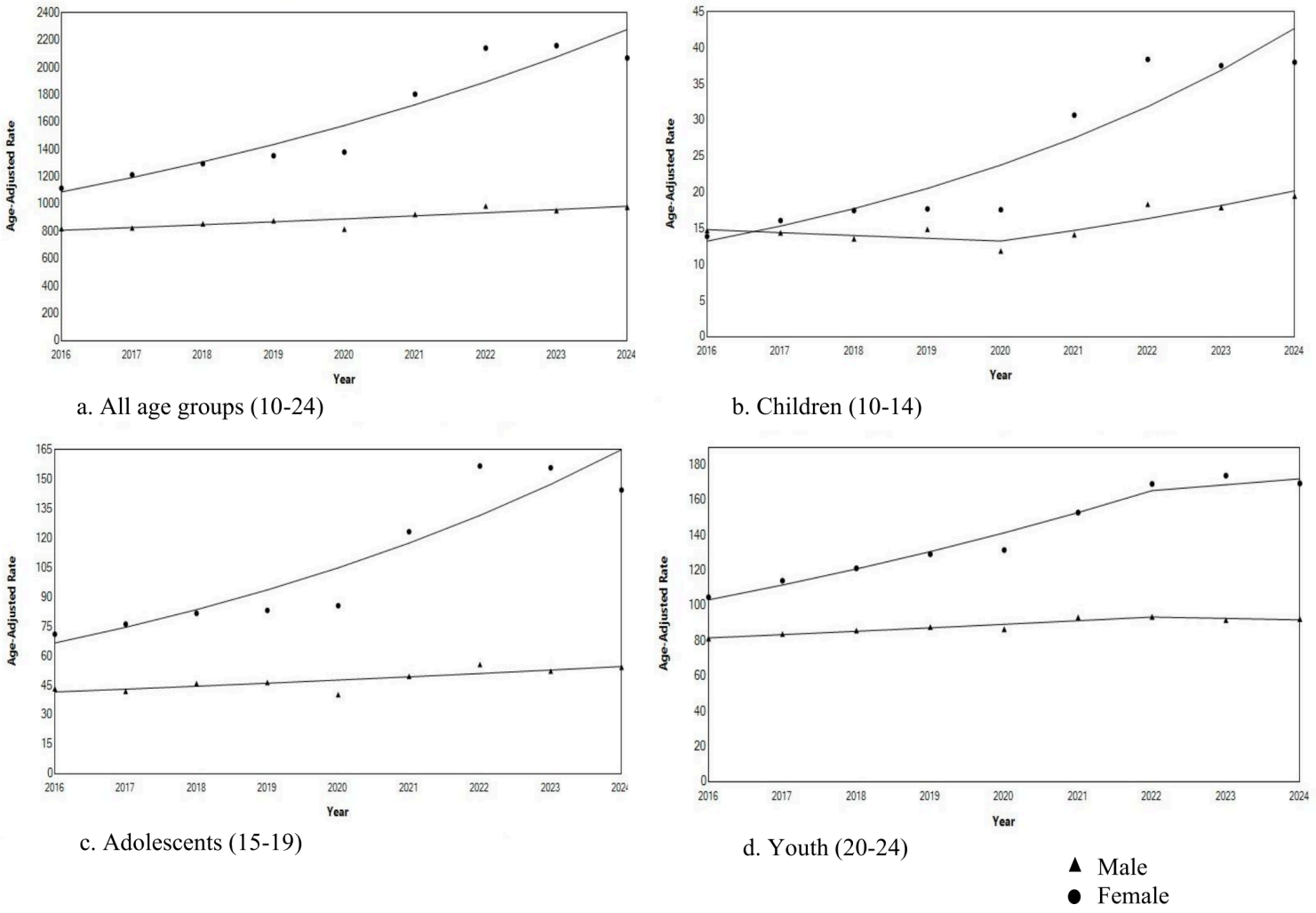


Figure 1

Age-adjusted rates of children, adolescents, and youth (10-24) who were prescribed antidepressants by gender

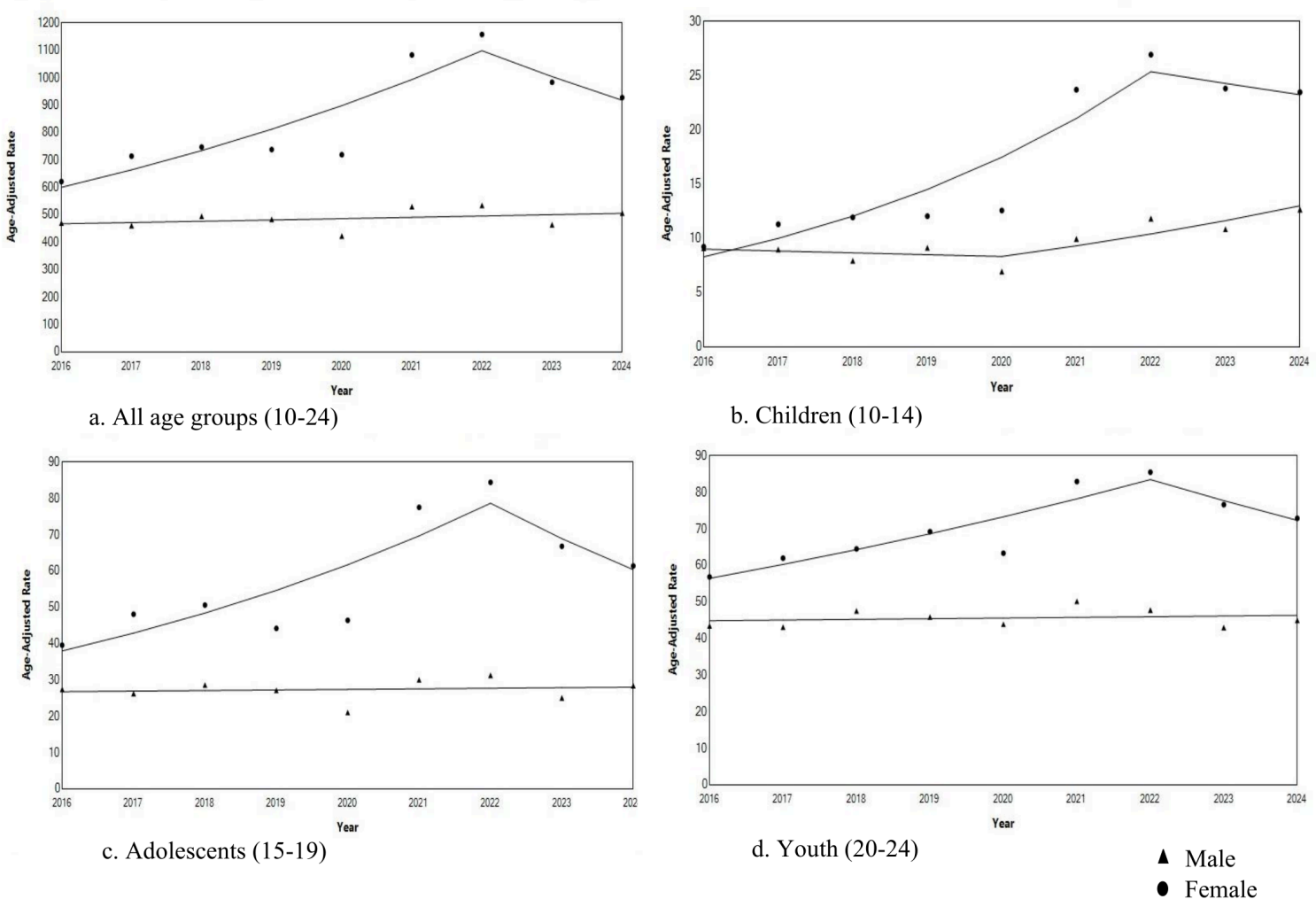


Figure 2

Age-adjusted rates of children, adolescents and youth (10-24) to whom antidepressants were newly prescribed by gender