Research Square

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Treatment Gaps in Paediatric ADHD Pharmacotherapy: A 10-Year Nationwide Cohort Study from Hungary

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Abstract

Background: Translating treatment guidelines for Attention-Deficit/Hyperactivity Disorder (ADHD) into uniform real-world practice remains a key public health challenge across Europe. Adding to previous data from other European countries, this study is the first to evaluate nationwide ADHD pharmacotherapy practices in Hungary.

Methods: Utilizing data from the health insurance system over a ten-year period (2013–2022) for 36,091 children newly diagnosed with ADHD, we tracked medication initiation, first-line treatment choices, 180-day persistence, and antipsychotic use.

Results: 21.7% [21.3; 22.2] of diagnosed children were started on ADHD-specific pharmacotherapy. Marked inter-regional variability in treatment initiation rates was observed across the country, ranging from 11.8% to 29.8% across regions. First-line treatment selection showed a nationwide preference for atomoxetine over methylphenidate, with nearly two-thirds of all treated children (65.0% [64.0; 66.1]) being prescribed atomoxetine initially. Six-month treatment persistence was significantly higher for atomoxetine than methylphenidate (63.4% versus 50.9%; absolute difference: 12.5 percentage points [10.3; 14.7]). The use of non-ADHD-specific medication was relatively frequent, with 9.4% of the entire diagnosed cohort receiving antipsychotics.

Conclusions: These findings reveal critical implementation gaps, widespread guideline divergence, and region- and gender-specific treatment disparities. Even within a small and centralized European healthcare infrastructure, achieving guideline-compliant care requires targeted interventions to optimize treatment initiation and persistence for vulnerable populations.

Introduction

Attention deficit hyperactivity disorder (ADHD) affects approximately 5% of children worldwide, causing a significant global burden of 13.78 disability-adjusted life years (DALYs) per 100,000 people and reducing life expectancy if untreated [1–4]. Consequently, effective, evidence-based treatment is vital. For core ADHD symptoms, pharmacotherapy consistently yields the most robust improvement [5]. However, considerable global variations in medication consumption highlight a widespread lack of uniformity in translating clinical evidence into real-world practice [6].

A recent study has described the administrative prevalence of paediatric ADHD in the Hungarian health care system between 2013 and 2022 [7]. Although standardized administrative prevalence rose steadily from 0.34% to 0.69%, even the peak remains far below the estimated 5% global population prevalence, meaning that the vast majority of affected children are missing diagnosis and treatment.

With its centralized, single-payer infrastructure, Hungary theoretically possesses the system to ensure uniform clinical standards and equitable access. Analysing nationwide pharmacotherapy patterns here illustrates how critical global issues – namely guideline divergence, undertreatment, and persistent regional inequities – manifest within a highly centralized healthcare environment.

Several ADHD medications are available in the United States and Europe. In Hungary, methylphenidate and atomoxetine were accessible during the study period, while lisdexamfetamine was introduced in 2025. Methylphenidate is a non-subsidized stimulant; atomoxetine, a selective norepinephrine reuptake inhibitor, has been 70% subsidized since 2014. Meta-analyses generally recommend methylphenidate as first-line treatment in children and adolescents [8]. Although antipsychotics are sometimes used for impulsivity and behavioural symptoms in paediatric ADHD, limited evidence leads experts to caution against their routine use for this indication [9].

Despite pharmacotherapy's central role in paediatric ADHD care, routine medication use in Hungary remains poorly understood. Nationwide analysis can identify treatment gaps, regional inequities, first-line choices, persistence, and non-ADHD-specific medication use. To our knowledge, this is the first nationwide study to examine these patterns among Hungarian children and adolescents diagnosed with ADHD. Using a comprehensive administrative database, we aimed to:

1. Initiation rate: Quantify the proportion of newly diagnosed patients initiating ADHD pharmacotherapy.
2. Regional variation: Map geographic disparities in initiation rates across Hungary's administrative regions.
3. Sex and age differences: Evaluate the effects of patient sex and age at diagnosis on medication initiation.
4. First-line choice: Identify initial drug selection (stimulants versus non-stimulants).
5. Persistence: Measure treatment continuation and adherence over a 180-day follow-up window.
6. Non-ADHD-specific medication: Investigate antipsychotic use within this diagnosed cohort.

Methods

Data source and participants

For this nationwide, retrospective cohort study, data on paediatric patients (aged 0 to 18 at the time of the diagnosis) for the period between January 1, 2013, and December 31, 2022 were requested from the National Health Insurance Fund database. The study was approved by the National Ethics Committee in Hungary (ETT TUKEB, approval number: BM/15397-1/2023).

ADHD diagnoses were identified using International Classification of Diseases (ICD-10) codes F9000, F9010, F9080, and F9090 [10]. Incident cases were defined as patients aged 18 years or younger with no recorded ADHD codes in the 365 days preceding their index date (the first recorded diagnosis). Due to a lack of pre-2013 data, the first study year mixed prevalent and incident cases; therefore, longitudinal trend analyses were restricted to 2014–2022.

Drug treatment was defined as the dispensing of at least two consecutive prescriptions within a maximum 90-day interval. Medications were classified using the World Health Organization's Anatomical Therapeutic Chemical (ATC) system. A medication was considered ADHD-specific if the primary indication in the Summary of Product Characteristics is ADHD. Only atomoxetine (ATX) and methylphenidate (MPH) met this criterion in Hungary during the study period (ATC group N06BA). Drugs in ATC group N05A were considered antipsychotics (see Online Resource 1 for the full list).

The study population comprised all paediatric patients (≤ 18 years) with an index ADHD diagnosis in Hungary's national healthcare system between January 1, 2013, and December 31, 2022. No additional clinical exclusion criteria were applied. Patients first recorded in 2013 were excluded from incidence calculations because this year included both incident and prevalent cases, but were retained for decade-long unique patient counts. In line with National Health Insurance Fund privacy protocols, cells with fewer than 10 individuals were suppressed.

Variables

Sociodemographic variables included sex, age (0–18 years), age groups (0–6, 7–10, 11–14, 15–18), and region. Geographic analysis followed the European Union NUTS classification (Regulation No 1059/2003), spanning eight Hungarian regions: Budapest, Pest, Southern Great Plain, Northern Great Plain, Northern Hungary, Southern Transdanubia, Central Transdanubia, and Western Transdanubia.

Two variables characterized ADHD-specific pharmacotherapy: the initiation rate (the proportion of all diagnosed ADHD patients who initiated medication within the public healthcare system) and the proportions prescribed ATX or MPH as first-line therapy.

To assess persistence, continuous "treatment episodes" (or vectors) served as the primary unit of analysis rather than individual patients. An episode was defined as an uninterrupted period of medication availability, initiated by at least one 30-day prescription. Discontinuation was defined as failing to obtain a subsequent prescription within a 90-day grace period post-supply; renewals after this window marked a new episode. This 90-day threshold accommodated common summer holiday medication breaks among Hungarian paediatric patients. Two metrics were calculated: (1) 180-day persistence rate (the proportion of episodes lasting at least 180 days) and (2) episode duration in days.

Non-ADHD-specific medication use, particularly antipsychotic prescriptions, was assessed among patients diagnosed with ADHD. Antipsychotics were defined as agents in ATC group N05A (for a full list, see Online Resource 1). Because patient-level data were unavailable, overlap between ADHD-specific and antipsychotic treatment could not be determined. We therefore used two boundary scenarios: complete mutual exclusivity and complete overlap, as intermediate estimates would be speculative.

Statistical analysis

Descriptive statistics were used to characterize pharmacotherapy initiation rates by region, sex, and age. Regional differences across Hungary's eight regions (each compared to all others combined) were evaluated using Pearson's chi-squared test; post-hoc analysis examined adjusted standardized residuals (> 1.96, > 2.576, and > 3.291 for $p < 0.05$, $p < 0.01$, and $p < 0.001$, respectively). Sex-specific rates were compared using a chi-squared test with Yates' continuity correction. Non-treatment risks by sex and age group were assessed via relative risks (RRs) and 95% confidence intervals (CIs); RRs were preferred over odds ratios to prevent association overestimation given high non-treatment prevalence. Absolute differences were reported in percentage points, with 95% CIs derived using the Wald method for independent proportions.

Descriptive statistics summarized first-line prescribing patterns. The primary outcome – the proportion of patients initiating ATX out of all medicated individuals – was calculated for the total cohort and stratified by region, with 95% CIs derived via the Wilson score method. A chi-squared test of independence assessed regional variations, and first-line choices were further stratified by sex and age group. For treatment episodes, sex differences in 180-day persistence rates were evaluated using chi-squared tests. Mean and median episode durations were calculated for both drugs by sex. Finally, persistence ratios (ATX vs. MPH reference) were computed overall and by sex, with CIs calculated on the log scale and exponentiated.

Aggregated, 10-year patient counts were analysed to estimate the prevalence of antipsychotic use within this population.

Wherever relevant, a p-value of less than 0.05 was considered statistically significant.

All statistical analyses were performed using the R statistical software environment (R Foundation for Statistical Computing, Vienna, Austria), version 4.5.2 [11]. Graphical representations of data were generated utilizing the ggplot2 and ggalluvial packages [12, 13].

Results

Pharmacotherapy Initiation: National Rates, Regional Variations, and Temporal Trends

From 2013 to 2022, Hungary recorded 36,091 incident paediatric ADHD cases. Of these, 7,847 initiated ADHD-specific pharmacotherapy, yielding an initiation rate of 21.7% (95% CI: 21.3–22.2%). Rates varied significantly by region ($\chi^2(7) = 367.9$, $p < 0.001$), spanning a 2.5-fold disparity from 11.8% in Northern Hungary to 29.8% in Southern Transdanubia (Table 1). Post-hoc analysis of adjusted standardized residuals identified these two regions as the primary variance drivers, with Southern Transdanubia significantly higher (+ 12.08) and Northern Hungary significantly lower (-14.34) than expected. Annually, initiation rose from 19.7% in 2014 to ~ 25% during 2015–2019 (peaking at 25.9% in 2019), before falling to 24.2% (2020) and 21.5% (2021). The 2022 decline (12.9%) reflects administrative data lag due to truncated follow-up windows.

Influence of Sex and Age on Treatment Initiation

Sex differences

A significant sex difference emerged ($\chi^2(1) = 195.22$, $p < 0.001$): 23.3% of boys (6,673/28,652) initiated medication over the ten-year period compared to 15.8% of girls (1,174/7,439). Girls were less likely to be medicated, carrying a 10% higher risk of remaining untreated than boys (RR = 1.1; 95% CI: 1.09–1.11).

Age Patterns

Pharmacotherapy initiation by age followed an inverted-V pattern, peaking in the 11–14 cohort at 33.2% (95% CI: 32.1–34.2%; Fig. 1). Compared to this cohort, all other age groups faced a significantly higher risk of remaining untreated. The relative risk of non-treatment was 1.09 for ages 7–10 (95% CI: 1.07–1.11), 1.15 for ages 15–18 (95% CI: 1.12–1.19), and 1.44 for ages 0–6 (95% CI: 1.42–1.46).

First-line Medication Preferences

Among patients starting ADHD-specific medication, 5,102 (65.0%) initially received ATX and 2,745 (35.0%) started MPH. First-line selection varied significantly by region ($\chi^2(7) = 322.15$, $p < 0.001$), ranging from 52.2% ATX in Pest to 81.6% in the Southern Great Plain (Table 2); MPH was never the predominant initial drug. First-line ATX use did not differ significantly by sex (males: 64.7% ± 1.1%; females: 66.6% ± 2.7%; $\chi^2(1) = 1.43$, $p = 0.23$). However, initial choice was significantly associated with age ($\chi^2(3) = 74.18$, $p < 0.001$), peaking in the 0–6 cohort (80.3%) and lowest in the 15–18 group (54.7%; Table 2). Compared to the 15–18 reference, first-line ATX choice was significantly higher across younger cohorts, with differences of + 25.6 percentage points for ages 0–6 (95% CI: +19.7; +31.1), + 11.8 for ages 7–10 (95% CI: +7.5; +16.1), and + 8.5 for ages 11–14 (95% CI: +4.0; +13.0). Clinical trajectories are illustrated on a Sankey diagram (Fig. 2).

Treatment Persistence and Episode Duration

From 2013 to 2022, 3,056 treatment episodes began with MPH and 5,391 with ATX. The 180-day persistence rate was significantly higher for ATX than MPH (63.4% vs. 50.9%; $\chi^2(1) = 124.95$, $p < 0.001$; Table 3), representing a 12.5 percentage-point absolute advantage (95% CI: 10.3–14.7) and a persistence ratio of 1.25 (95% CI: 1.20–1.30). ATX episodes lasted longer, with a highly right-skewed distribution with a median of 214 days (mean: 394) versus 132 days for MPH (mean: 205).

Sex-stratified analyses (Table 3) showed that ATX persistence outperformed MPH in both sexes (boys: $\chi^2(1) = 95.49$, $p < 0.001$; girls: $\chi^2(1) = 32.08$, $p < 0.001$). While ATX persistence did not differ significantly between boys (63.6%) and girls (62.3%; $\chi^2(1) = 0.43$, $p = 0.513$), MPH persistence was significantly higher in boys (51.8% vs. 45.3%; $\chi^2(1) = 5.94$, $p = 0.015$). Consequently, the inter-medication persistence gap was more pronounced in females (+ 17.0 percentage points; 95% CI: 11.2–22.8; persistence ratio: 1.38 [95% CI: 1.22–1.55]) than males (+ 11.8 percentage points; 95% CI: 9.4–14.1; persistence ratio: 1.23 [95% CI: 1.18–1.28]).

Antipsychotic Use in ADHD Patients

Over the ten-year period, 3,408 paediatric ADHD patients received antipsychotic medications. Due to data aggregation, the exact overlap with the 7,847 patients on ADHD-specific pharmacotherapy is unknown. Assuming zero overlap, antipsychotics represent 30.3% of all pharmacotherapy cases; assuming complete overlap, 43.4% of medicated patients received an antipsychotic. Overall, 9.4% of the total diagnosed cohort (36,091) were prescribed an antipsychotic.

Discussion

The Treatment Gap: International Comparisons and Systemic Barriers

This study provides the first nationwide report on paediatric ADHD pharmacotherapy practices in Hungary. Although medication utilization increased between 2013 and 2022, treatment rates remained low; only about one-fifth of diagnosed children receive prescriptions, substantially trailing Germany (38%), Taiwan (57.3%), and the United States (69%) [14–16]. Factoring in Hungary's severe systemic underdiagnosis (0.7% administrative prevalence), this low treatment rate uncovers a compounded healthcare deficit: less than 3% (~ 1 in 33) of all affected children receive pharmacotherapy [7]. This deficit is documented cross-nationally: Hungary's 2019 consumption rate (1.35 DDD/TID) was substantially lower than Western (17.37 DDD/TID) or Northern European (11.72 DDD/TID) averages [6]. This gap is particularly concerning because alternative interventions fail to match the efficacy of pharmacotherapy in reducing core ADHD symptoms [17, 18].

While inadequate parental awareness may drive the low 0.69% administrative prevalence, the reasons nearly 80% of diagnosed cases bypass indicated pharmacotherapy need investigation. Systemic and physician-level barriers likely include a lack of clinical consensus on comparative efficacy, out-of-pocket costs, and the administrative burden of prescribing relative to recommending non-pharmacological alternatives like neurofeedback. Furthermore, family-level dynamics like socioeconomic status significantly influence access, while persistent parental resistance can induce physician "prescribing inertia," leading clinicians to pre-emptively withhold medication recommendations to avoid conflict or perceived futility [19, 20].

This low treatment rate carries severe consequences for patients, families, and society at large. Economically, the cost of untreated ADHD in Hungary was estimated at 33 billion HUF in 2010, equivalent to approximately 63 billion HUF (164 million EUR) today [21].

Regional Variability and Healthcare Accessibility

The overall low treatment rate is further compounded by wide regional disparities, ranging from 11.8% to 29.8%. Although regional variation in ADHD care is documented internationally (e.g., Denmark, Norway), Hungary's small geographic size and centralized, single-payer healthcare system should theoretically promote consistency [22, 23]. Instead, a child's residence alters their pharmacotherapy likelihood 2.5-fold. Healthcare access is a plausible driver – online directories list only three specialists for Northern Hungary's paediatric population of 210,000 [24]. However, evidence from a similar Norwegian study suggests that individual clinical attitudes and local practice styles are major drivers for regional differences, underlining the need to look beyond structural accessibility alone [23].

Sex Disparities: The Systemic Under-Treatment of Females

Boys were significantly more likely to receive medication than girls (23.3% vs. 15.8%). Globally, girls with ADHD face under-recognition and under-treatment due to less disruptive symptom presentation, referral bias, and societal expectations [25]. In Hungary, this manifests intensely, with just over 1,000 girls medicated across the 10-year study period. This low rate is alarming because female ADHD impairment is equally severe, driving elevated risks for secondary psychopathology, psychiatric hospitalizations, unintended teen pregnancies, lifetime work-related disability, non-suicidal self-injury, and suicidal behaviour [26]. Educating teachers, parents, and clinicians to identify female ADHD presentations is therefore critical.

Age-Related Trends in Prescribing

Pharmacotherapy initiation by age peaked in the 11–14 cohort, followed by the 7–10 group. Low prescription rates among ages 0–6 are less problematic, as parent training is more beneficial at this stage [27]. Also, high preschool medication rates typically reflect limited access to evidence-based behavioral interventions [28]. However, treatment hesitancy spans all cohorts in Hungary, notably later adolescence (15–18 years). This group's low 22.8% initiation rate mirrors global trends of adolescent reluctance, often driven by diminishing parental oversight, poor insight, family resistance, and inadequate clinical services [29]. Leaving over 78% of incident adolescent cases untreated is highly concerning, given that untreated ADHD in this age group escalates risks for addiction, suicidal behaviour, accidents, and physical health complications [30].

First-Line Prescribing Practices

A notable finding was that ATX was the predominant first-line selection, especially among younger children. This directly contrasts with established guidelines prioritizing stimulants – specifically MPH – due to superior efficacy and safety [8]. While recent literature suggests reconsidering non-stimulants as first-line options, our data show that ATX is heavily favoured over MPH rather than treated as a mere equivalent [31]. Several structural, psychological, and economic barriers likely drive this practice. Structurally, controlled substance regulations impose significant administrative overhead on prescribing MPH on overburdened clinicians. Psychologically, families, and patients often harbour concerns regarding stimulant safety, stigma, and dependence [32]. Clinicians have also reported various stimulant-related fears, including misuse or diversion risk, symptom feigning, or the risk of parents exaggerating symptoms purely to secure medication as a means to boost academic grades [33]. Economically, a critical local driver is Hungary's medication subsidization policy: families must pay the full cost for MPH out-of-pocket, whereas ATX is partially subsidized, requiring only a 30% co-payment.

Treatment Persistence

Overall persistence was poor, with over 40% of patients discontinuing within 180 days. A stark gap emerged between medications: barely half of MPH patients maintained therapy at 180 days compared to 63.4% of ATX users. Premature discontinuation is a classic challenge in ADHD management, where core symptoms inherently disrupt adherence. Internationally, one-year persistence never approaches 100%; it drops as low as

19% for immediate-release MPH in a Dutch sample [34]. An eight-country study found that only 65% of children and 47% of adolescents remain medicated at one year [35]. Ferrin et al. reported average persistence spanning 91.5 to 170.6 days, with only 22.9% of patients exhibiting good adherence (medication possession ratio of 80% or greater) at 12 months [36]. Complex dosing schedules represent a known barrier; simpler, single-dose regimens enhance compliance, which may explain ATX's persistence advantage over multiple-dose alternatives in our cohort [34, 36]. Beyond regimen complexity, geographic, financial, and parental attitude barriers may also hamper continued use [37]. While targeted adherence interventions have been developed globally, none are available in Hungary despite their clear necessity [38].

The Use of Antipsychotics in ADHD

Finally, antipsychotic utilization reached 9.4% across the total paediatric ADHD cohort, representing an estimated 30.3% to 43.4% of the medicated population. This elevated rate echoes troubling international trends, such as a 3% annual increase in England, where 7.1% of paediatric antipsychotic prescriptions involve ADHD patients [39]. Our 10-year aggregated rate (9.4%) is highly comparable to the initiation incidence of 19.6 per 1,000 person-years found in US IQVIA PharMetrics data, but higher than a separate US cohort reporting a 2.6% rate [40, 41]. Notably, Sultan et al. found that 47.9% of these children bypassed ADHD-specific medications entirely, and only 52.7% had a documented clinical rationale [41]. While clinicians may use antipsychotics to manage aggression, conduct comorbidities, stimulant rebound, or sleep issues, long-term paediatric safety and efficacy data in ADHD are scarce [42]. It should be noted that many of these symptoms are often manageable via ADHD medication optimization or behavioural interventions [43]. Nationally, asymmetric financial subsidization may further drive antipsychotic prescription: the state completely funds antipsychotics, while all ADHD-specific medications require parental out-of-pocket payments.

Limitations

Our study has several limitations. First, relying on administrative data introduces potential diagnostic misclassification. Second, the database lacks information on non-pharmacological interventions, preventing evaluation of concurrent behavioural support. Third, the aggregated data restricted tracking to treatment episodes (vectors) rather than individual patients, barring multivariable regression. Using a 90-day grace period means patients restarting therapy after 90 days generated multiple vectors, meaning that the true number of unique treated individuals is even lower, further reinforcing our primary finding of low overall treatment rates. Additionally, vector-level data obscured the exact overlap between ADHD-specific drugs and antipsychotics, though our minimum/maximum boundary modelling confirms antipsychotic use remains disproportionately high. Finally, we lacked individual-level data on comorbidities, preventing us from evaluating how co-occurring conditions influenced treatment decisions or antipsychotic initiation. However, because major protocols (such as the 2018 NICE guideline) explicitly state that comorbidities should not alter first-line medication choice, this missing data cannot explain the observed clinical deviations from standard treatment algorithms [44].

Conclusions

This first nationwide report on Hungarian paediatric ADHD pharmacotherapy reveals that most diagnosed children remain untreated, while those who are treated often receive medications unsupported by evidence or international guidelines. These findings should inform local clinical guidelines and psychiatric training, with a distinct emphasis on female patients. Addressing these gaps requires coordinated health policy reform: revising medication subsidies that currently disincentivize evidence-based treatments and implementing standardized national care pathways to eliminate regional inequalities. Additionally, introducing targeted adherence interventions is vital to improve poor treatment persistence. Ultimately, since most affected children never access care – and most diagnosed individuals remain unmedicated – broad public awareness campaigns are essential to promote evidence-based treatment options.

Declarations

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Competing Interests

P Nagy has received compensation for serving as consultant or speaker for Medice and Egis Pharmaceuticals, unrelated to this work.

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Ethics approval

The study was approved by the National Ethics Committee in Hungary (ETT TUKEB, approval number: BM/15397-1/2023). The study was performed in accordance with the ethical standards of the 1964 Declaration of Helsinki and its later amendments.

Informed consent

For this type of study, formal informed consent is not required. The requirement for informed consent was formally waived by the National Ethics Committee (ETT TUKEB) due to the retrospective, strictly anonymous nature of the administrative claims data utilized in the registry analysis.

Authors' contribution

All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by Peter Nagy, Bálint Mazzag and Róbert Frigyesi. Methodological suggestions and supervision were provided by Róbert Urbán, András Fogarasi and Melinda Pénzes. The first draft of the manuscript was written by Peter Nagy and all authors commented on the first and subsequent versions of the manuscript. All authors read and approved the final manuscript.

Availability of data and material

The data that support the findings of this study were obtained from the National Health Insurance Fund database in Hungary. Legal and data privacy restrictions apply to the availability of these administrative claims data, which were used under an authorized institutional license for the current study and are not publicly available. Aggregated data used in the statistical analysis are available from the corresponding author upon reasonable request, subject to approval by the National Health Insurance Fund and the National Ethics Committee.

Code availability

The custom analytical scripts and statistical modelling code developed in the R software environment for this study are not publicly deposited but are available from the corresponding author upon reasonable request.

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Tables

Table 1. Regional incident paediatric ADHD cases and pharmacotherapy initiation rates in Hungary, 2013–2022.

Region	Children on Medication (n)	Total Incident Cases (N)	Proportion treated % [95% CI]	Difference vs rest of country, pp [95% CI]	Adjusted Residual
Budapest	1,488	7,188	20.7% [19.8; 21.7]	−1.4 [−2.4; −0.4]	-2.44*
Southern Great Plain	733	3,348	21.9% [20.5; 23.3]	+0.1 [−1.4; +1.6]	$+0.19^{ns}$
Southern Transdanubia	1,043	3,504	29.8% [28.3; 31.3]	+9.2 [+7.7; +10.8]	+12.08***
Northern Great Plain	850	4,324	19.7% [18.5; 20.9]	−2.4 [−3.7; −1.2]	-3.58***
Northern Hungary	378	3,206	11.8% [10.7; 13.0]	−10.9 [−12.1; −9.7]	-14.34***
Central Transdanubia	1,208	5,477	22.1% [21.0; 23.2]	+0.4 [−0.8; +1.7]	$+0.57^{ns}$
Western Transdanubia	700	2,703	25.9% [24.3; 27.6]	+4.5 [+2.8; +6.2]	+5.42***
Pest	1,409	6,131	23.0% [21.9; 24.1]	+1.5 [+0.3; +2.7]	+2.54*
Unknown residence	38	210	N/A	N/A	N/A
Total	**7,847**	**36,091**	**21.7% [21.3; 22.2]**		

Note. CI = confidence interval; pp = percentage points; ns = non-significant. Regional treatment CIs were calculated via the Wilson score method. "Differences versus the rest of the country" indicate absolute percentage-point differences between the index region and all others combined (CIs via the Wald method). Adjusted standardized residuals determined significant regional deviations from the 21.7% national treatment rate. "Unknown residence" metrics were omitted because data may be discordantly missing or changed between diagnosis and treatment, preventing a matched longitudinal cohort. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Table 2. Atomoxetine as first-line ADHD medication by region and age group in Hungary, 2013–2022.

Subgroup	Total Treated Patients (N)	ATX first (n)	Proportion on ATX first [95% CI]	Difference, pp [95% CI]
Region				**Difference vs rest of country**
Budapest	1,488	874	58.74% [56.22; 61.21]	−7.8 [−10.5; −5.0]
Southern Great Plain	733	598	81.58% [78.61; 84.22]	+18.3 [+15.2; +21.3]
Southern Transdanubia	1,043	816	78.24% [75.63; 80.63]	+15.2 [+12.5; +18.0]
Northern Great Plain	850	603	70.94% [67.80; 73.89]	+6.6 [+3.4; +9.9]
Northern Hungary	378	269	71.16% [66.4; 75.5]	+6.4 [+1.7; +11.1]
Central Transdanubia	1,208	748	61.92% [59.15; 64.62]	−3.7 [−6.6; −0.7]
Western Transdanubia	700	438	62.57% [58.93; 66.08]	−2.7 [−6.5; +1.0]
Pest	1,409	736	52.24% [49.62; 54.83]	−15.6 [−18.4; −12.7]
Unknown residence	38	23	N/A	N/A
Age Group				**Difference vs reference**
0-6	386	310	80.3% [76.1; 84.0]	+25.6 [+19.7; +31.1]
7-10	4,250	2,827	66.5% [65.1; 67.9]	+11.8 [+7.5; +16.1]
11-14	2,590	1,637	63.2% [61.3; 65.0]	+8.5 [+4.0; +13.0]
15-18	570	312	54.7% [50.6; 58.8]	Reference
18+[a]	51	19	37.3% [25.3; 51.0]	N/A

Note. ATX = atomoxetine; CI = confidence interval; pp = percentage points. ATX-first proportion CIs were calculated via the Wilson score method. Regional differences indicate absolute percentage-point gaps between the index region and all others combined; age differences indicate gaps relative to the 15–18 reference group (difference CIs via the Wald method). 'Unknown residence' metrics were omitted because data may be discordantly missing across categories, preventing a matched cohort.

[a]A small number of patients diagnosed before age 18 but initiating pharmacotherapy after age 18 are shown separately for numerical consistency and excluded from paediatric age-group comparisons.

Table 3. Persistence rates of treatment episodes, stratified by drug type and sex.

Group	Treatment	Total Started Episodes (N)	Episodes ≥ 180 Days (n)	180-day persistence (95% CI)	Absolute persistence difference, pp (95% CI)	Persistence ratio (95% CI)
Overall	MPH	3056	1555	50.9% (49.1; 52.7)	Reference	Reference
	ATX	5391	3416	63.4% (62.1; 64.6)	+12.5 (10.3; 14.7)	1.25 (1.20; 1.30)
Boys	MPH	2634	1364	51.8% (49.9; 53.7)	Reference	Reference
	ATX	4577	2909	63.6% (62.2; 64.9)	+11.8 (9.4; 14.1)	1.23 (1.18; 1.28)
Girls	MPH	422	191	45.3% (40.6; 50.0)	Reference	Reference
	ATX	814	507	62.3% (58.9; 65.5)	+17.0 (11.2; 22.8)	1.38 (1.22; 1.55)

Note. ATX = atomoxetine; MPH = methylphenidate; CI = confidence interval; pp = percentage points. Persistence rate 95% CIs used the Wilson score method. Absolute differences and ratios compare ATX with MPH (reference) within subgroups. CIs for absolute differences were calculated via the Wald method; ratio CIs used log-transformed ratios of independent

Figures

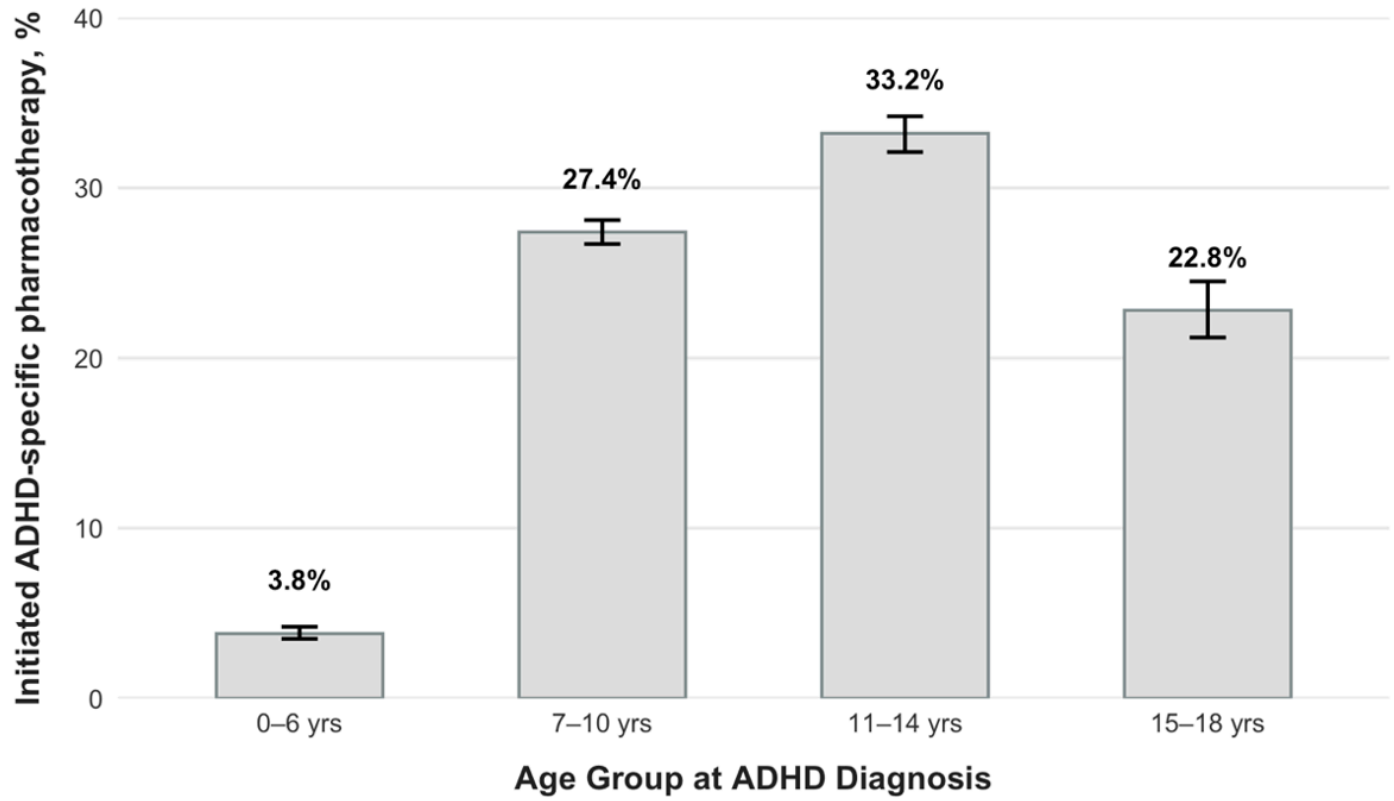


Figure 1

Proportion of incident paediatric ADHD cases initiating ADHD-specific pharmacotherapy by age group. Error bars indicate 95% confidence intervals.

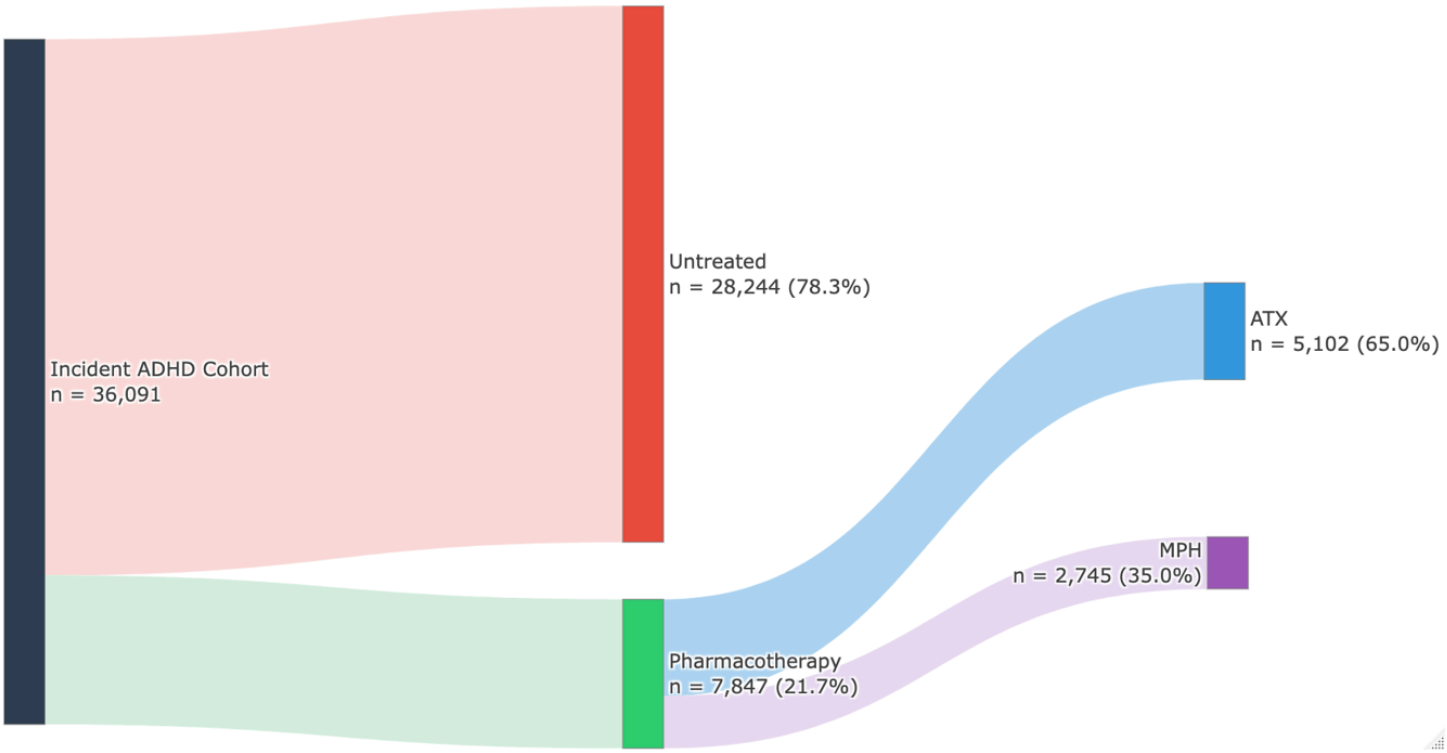


Figure 2

Sankey diagram of the paediatric ADHD treatment cascade. The figure maps patient flow from the initial diagnosis to initial treatment choices. *See the note on the number of treated patients at Table 1. ATX: atomoxetine; MPH: methylphenidate.*

Supplementary Files

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