

SHORT COMMUNICATION

Incidence of ADHD medication use among Finnish children and adolescents in 2008–2019: a need for practice changes?

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Abstract

Aims: This study examined the incidence of attention-deficit/hyperactivity disorder medication among children and adolescents by sex and age group in Finland during 2008–2019. **Methods:** The data on children and adolescents aged 6–18 years receiving reimbursement for any attention-deficit/hyperactivity disorder medication was collected from the nationwide register on reimbursed purchases. The incidence was calculated as a ratio of the number of new users and the number of age and sex-matched population at risk. Negative binomial models were used to calculate rate ratios (RRs). **Results:** In 2019, the incidence of attention-deficit/hyperactivity disorder medication was 13.4 per 1000 boys and 4.8 per 1000 girls. Among boys, the incidence became 3.7 times greater during the observed years (RR 95% confidence interval (CI) 2.0, 6.5, $P < 0.0001$), whereas in girls it was 7.6 times greater (RR 95% CI 2.1, 27.4, $P = 0.0019$). The boys had 2.8 times the incidence rate compared with the girls (RR 95% CI 2.2, 3.6, $P < 0.0001$). The increase was associated with age only among boys ($P = 0.0001$). The highest incidence rate 23.4 per 1000 individuals (95% CI 22.5, 24.4) was found in 2019 among 6–8-year-old boys. **Conclusions:** The incidence of attention-deficit/hyperactivity disorder medication use among children and adolescents increased significantly in Finland during the study period. Incidence was higher among boys, but the increase was greater among girls. The most common group to start attention-deficit/hyperactivity disorder medication was 6–8-year-old boys. These findings warrant critical evaluation of the diagnostic and treatment policies currently available in Finland for the treatment of attention-deficit/hyperactivity disorder and related symptoms.

Keywords: Attention-deficit/hyperactivity disorder, ADHD, incidence, medication, Finland, registry-based data, reimbursement data

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder typically diagnosed in childhood. It affects around 2.9–7.2% of school aged children and adolescents globally [1, 2].

Since 2007 the Finnish clinical guideline for the treatment of ADHD has recommended medication for children aged 6 years and over if their ADHD

symptoms are causing persistent significant impairment and other psychosocial interventions are considered insufficient [3].

In recent years, the prevalence of ADHD medication among children and adolescents has increased in several Nordic countries [4, 5], also in Finland [6, 7]. In 2018, the prevalence in Sweden was around 3.0% and around 2.0% for Norway and Denmark [4].

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By 2018 in Finland, the prevalence of ADHD medication was 4.4% among boys and 1.0% among girls [6]. Just recently, it was recommended to Finland by the UN Committee on the Rights of the Child to ensure that medications for children, including those to treat ADHD, are prescribed only when strictly medically indicated after an individualised assessment of the best interest of the child [8]. However, recent data on the incidence of ADHD medication use among this vulnerable patient group in Finland and other Nordic countries are scarce, although trends in incidence may better reflect changing prescribing patterns.

The aim of this study was to evaluate the incidence of ADHD medication prescriptions by age and sex among Finnish children and adolescents.

Methods

Data

This was a descriptive study based on nationwide administrative registers maintained by the Social Insurance Institution of Finland (SII) [9, 10]: dispensations reimbursable under the National Health Insurance (NHI) scheme register including information on all reimbursed purchases from all Finnish pharmacies, and the register of disease-based reimbursement entitlements. All permanent residents of Finland are covered under the NHI system maintained by the SII.

We identified ADHD drug purchases (the anatomical therapeutic chemical (ATC) classification codes N06BA02, N06BA04, N06BA09, N06BA12 and C02AC02) from dispensations reimbursable under the NHI scheme register. For each purchase, pseudonymised ID, age and sex of the patient and the dispensing date were collected.

According to national regulations, the study required no ethical approval. As the register holder, SII approved the use of the data for the current study.

Cohort definition

The study population included all children and adolescents 18 years of age and under, who had received their first reimbursement for ADHD medication purchase between 1 January 2008 and 31 December 2019 in Finland ($n=41,920$). To ascertain true ‘naïve’ use we excluded all patients with any purchases during the years 2006–2007 ($n=4831$). To avoid misclassification, we also excluded patients diagnosed with narcolepsy ($n=67$) using the register of disease-based reimbursement entitlements. In addition, children aged under 6 years ($n=1162$) were excluded.

Statistical methods

The population was classified by sex into four age groups (6–8, 9–12, 13–15 and 16–18 years). The

incidence rate (IR) was calculated as a ratio of the number of new users and the number of subjects at risk.

The annual, sex and age-specific IR was reported with 95% Jeffreys confidence interval (CI).

Rate ratios (RRs) were modelled using negative binomial models. The initial model included as factors: the year of initiation, sex and age group and all interactions. From this model, non-significant factors were gradually omitted. As the interaction between sex and age group was statistically significant, the modelling was repeated separately for both sexes.

A significance level was set at 0.05. Analyses were performed using SAS (version 9.4) for Windows. Graphs were constructed in R version 4.2.1 using the ggplot2 package.

Results

In total 40,691 subjects aged 6–18 years purchased their first ADHD medication during 2008–2019. The median age of the subjects was 9 years ($Q1=8$, $Q3=12$) and 77.4% were boys.

The incidence of ADHD medication use increased for all study years ($P<0.0001$). In 2008 there were 1653 new users (IR 2.1, 95% CI 2.0, 2.2) while in 2019 there were 6760 (IR 9.0, 95% CI 8.8, 9.2). In 2019 the incidence was 4.3 times greater than in 2008 (RR 95% CI 2.5, 7.2, $P<0.0001$).

The statistically significant change was already seen among boys from 2015 onwards, whereas it was seen from 2017 onwards among girls (Table I).

The IR was also associated with sex ($P<0.0001$). The boys had on average 2.8 times the IR compared with girls (RR 95% CI 2.2, 3.6, $P<0.0001$) (Figure 1).

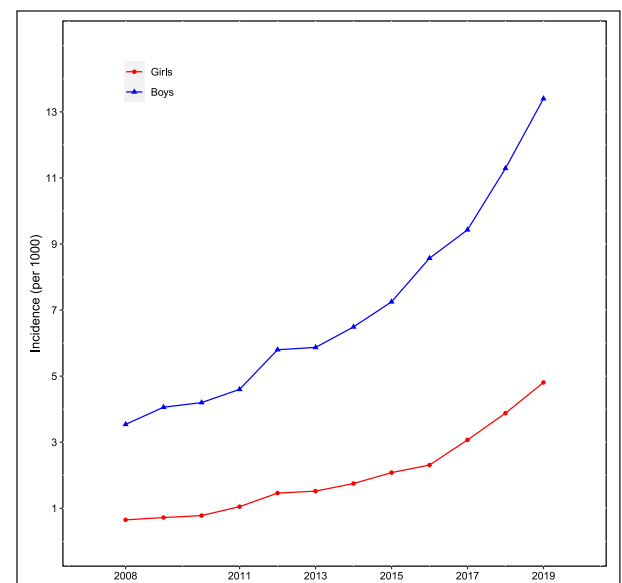


Figure 1. The incidence of attention-deficit/hyperactivity disorder (ADHD) medication use among Finnish children and adolescents by sex between 2008 and 2019.

Table I. The annual numbers of new users of ADHD medications, incidence per 1000 subjects with 95% confidence intervals by sex and the statistical significance of change compared to 2008.

Year	Girls				Boys			
	<i>n</i>	Incidence	95% CI	<i>P</i> value	<i>n</i>	Incidence	95% CI	<i>P</i> value
2008	257	0.65	(0.58, 0.73)	Reference	1396	3.54	(3.35, 3.73)	Reference
2009	282	0.72	(0.64, 0.81)	0.902	1583	4.06	(3.87, 4.26)	0.707
2010	301	0.78	(0.69, 0.87)	0.823	1617	4.20	(4.00, 4.41)	0.614
2011	401	1.05	(0.95, 1.15)	0.537	1749	4.60	(4.39, 4.82)	0.443
2012	558	1.46	(1.35, 1.59)	0.268	2182	5.80	(5.56, 6.04)	0.146
2013	576	1.52	(1.4, 1.65)	0.237	2187	5.87	(5.63, 6.12)	0.143
2014	659	1.75	(1.62, 1.88)	0.162	2403	6.49	(6.24, 6.76)	0.078
2015	786	2.08	(1.94, 2.23)	0.095	2677	7.25	(6.98, 7.53)	0.037
2016	877	2.31	(2.17, 2.47)	0.067	3157	8.57	(8.27, 8.87)	0.008
2017	1170	3.07	(2.9, 3.25)	0.020	3475	9.43	(9.12, 9.74)	0.003
2018	1481	3.88	(3.69, 4.08)	0.006	4157	11.29	(10.95, 11.64)	<0.001
2019	1841	4.81	(4.6, 5.04)	0.002	4919	13.40	(13.03, 13.77)	<0.0001

ADHD: attention-deficit/hyperactivity disorder; CI: confidence interval.

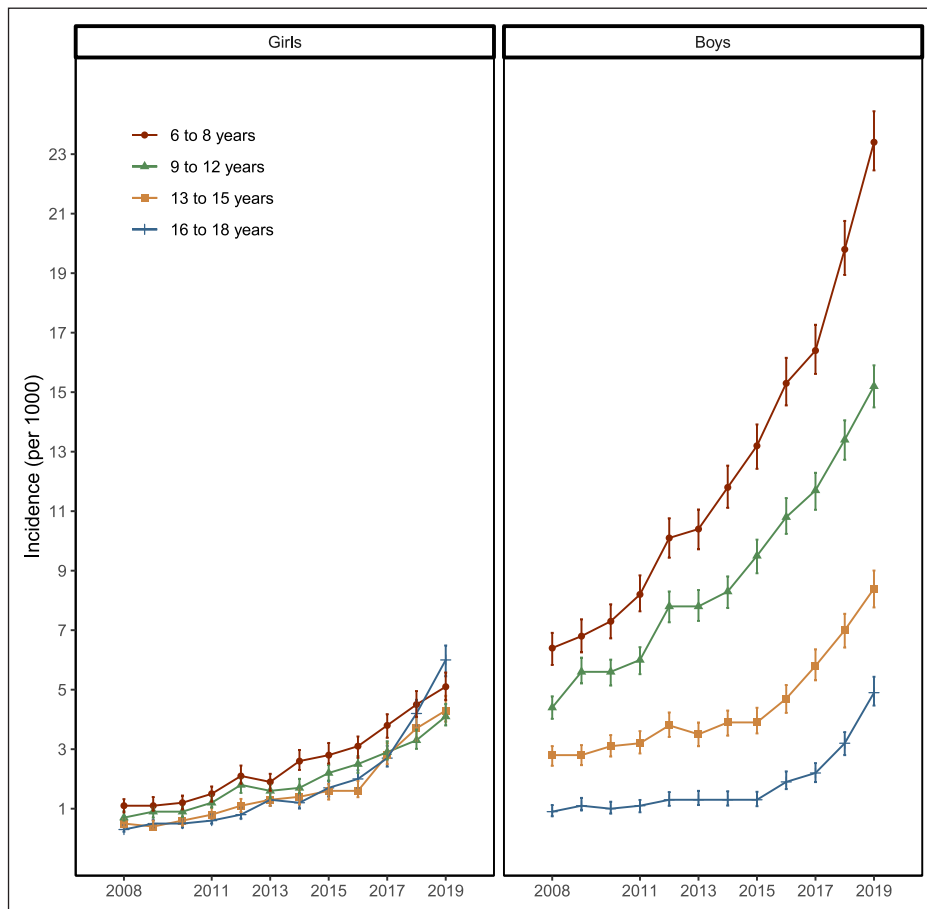


Figure 2. The incidence of attention-deficit/hyperactivity disorder (ADHD) medication use among Finnish children and adolescents by sex and age group between 2008 and 2019.

The increase was greater among girls with the incidence increasing 7.6-fold (RR 95% CI 2.1, 27.4, $P=0.0019$), whereas among boys the increase was 3.7-fold (RR 95% CI 2.0, 6.5, $P<0.0001$).

The IR was associated with age among boys ($P=0.0001$) (Figure 2). The IR was 6.8 times higher

among 6–8 year-olds as compared with the reference group of 16–18 year-olds (RR 95% CI 4.3–10.6, $P<0.0001$). By comparison, the incidence rate was 3.8 times higher among 9–12 year-olds (RR 95% CI 2.4, 6.0, $P<0.0001$) and 2.5 times higher among 13–15 year-olds (RR 95% CI 1.5, 4.1, $P=.0003$).

Discussion

The incidence of ADHD medication use among Finnish children and adolescents increased steadily from 2008 to 2019. The incidence remained higher for boys but increased more for girls. However, incidence was especially high among young boys.

The direct comparison of our results with other European countries is difficult because no European studies on incidence covering our full study period are available. Furu et al. assessed the incidence of ADHD medication use for all five Nordic countries during 2008–2012 [11]. In 2012, the incidence among 6–17 year-olds was highest in Iceland (17 per 1000 boys, nine per 1000 girls) and lowest for girls in Finland (two per 1000 girls and six per 1000 boys) [11].

We observed diminishing sex disparities since the incidence increased more for girls. Similarly, a recent study from Australia reported the incidence of ADHD medication use during 2012–2020 to increase the most among 13–17-year-old girls (from 1.4 to 5.3 per 1000) [12]. The incidence for 6–12-year-old boys in 2019 in Australia was 15.8 per 1000.

The use of ADHD medications for children and adolescents appears now to be more common in Finland than in Norway or Denmark [4, 6]. Until now, increasing rates of ADHD medication use in Finland have been speculated to reflect the better recognition of ADHD in childhood instead of a true increase in the frequency of ADHD diagnoses or unwarranted channeling of ADHD medications. Considering our findings, better recognition might still explain the increase among girls but should eventually result in the incidence also plateauing among young boys. This was not observed here despite the more than 10 years of follow-up in narrow age categories in which small practice changes could be noticed.

A recent review on over 300 published studies found convincing evidence of ADHD overdiagnosis and overtreatment in children and adolescents, especially on the milder end of the ADHD spectrum [13]. In Finland, younger relative age was associated with an increased risk of receiving a diagnosis and medication for ADHD [7, 14], especially during the first school years (ages 6–8). Furthermore, excessive exposure to screens [15–20] and shorter sleep duration during childhood [21] are known risk factors for inattentive or hyperactive symptoms. Also, the changes in school environments [22] and increasing social inequalities [23, 24] may play a role. Data from France indicate that the pharmacological treatment of ADHD may be prioritised over psychosocial support for children from underprivileged families [25]. Thus, concern arises that psychosocial interventions including parental support are not appropriately

utilised or available in Finland for the treatment of ADHD and related symptoms especially for young boys starting school.

The major strength of our study is that the data cover the whole Finnish population over a 10-year study period. Major limitations were that only reimbursed purchases were included and there were no records available for clinical analysis of patient-level data on ADHD risk factors nor the non-pharmacological treatment approaches applied. As a further limitation common to all register-based studies, purchases of ADHD medication may not always translate to actual use.

Nonetheless, the present findings warrant critical evaluation of the current diagnostic and medical treatment policies in ADHD and related symptoms in Finland, and of the sufficiency of parental and other psychosocial support offered by society especially for young children and their families.

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References

- [1] Sacco R, Camilleri N, Eberhardt J, et al. A systematic review and meta-analysis on the prevalence of mental disorders among children and adolescents in Europe. *Eur Child Adolesc Psychiatry* 2022;30:1–18.
- [2] Thomas R, Sanders S, Doust J, et al. Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. *Pediatrics* 2015;135:e994–e1001.
- [3] Working group appointed by the Finnish Medical Society Duodecim, the Finnish Association of Paediatric Neurology, the Finnish Society for Child and Adolescent Psychiatry, the Finnish Society for Adolescent Psychiatry. *ADHD*

- (Attention-deficit hyperactivity disorder). Helsinki: The Finnish Medical Society Duodecim, 2017. www.kaypahoito.fi (accessed December 2022).
- [4] Sørensen AMS, Wesselhöft R, Andersen JH, et al. Trends in use of attention deficit hyperactivity disorder medication among children and adolescents in Scandinavia in 2010–2020. *Eur Child Adolesc Psychiatry*. Epub ahead of print 13 July 2022. doi: 10.1007/s00787-022-02034-2. Erratum in: *Eur Child Adolesc Psychiatry* 25 October 2022 PMID: 35831669.
 - [5] Raman RR, Man KKC, Bahmanyar S, et al. Trends in attention-deficit hyperactivity disorder medication use: a retrospective observational study using population-based databases. *Lancet Psychiatry* 2018;5:824–835.
 - [6] Vuori M, Koski-Pirilä A, Martikainen JE, et al. Gender- and age-stratified analyses of ADHD medication use in children and adolescents in Finland using population-based longitudinal data, 2008–2018. *Scand J Public Health* 2020;48:303–307.
 - [7] Vuori M, Martikainen JE, Koski-Pirilä A, et al. Children's relative age and ADHD medication use: a Finnish population-based study. *Pediatrics* 2020;146:e20194046.
 - [8] UN Committee on the Rights of the Child. *Recommendations to Finland. Concluding observations on the combined fifth and sixth reports of Finland*. Adopted by the Committee at its 93rd session (8–26 May 2023). Advance unedited version 2 June 2023. https://um.fi/documents/35732/0/CRC_C_FIN_CO_5-6_52903_E+%283%29.pdf, 32(d). (accessed 27 June 2023).
 - [9] Furu K, Wettermark B, Andersen M, et al. The Nordic countries as a cohort for pharmacoepidemiological research. *Basic Clin Pharmacol Toxicol* 2010;106:86–94.
 - [10] Laugensen K, Ludvigsson J, Schmidt M, et al. Nordic health registry-based research: a review of health care systems and key registries. *Clin Epidemiol* 2021;13:533–554.
 - [11] Furu K, Karlstad Ø, Zoega H, et al. Utilization of stimulants and atomoxetine for attention-deficit/hyperactivity disorder among 5.4 million children using population-based longitudinal data. *Basic Clin Pharmacol Toxicol* 2017;120:373–379. doi: 10.1111/bcpt.12724 Epub 30 January 2017. PMID: 27911044.
 - [12] Bruno C, Havard A, Gillies MB, et al. Patterns of attention deficit hyperactivity disorder medicine use in the era of new non-stimulant medicines: a population-based study among Australian children and adults (2013–2020). *Aust N Z J Psychiatry* 2023;57:675–685.
 - [13] Kazda L, Bell K, Thomas R, et al. Overdiagnosis of attention-deficit/hyperactivity disorder in children and adolescents: a systematic scoping review. *JAMA Netw Open* 2021;4:e215335. doi: 10.1001/jamanetworkopen.2021.5335 PMID: 33843998; PMCID: PMC8042533.
 - [14] Sayal K, Chudal R, Hinkka-Yli-Salomäki S, et al. Relative age within the school year and diagnosis of attention-deficit hyperactivity disorder: a nationwide population-based study. *Lancet Psychiatry* 2017;4:868–875.
 - [15] Eirich R, McArthur BA, Anhorn C, et al. Association of screen time with internalizing and externalizing behavior problems in children 12 years or younger: a systematic review and meta-analysis. *JAMA Psychiatry* 2022;79:393–405. doi: 10.1001/jamapsychiatry.2022.0155 PMID: 35293954; PMCID: PMC8928099.
 - [16] Nikkelen SW, Valkenburg PM, Huizinga M, et al. Media use and ADHD-related behaviors in children and adolescents: a meta-analysis. *Dev Psychol* 2014;50:2228–2241. doi: 10.1037/a0037318 Epub 7 July 2014. PMID: 24999762.
 - [17] Beyens I, Valkenburg PM and Piotrowski JT. Screen media use and ADHD-related behaviors: four decades of research. *Proc Natl Acad Sci USA* 2018;115:9875–9881. doi: 10.1073/pnas.1611611114 PMID: 30275318; PMCID: PMC6176582.
 - [18] Peralta GP, Fornis J, García de la Hera M, et al. Sleeping, TV, cognitively stimulating activities, physical activity, and attention-deficit hyperactivity disorder symptom incidence in children: a prospective study. *J Dev Behav Pediatr* 2018;39:192–199. doi: 10.1097/DBP.0000000000000539 PMID: 29261536.
 - [19] Thorell LB, Burén J, Ström Wiman J, et al. Longitudinal associations between digital media use and ADHD symptoms in children and adolescents: a systematic literature review. *Eur Child Adolesc Psychiatry*. Epub ahead of print 2022 Dec 23. doi: 10.1007/s00787-022-02130-3
 - [20] Niiranen J, Kiviruusu O, Vornanen R, et al. High-dose electronic media use in five-year-olds and its association with their psychosocial symptoms: a cohort study. *BMJ Open* 2021;11:e040848.
 - [21] Huhdanpää H, Morales-Muñoz I, Aronen ET, et al. Prenatal and postnatal predictive factors for children's inattentive and hyperactive symptoms at 5 years of age: the role of early family-related factors. *Child Psychiatry Hum Dev* 2021;52:783–799. doi: 10.1007/s10578-020-01057-7
 - [22] Finnish National Agency for Education. *The National Core Curriculum for Basic Education* 2014. https://www.oph.fi/sites/default/files/documents/perusopetuksen_opetussuunnitelman_perusteet_2014.pdf. (accessed 27 June 2023).
 - [23] Bernelius V and Huilla H. *Educational equity, social and spatial segregation and opportunities for targeted support*. Finnish Government. Publications of the Finnish Government 2021:7. <http://urn.fi/URN:ISBN:978-952-383-761-4> (accessed 4 December 2023).
 - [24] Official Statistics of Finland (OSF). *Households' assets*. 2021. ISSN=2242-3230. 2019. Helsinki: Statistics Finland. http://www.stat.fi/til/vtutk/2019/vtutk_2019_2021-06-08_tie_001_en.html (accessed 28 June 2023).
 - [25] Ponnou S and Thomé B. ADHD diagnosis and methylphenidate consumption in children and adolescents: a systematic analysis of health databases in France over the period 2010–2019. *Front Psychiatry* 2022;13:957242. doi: 10.3389/fpsy.2022.957242 PMID: 36299551; PMCID: PMC9590284.