Psychotropic use in children and adolescents in Scandinavia and Catalonia: a 10-year population-based study

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Abstract
Rationale  The use of psychotropic drugs in the paediatric population has not been the subject of many studies, due to the fact that this population is generally not included in clinical trials and these drugs are not authorized for use on minors.
Objectives  This study aims to provide an accurate description of psychotropic drug use in children and adolescents in the North of Europe and Catalonia.
Methods  Data from 2008 to 2017 on psychotropic drug consumption in children and adolescents were retrieved from the databases of Catalonia, Denmark, Norway and Sweden. Psychotropic drugs were divided into antipsychotics, anxiolytics (also hypnotics and sedatives), antidepressants and psychostimulants. Data were stratified by group of age (0–4, 5–9, 10–14 and 15–19/15–17 for Denmark and Catalonia) and sex.
Results  Overall, the group of anxiolytics shows the highest consumption and the group of antipsychotics the lowest. In 2017, Sweden was the country with the highest consumption of psychotropic drugs (6.67‰) and has the highest increase in consumption (152.8%), and Denmark has the lowest consumption for all groups (3.13‰). Catalonia shows a decrease in psychotropic drugs (~15.9%). Girls consume more than twice as many antidepressants as boys while the opposite is true for psychostimulants. Risperidone and quetiapine are among the most consumed antipsychotics in the Nordic countries, whereas in Catalonia they are risperidone and aripiprazole. Among antidepressants, sertraline is the most consumed. No differences are found among the psychostimulants.
Conclusions  Psychotropic consumption in younger populations is increasing, although there are differences between the countries as far as which drugs are used. Nordic countries show a higher prevalence of use than Catalonia. Psychotropic drug consumption increases with age, except for psychostimulants, which have the highest utilization rate among 10–14-year-olds.

Keywords  Psychopharmacology · Epidemiologic study · Child · Adolescent · Prevalence
**Introduction**

Drug utilization studies in the paediatric population pose a variety of challenges. This population is not normally included in clinical trials, leaving doctors to adjust doses individually for each dispensation based on the body weight, degree of impairment and specific symptoms of each patient (Joseph et al. 2015). Children treated with psychotropic drugs are no exception. Children, who are in constant physical and psychological change as they go from infanthood to late adolescence, can be affected not only by common mental health problems of adults such as anxiety and depression but also by behavioural problems and learning disabilities.

There have been studies on the utilization of psychotropic medication in the paediatric population (children and adolescents <18) in Europe (Abbas et al. 2016; Hartz et al. 2016; Kovess et al. 2015; Piovani et al. 2016; Sarginson et al. 2017; Steinhausen and Bisgaard 2014). There is a large variation in the utilization of psychotropic medication at an international level in the paediatric population which may be the result of multiple factors and influences, such as each country’s cultural approach towards mental diseases, their common clinical practices or their healthcare policies (Steinhausen 2015; Vitiello 2008).

Over the last decades, what we observe in the literature is an upward trend in the utilization of psychotropic drugs in children and adolescent populations, with higher rates in the USA than in Europe (Steinhausen 2015), except for the antidepressants, as a result of the FDA alert of risk of suicide in 2004 (Soria Saucedo et al. 2018). A German study with data from almost 4 million children and adolescents (0–17 years) showed that the utilization of psychotropics rose from 19.6/1000 persons in 2004 to 27.1 in 2012 (Abbas et al. 2016). Denmark showed also an increase in the number of prescriptions for psychotropic medication in paediatric population from 1.34 to 12.35 per 1000 person-years (1996–2010) (Steinhausen and Bisgaard 2014). In Italy, the rate of new prescriptions for children of psychotropics under 18 years showed a decrease from 2006 to 2011 (from 1.15 to 1.03/1000 children) (Piovani et al. 2016). In France, random samples from the French National Health Insurance (CNAM) of children under 17 showed that 2.5% had been prescribed a psychotropic drug prescription in 2010, mostly anxiolytics (1.9%) and minority stimulants (0.2%) (Kovess et al. 2015).

Most of these studies bring attention to the fact that the prevalence of different psychotropic groups varies according to age and sex. While stimulants and antipsychotics are more consumed by boys ages 8 to 12, antidepressants are more consumed by girls 14–16 years of age.

In the literature, the psychotropic drug utilization studies that we find focus on just one country, or just for one or two groups of psychotropic drugs. The aim of this study is to provide a comparison of the 4 groups of psychotropic drugs in children and adolescents in 4 European countries stratified by age and sex and to analyse the most consumed drugs for each group in each country in order to see what differences come up when treating this population.

**Methods**

We carried out a cross-sectional study from 2008 to 2017 to formulate an accurate description on psychotropic drug utilization in children and adolescents in four European countries.

**Study population**

Children and adolescents registered in the databases of Catalonia (Spain), Denmark, Norway and Sweden during the study period with at least one prescription/dispensing of a psychotropic drug in each year of study were counted in order to estimate the prevalence of use. In Catalonia and Denmark, children <18 years were the study population, whereas in Norway and Sweden, the population was children ≤19 years.

**Drugs of study**

Data on drug dispensation was obtained from each database and aggregated into different groups according to the Anatomic Therapeutic Chemical (ATC) classification in the following: N05A (antipsychotics), N05B/N05C (anxiolytics/hypnotics and sedatives), N06A (antidepressants) and N06BA (psychostimulants).

**Data sources**

Four healthcare databases were involved in this study:

1. Catalonia: Information System for the Development of Research in Primary Care (SIDIAP, http://www.sidiap.org/). This is a clinical database of anonymized longitudinal patient records of more than six million people (80% of the Catalan population, representing 10% of the total population of Spain). This database provides information regarding prescribed drugs and their invoice from the National Health System (not OTC products information available).

2. Denmark: the Danish Health Data Authority provides through the Medstat.dk (http://medstat.dk/) data on the sale of medicines in Denmark based on the data reported to the Register of Medicinal Product Statistics. As it is mandatory to report the sales of medicines, the data cover all sales in Denmark. Data retrieved were restricted to the sales from Primary Care sector.
3. Norway: the Norwegian Prescription Database (NorPD, http://norpd.no/) from the Norwegian Institute of Public Health (NIPH) contains data about dispensed drugs in Norway (drugs used in hospitals and nursing homes are also included).

4. Sweden: The National Board of Health and Welfare (Socialstyrelsen) statistics database (http://www.socialstyrelsen.se/statistik/statistikdatabas/lakemedel) contains information about medicines obtained from prescriptions in pharmacies and does not include those given to patients while in hospital.

**Users**

Children and adolescents with at least one dispensation of a psychotropic drug in the year in the four databases were included as users.

**Ethical standards**

The present study follows national and international regulations: Declaration of Helsinki Ethical Principles for Medical Research Involving Human Subjects and Good Research Practice principles and guidelines. The IDIAP Jordi Gol Clinical Research Ethics Committee, the ICS’s institution of reference for research in primary care, approved the study protocol (P18/037). Regarding the data contained in the databases and in accordance with legislation regarding confidentiality and data protection (Regulation (EU) 2016/679; Ley orgánica de Protección de Datos y Garantías Digitales 3/2018), these data are anonymized. Thus, it is not necessary to ask for informed consent from the participants.

**Data analysis**

The prevalence data on psychotropic use for each year was the proportion of children/adolescents with at least one dispensation of a psychotropic drug at some point during the year. Individuals who had multiple psychotropic drugs dispensed were counted more than once, one time for each different drug dispensed. The denominator was the total population at each year of study, or the stratified population by age group (0–4, 5–9, 10–14 and 15–17; Norway and Sweden were 15–19) and sex. Results were expressed in users per 1000 children (‰).

The percentage of increase through the decade was calculated as

\[
\%_{2017} - \%_{2008} / \%_{2008} \times 100.
\]

The percentage of drugs used by group was calculated as users of the drug divided by the total of each psychotropic group users.

**Results**

The overall utilization of psychotropic drugs in children and adolescents increased in the studied period (2008–2017) in all the Nordic countries (increases of 58.2% for Denmark, and 43.9% and 152.8% for Norway and Sweden, respectively), while the opposite was true in Catalonia (showing a decrease of 15.9%). (To see total psychotropic utilization by year and country please, see Table and Fig. 1 of the Supplementary material.)

In all four countries, the drug group with the highest utilization was anxiolytics (containing hypnotics and sedatives) followed by the stimulants, and antipsychotic, the group with the lowest utilization.

**Utilization by groups**

Figure 1 shows the prevalence of use of the different psychotropic drug groups over the 10-year span between 2008 and 2017.

**Antipsychotics (N05A)**

This group had the lowest utilization in all the countries studied. In 2017, the highest prevalence was observed in Catalonia (7.41‰) and the lowest in Denmark (2.40‰).

During the studied decade, Sweden, Norway and Catalonia saw increases in their utilization (57.6%, 45.1% and 35.7%, respectively) while in Denmark, it remained stable (−2.8%).

**Anxiolytics, hypnotics and sedatives (N05B and N05C)**

Over the years of the study, this group shows the highest prevalence of use in all countries except in Denmark where prevalence of psychostimulants was 13.54‰ whereas for anxiolytics was 12.15‰. All Nordic countries show an increase in their utilization, but Catalonia is the country which had the highest utilization every year, although there are two pronounced drops in 2009 (25.18‰) and 2013 (34.24‰) and a downward trend from 2015 to 2017 (18% of decreasing rate). In 2017, Catalonia and Sweden were the countries with highest utilization (35.33‰ and 33.36‰ respectively), although the trends are opposite; while in Catalonia, the use of these groups showed a decrease (−32.1%), in Sweden, an increase during the last decade can be observed (190.8%).
Antidepressants (N06A)

Sweden shows the highest utilization of this group throughout the study period, as well as the highest increase, almost double (from 7.18‰ in 2008 to 13.68‰ in 2017). Denmark is the only country that shows a decrease (−30.9%).

Psychostimulants (N06BA)

Although all countries experienced an increase in the utilization of psychostimulants over this decade, Sweden shows the highest increase (189.4%) reaching an increase of 22.17‰. After 2012, the utilization of this group stabilized for Catalonia, Denmark and Norway, showing in 2017 a utilization of 16.73‰, 3.54‰ and 15.72‰ respectively.

Utilization by sex

Figure 2 shows the utilization of the different psychotropic groups during the study period, stratified by sex.

There is no significant difference between both sexes regarding utilization of antipsychotics except in Catalonia, where the prevalence of use in boys in 2017 doubled that in girls (10.33‰ vs 4.32‰). In the Nordic countries, this utilization is almost the same over the last 4 years of study in both boys and girls alike (between 2.09 and 3.29‰).

In the case of anxiolytics, hypnotics and sedatives, there is no difference in utilization between the sexes in any of the four countries over the whole study period.

Antidepressant utilization shows differences between sexes, being twice as common among girls than among boys, except in Catalonia, where the utilization rates are closer for both groups, with girls a bit higher than boys (in 2017, boys 4.12‰ and girls 5.79‰).

The highest difference of utilization between boys and girls in all the studied countries was of psychostimulants. In Catalonia and Denmark, it was around 3-fold (2017, Catalonia 24.35‰ vs 8.66‰, boys and girls respectively and Denmark 19.10‰ vs 7.70‰) and in Norway and Sweden it was around 2-fold (2017, Norway 21.59‰ vs 9.51‰, boys and girls respectively and Sweden 29.31‰ vs 14.55‰). Despite these differences, the increase rate in the psychostimulants utilization between 2008 and 2017 is twice as high in girls as in boys.

Utilization by sex and age in 2017

Figure 3 shows the psychotropic drug utilization during the last year (2017) of the study stratified by age group and sex.

For both sexes, the use of psychotropic drugs increases with age, except for the anxiolytics, hypnotics and sedatives group in Catalonia.
Antipsychotics

In all 4 countries, utilization rates at least double in each age group, as age goes up. This increase is up to 5-fold in girls in the Nordic countries between 10 and 14 and 15–17/19 years. In Catalonia, there is no difference between how steeply utilization rates increase between the sexes based on age.

Anxiolytics, hypnotics and sedatives

Catalonia is the only country with a higher utilization for the 0–4-year age group as they have the highest drug utilization of all ages in both sexes (64.48‰ for boys and 61.98‰ for girls vs 16.01‰ and 30.01‰ respectively in the 15–17-year group). The Nordic countries’ utilization of anxiolytics is the lowest in this age group (0–4 years).

Anxiolytics, hypnotics and sedatives utilization in girls is lower than in boys until 15–17/19 years. Catalonia and Denmark show a lower utilization for this age group, but it should be noted that the data for this age group only includes those between 15 and 17 years in these two countries, whereas it is 15 and 19 for Norway and Sweden. Sweden girls of 15–19 years have the highest utilization in this group, with 92.73‰ vs 55.56‰ in boys of this age.

Antidepressants

Antidepressant utilization rates are similar in boys and girls in the age groups 0–4, 5–9 and 10–14, being less than 1‰ in the first two age groups in all four countries. Utilization rates increase up to 3 times from 10 to 14 years to 15–17/9 years in boys and up to 5–6 times in girls. In Norway, the utilization rate rises in the group of 10–14 from 1.74‰ and 1.8‰, boys and girls, to 11.68‰ and 30.54‰ respectively. Sweden shows the highest prevalence in the 15–19-year age group: 69.35‰ girls and 29.35‰ boys.

Psychostimulants

The highest utilization rates for psychostimulants are observed in boys between 10 and 14 years with a decrease in the next age group (15–17/9 years) in the Nordic countries. In Catalonia, the utilization rate remains stable from 10 to 17 years (50.42‰ in 10–14 years and 50.80‰ in 15–17 years) for boys while there is an increase in girls from 10 to 14 to 15–17 (17.61‰ to 19.39‰ respectively).

In the case of the girls, the use of psychostimulants increases with age, reaching its highest utilization in the 15–17/9 group. The increments in Sweden (69.3%) and Denmark (64.8%) are the highest, while those in Norway
and Catalonia go down (by 13.7% and 10.1%, respectively), from 10 to 14 to 15–17/9 years.

**Drugs most used in 2017**

Figure 4 shows the drugs most used in each group in 2017.

**Antipsychotics**

In Denmark and Norway, the most used is quetiapine (33% and 38% respectively) followed by risperidone (24% and 28% respectively). In Catalonia, the most used antipsychotic is risperidone (43%), followed by aripiprazole (28%), which the same as in Sweden (31% and 26% respectively). Lithium is in the fifth position in Sweden (4.3%) but is 1% or less in the other three countries (Catalonia 0.9%, Denmark 0.1% and Norway 1.2%).

**Anxiolytics, hypnotics and sedatives**

Hydroxyzine is by far the most used drug of this group in Catalonia (80%); meanwhile, in the Nordic countries, it is melatonin (Denmark 66.5%, Norway 63.5% and Sweden 52.4%). Diazepam is also among the five most used drugs in all the countries.

**Antidepressants**

Sertraline is the most used drug in all countries. For Denmark, sertraline represents 62% of all antidepressants dispensed, in Norway, it is 30% and in Sweden, it is 43%. In Catalonia, the utilization rate of sertraline is 34%, behind that of fluoxetine (36%).

**Psychostimulants**

All countries show methylphenidate as the most used drug in this group (Catalonia 80%, Denmark 65%, Norway 77% and Sweden 61%) followed by lisdexamfetamine and atomoxetine.

**Discussion**

The present study shows the prevalence of use of psychotropic drugs in children and adolescents in the Nordic countries and...
in Catalonia. We provide a description of psychotropic use in four European countries from a national perspective. The Nordic national databases and the Catalan data provide a snapshot of the utilization of psychotropic drugs based on real-world data in a population not generally enrolled in clinical trials and for whom there is little research regarding doses for their pharmacokinetics during infancy, childhood, and adolescence. Having analysed data from four countries allows us to compare their utilization, not only globally on psychotropics but also by specific drugs.

As also reported in various previous studies, the rates of utilization of psychotropic in children and adolescents are trending upward (Abbas et al. 2016; Hartz et al. 2016; Hsia and Maclennan 2009; Kovess et al. 2015; Piovani et al. 2016; Steinhausen and Bisgaard 2014), except in Catalonia where we see a decrease in their utilization. In Catalonia, the prevalence of psychotropic use is lower than in the Nordic countries, a trend which has also been observed in other South European countries as Italy and France (Kovess et al. 2015; Piovani et al. 2016). A French study analysing the patterns of psychotropic utilization in children of 6–17 years showed an increase of 3.9% in antidepressants from 2009 to 2016, while in our study from 2009 to 2016, their utilization decreased in Catalonia (−7.7%) (Revet et al. 2018).

It has been shown that the increase of psychotropic utilization is rooted mainly in the increase in the use of methylphenidate by boys aged 5–14 years (Hugtenburg et al. 2004; Raman 2018). In our study, this group was the one with the highest increase in its utilization in every country except for Norway where the highest increase was shown for anxiolytics, hypnotics and sedatives.

It also merits mentioning that even if Catalonia does not show an increase for overall psychotropic utilization, in the case of antipsychotics, its prevalence has indeed increased (35.7%) and shows the highest utilization among all the studied countries. This higher utilization pattern could be the result of an off-label use for non-psychotic disorders such as ADHD, developmental disorders or conduct or disruptive behaviour disorders as described in American children (Bushnell et al. 2020).

Although different patterns between countries are observed, the differences according to sex in each psychotropic group study are similar. In this study, there is a great difference between sexes regarding psychostimulants use (much higher in boys than in girls). Antipsychotics are more consumed by boys and antidepressants by girls, while no difference between sexes in the use of anxiolytics, hypnotics and sedatives group has been found. The difference in utilization patterns between the sexes has also been observed in previous studies (Abbas et al. 2016; Hartz et al. 2016; Hsia and Maclennan 2009; Kovess et al. 2015; Piovani et al. 2016; Steinhausen and Bisgaard 2014).

The observations about psychotropic use related to age are also in line with those of previous studies: the utilization tends to increase with age, except in the psychostimulants group, where the highest utilization occurs in the 10–14-year age group, and then decreases in boys. In girls, the psychostimulants used by the 15–17/19-year-old group tend to be similar to the one in the 10–14-year group (even increasing in Sweden).
It must be noted that the majority of the psychotropic drugs are not approved to be used in children or adolescents under 18, and consequently, their use is often off-label. A Danish study found that overall 88.0% of the prescriptions of psychotropic were off-label, with a slightly higher rate for hypnotics and sedatives and even slightly higher for antidepressants (Nielsen et al. 2017), with the exception of ADHD drugs which are mainly used on-label.

Data from an Italian study shows that risperidone is the most used antipsychotic drug and that sertraline and fluoxetine are the antidepressants with the highest prevalence, which is similar to what our own study data shows, where risperidone is the most commonly dispensed antipsychotic drug, except in Denmark and Norway (where it is quetiapine), and that sertraline is the preferred antidepressant followed by fluoxetine (Piovani et al. 2016). Risperidone is indicated for the short-term symptomatic treatment (up to 6 weeks) of persistent aggressive conduct disorder in children from the age of 5 through adolescence and sertraline is indicated for the treatment of obsessive-compulsive disorder in children and adolescents (6–17 years), but not for depression in children less than 18 years of age.

Some psychiatric diagnoses are not made until a certain age (e.g. ADHD, schizophrenia) and for the youngest patients, some of these drugs may be used as a comedication or for other developmental or behavioural disorders (Bushnell et al. 2020).

The anxiolytics, hypnotics and sedatives group does not follow the same pattern. Its highest prevalence is in the 0–4-year group (both girls and boys) in Catalonia and descends as ages rise until the 10–14-year group, reaching the same prevalence as the 15–17-year group (boys) or slightly higher (girls). This pattern is not observed in the Nordic countries and is clearly linked to the prevalence of hydroxyzine use in Catalonia, where hydroxyzine accounts for more than 80% of the utilization of this group, mainly in children from 0 to 4 years. We analysed this group (N05B + N05C) in Catalonia taking hydroxyzine out of the equation and the results on utilization were similar to those of the Nordic countries (Fig. 2 of the Supplementary material). Hydroxyzine, although classified as an anxiolytic (N05BB01) by the ATC classification, has an indication in the paediatric population for the treatment of pruritus that could be related to atopic skin diseases, urticaria, chickenpox or bug bites, which leads us to believe that it was not used for treating anxiety but instead mainly or solely as a remedy for pruritus (Atarax SmPC 2017). The two biggest drops in its utilization take place at the same time as there was a lack of supply in Spain, and the downward trend seen over the last 2 years of the study could be the result of the 2015 EMA alert regarding the risk of QT prolongation (Atarax 2009; EMA 2015).

In the hypnotics and sedatives group (N05C), melatonin has a high rate of utilization in the Nordic countries. Melatonin’s only indication is as monotherapy for the short-term treatment of primary insomnia characterized by poor sleep quality in patients aged 55 or over (Circadin SmPC 2015). In Spain, no data on melatonin use is available because it is not reimbursed by the National Health Service (it is considered as an OTC product). A Swedish study on paediatric use of melatonin shows that 50% of the patients did not have a psychiatric diagnosis and the most commonly documented diagnoses were behavioural and emotional disorders (Kimland et al. 2020). Some other drugs in this group, such as midazolam which use is seen in the Nordic countries, can also be used for seizures (Lather et al. 2019).

There are fewer studies showing the use of drugs in each group. A French study also mentions the use of hydroxyzine as the most common drug of the anxiolytics drug group (Kovess et al. 2015).

When our study results are compared with those based on adolescents (12–19 years) in the USA from a time period 10 years earlier, they are similar in antidepressants and psychostimulants being the most used psychotropic drugs, and also similar to our results, boys used more psychostimulants and girls more antidepressants for this age group (Jonas et al. 2013).

Clinical significance

- There is a lack of appropriate guidance for the use of psychotropic drugs in children, due to the fact that limited clinical trials or observational studies on psychotropic use in children and adolescents have been done.
- This cross-national comparison shows differences in the paediatric psychotropic use in 4 countries, a population not normally included in clinical trials, so observational studies on their effectivity and safety are sorely needed in this population.
- There has been an increase in the use of psychotropic drugs in children and adolescents in the last decade.
- Anxiolytics, hypnotics and sedatives are the most commonly consumed followed by the psychostimulants, while antipsychotics have the lowest utilization. Utilization increases with age and is higher in girls.

Strengths and limitations

Of all the cases found in the database of the four countries, it was those with dispensation of a psychotropic drug at least once in the year contemplated that were included as users in this study. It is not possible to discern if the same person may, in some cases, have ended up being counted more than once, which could happen if the same user has dispensations for drugs in two or more different groups. Reports on concommitant
psychotropic prescriptions in children reveal that psychostimulants and antidepressants are more often prescribed in tandem with another class of psychotropic drug (Comer et al. 2010). In a US study, more boys than girls had taken different classes of psychotropic medications (Comer et al. 2010), and in France, benzodiazepines were practically the only prescribed psychotropic medication (Kovess et al. 2015). As this is a cross-sectional study, we have not analysed how many of these children and adolescents may be medicated with more than one psychotropic drug or if each new dispensation represents a switch to another drug or an addition to their regimen. The research group conducted a study which surveyed primary care paediatricians in Catalonia last year in order to get a better understanding of the diagnosis registered in the health records of children with prescriptions of psychotropics, information which we think could be of territorial interest.

We arranged the age groups 0–4 years (infanthood), 5–9 years (young children), 10–14 years (tweens and early teens) and 15–17/19 years (late teens), but the ages also could have been based on schooling, preschool, primary and secondary. In the case of Norway and Sweden, the age groups for which data were available had already been established to the exclusion of data based on exact age, so the decision was made to analyse Catalonia and Denmark’s data following the same groupings in order to give homogenized results. For Catalonia, data were only available up to the age of 17. Therefore, for Denmark, whose database does have data on utilization based on exact age, users only up to the age of 17 were included in order to align with the data from Catalonia.

The data on dispensation do not contain structured data on cause and/or diagnosis of prescription. Many drugs can have several approved indications. A recent meta-analysis shows prevalence of mental disorders in children and adolescents at 13.4% (Polanczyk et al. 2015). The most common group of mental disorders is anxiety disorders (6.5%), followed by disruptive behaviour disorder (5.7%), ADHD (3.4%) and any depressive disorder (2.6%). These rates of prevalence line up with our prevalence utilization rates, as the most commonly consumed psychotropic groups (anxiolytic, hypnotic and sedatives followed by the psychostimulants) are indeed indicated for the treatment of those disorders. The aim of this study was not to analyse the mental health diagnoses of a paediatric population for whom we have found that sometimes drug prescription proceeds registering a diagnosis (or at least diagnosis is registered) (Perapoch et al. 2019).

For the Nordic countries, prescriptions of psychotropic groups are made by psychiatrists and are included in the hospital (secondary) sector but not dispensed by hospital pharmacies. Norwegian data also includes hospital and nursing homes, but as these drugs are used in children who normally are not hospitalized nor in nursing homes, we do not think this factor contributes to consumption rates for this country (to support this idea, it should be noted the rate in Norway was lower than that of Sweden, whose data only accounted for pharmacy dispensations, not those for hospitals). In Catalonia, children with mental problems are treated at a specialized level in the Mental Health Centres for Children and Adolescents (CSMUJ) or by private psychiatrists. The initial drug prescribed by specialists stays on continuous prescription in follow-up carried out by the primary care physicians and paediatricians.

Not included in our analysis are alpha-agonists and anticonvulsants, which are used off-label for developmental disabilities and as mood stabilizers, because these drugs are already mainly off-label use when prescribed for mental disorders in children.

Conclusions

There has been an increase in the use of psychotropic drugs in children and adolescents over the last decade. Anxiolytics, hypnotics and sedatives are the most consumed followed by psychostimulants, while antipsychotics have the lowest utilization.

No information regarding the clinical indication for the use of these drugs is possible through the administrative data used in this study. Data for the group of users ages 15–19 may be higher in Sweden and Norway than in Catalonia and Denmark, taking into account the fact that we only have data up to the age of 17 years for these two last countries, and this age group tends to be one with the highest utilization.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00213-021-05809-8.

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Author contribution AGL, AGS, CVU and RMP were involved in the protocol design, acquisition of data, analysis and interpretation of the results and final discussion of the project. OPV contributed to the design, data analysis and reviewed the final version of the manuscript. AGC, LGG, XBP and ARQ contributed to the protocol design and interpretation of the results as well to the discussion; they revised the work critically and reviewed the final version of the manuscript. All the authors agree to be accountable for all aspects of the work.

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Data availability In accordance with current European and Spanish organic law, the Catalan data used in this study is available only to the researchers participating in this project. Therefore, we are not allowed to distribute or make the data publicly available to other parties. However, researchers from public institutions can request data from the...
SIDIAP if those requests comply with certain requirements. Further information is available online (https://www.sidiap.org/index.php/menu-sollicitudes-en/application-procedure).

Data from Scandinavian countries can be accessed on their webpages as explained in the Methods section.

**Declarations**

**Conflict of interest** The authors declared the following potential conflicts of interest with respect to the research, authorship and/or publication of this article:

L.G.G. received travel awards for taking part in psychiatric meetings from Shire in the last 3 years.

J.A.R.-Q. was on the speakers’ bureau and/or acted as a consultant for Eli Lilly, Janssen-Cilag, Novartis, Shire, Lundbeck, Almirall, Braingaze, Sincrolab and Rubió in the last 5 years. He also received travel awards (air tickets + hotel) for taking part in psychiatric meetings from Janssen-Cilag, Sincrolab and Rubió in the last 5 years. He also received unrestricted educational and research support from the following pharmaceutical companies in the last 5 years: Eli Lilly, Lundbeck, Janssen-Cilag, Actelion, Shire, Ferrer and Rubió.

The rest of the authors have no conflicts of interest relevant to this article to disclose.

**References**

Abbas S, Ihle P, Adler J-B, Engel S, Günster C, Linder R, Lehmkuhl G, Schübert I (2016) Psychopharmacological prescriptions in children and adolescents in Germany: Deutsches Arzteblatt International 113(22–23):396–403. https://doi.org/10.3238/arztebl.2016.0396

Atarax 2mg/ml jarabe. Summary of Product Characteristics (2017) Spanish Agency of Medicines and Medical Devices (AEMPS). Available at: https://cima.aemps.es/cima/dochtml/it/26269/FT_26269.html

Atarax Xarop 125mg (2009) Direcció General de Recursos Sanitarix. Generalitat de Catalunya. Departament de Salut. Nota Informativa: Desproveïment d’atarax xarop 125 ml (CN: 663025). Referència 2009046 CB. Catalunya

Bushnell GA, Crystal S, Olfsen M (2020) Trends in antipsychotic medication use in young privately insured children. J Am Acad Child Adolesc Psychiatry. https://doi.org/10.1016/j.jaac.2020.09.0232020.09.023

Circadin 2mg (2015). Summary of Product Characteristics. European Medicines Agency. Available at: https://www.eea.europa.eu/documents/product-information/circadin-epar-product-information_en.pdf

Comer JS, Olfsen M, Mojtabai R (2010) National trends in child and adolescent psychotropic polypharmacy in office-based practice, 1996-2007. J Am Acad Child Adolesc Psychiatry 49(10):1001–1010. https://doi.org/10.1016/j.jaac.2010.07.007

Coordination Group for Mutual Recognition and Decentralised Procedures - Human. EMA (2015) Hydroxyzine-containing medicines: New restrictions to minimise the risks of effects on heart rhythm. https://www.ema.europa.eu/en/documents/referral/hydroxyzine-article-31-referralnew-restrictionsminimiserisks-effects-heart-rhythm-hydroxyzine_en.pdf

Hartz I, Skurtveit S, Steffenak AKM, Karlstad Ø, Handal M (2016) Psychotropic drug use in children and adolescents during 1992–2001: a population-based study in the UK. Eur J Epidemiol 24(4):211–216. https://doi.org/10.1007/s10654-009-9321-3

Hugtenburg JR, Heerdink ER, Egberts ACG (2004) Increased psychotropic drug utilization by children in the Netherlands during 1995–2001 is caused by increased use of methylphenidate by boys. Eur J Clin Pharmacol 60(5):377–379. https://doi.org/10.1007/s00228-004-0765-9

Jonas BS, Qiuiping G, Albertorio-Diaz JR, Qiuiping G, Albertorio-Diaz JR (2013) Psychotropic medication use among adolescents: United States, 2005–2010. National Center for Health Statistics 135

Joseph PD, Craig JC, Caldwell PHY (2015) Clinical trials in children. Br J Clin Pharmacol 79(3):357–369. https://doi.org/10.1111/bcp.12305

Kimland EE, Bardage C, Collin J, Järleborg A, Ljung R, Iliadou AN (2020). Pediatric use of prescribed melatonin in Sweden 2006–2017: a register based study. Eur Child Adolesc Psychiatry. https://doi.org/10.1007/s00787-020-01598-1

Kovess V, Choppin S, Gao F, Pivette M, Husky M, Leray E (2015) Psychotropic medication use in French children and adolescents. J Child Adolesc Psychopharmacology 25(2):168–175. https://doi.org/10.1089/cap.2014.0058

Lather T, Behgal J, Bharadwaj H, Kaushik IS (2019) Impact of prescribing intranasal midazolam as rescue medication for domiciliary management of acute seizure among children with epilepsy. Epilepsy Behav 96:41–43. https://doi.org/10.1016/j.yebeh.2019.04.016

Nielsen ES, Rasmussen L, Hellfritzsch M, Thomsen PH, Norgaard M, Laursen T (2017) Trends in off-label prescribing of sedatives, hypnotics and antidepressants among children and adolescents - a Danish, nationwide register-based study. Basic Clin Pharmacol Toxicol 120(4):360–367. https://doi.org/10.1111/bcpt.12706

Perapich J, Vidal R, Gómez-Lumbraeras A, Hermosilla E, Riera L, Cortés J, Céspedes MC, Ramos-Quiroga JA, and Morros R. 2019. Prematurity and ADHD in childhood: an observational register-based study in Catalonia. J Atten Disord. https://doi.org/10.1177/1087054719864631

Piovani D, Clavenna A, Cartabia M, Bonati M (2016) Psychotropic medicine prescriptions in Italian youths: a multiregional study. Eur Child Adolesc Psychiatry 25(3):235–245. https://doi.org/10.1007/s00787-015-0726-0

Polanczyk GV, Salum GA, Sugaya LS, Caye A, Rohde LA (2015) Annual research review: a meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. J Child Psychol Psychiatry 56(3):345–365. https://doi.org/10.1111/jcpp.12381

Raman SR, Man KKC, Bahmanyar S, Berard A, Bildor S, Boukhris T, Bushnell G, Crystal S, Funu K, KaoYang Y-H, Karlstad Ø, Kieler H, Kubota K, Lai EC-C, Martikainen JE, Maura G, Moore N, Montero D, Nakamura H, Neumann A, Pate V, Pottegård A, Pratt NL, Roughhead EE, Saint-Gerons DM, Stürmer T, Su C-C, Zoega H, Sturkenboom MCM, Chan EW, Coghill D, Ip P, Wong ICK (2018) Trends in attention-deficit hyperactivity disorder medication use: a retrospective observational study using population-based databases. Lancet Psychiatry 5(10):824–835. https://doi.org/10.1016/S2215-0366(18)30293-1

Revet A, Montastruc F, Raynaud J-P, Barcault B, Montastruc J-L, Lapeyre-Mestre M (2018) Trends and patterns of antidepressant use in French children and adolescents from 2009 to 2016. J Clin Psychopharmacol 38(4):327–335. https://doi.org/10.1097/JCP.0000000000000891

Sargison J, Webb RT, Jill Stocks S, Esmaeil A, Garg S, Ashcroft DM (2017) Temporal trends in antidepressant prescribing to children in UK primary care, 2000–2015. J Affect Disord 210:312–318. https://doi.org/10.1016/j.jad.2016.12.047

Soria Saucedo R, Liu X, Hincapie-Castillo JM, Zambrano D, Bussing R, Winterstein AG (2018) Prevalence, time trends, and utilization patterns of psychotropic polypharmacy among pediatric Medicaid

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beneficiaries, 1999–2010. Psychiatr Serv 69(8):919–926. https://doi.org/10.1176/appi.ps.201700260

Steinhausen H-C (2015) Recent international trends in psychotropic medication prescriptions for children and adolescents. Eur Child Adolesc Psychiatry 24(6):635–640. https://doi.org/10.1007/s00787-014-0631-y

Steinhausen HC, Bisgaard C (2014) Nationwide time trends in dispensed prescriptions of psychotropic medication for children and adolescents in Denmark. Acta Psychiatr Scand 129(3):221–231. https://doi.org/10.1111/acps.12155

Vitiello B (2008) An international perspective on pediatric psychopharmacology. Int Rev Psychiatry 20(2):121–126. https://doi.org/10.1080/09540260801887710

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