The incidence of disruptive behaviour disorder and ADHD diagnoses: a register-based study of perinatal and psychosocial factors

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Abstract

Background Disruptive behaviour disorders (DBDs) frequently occur alongside attention deficit hyperactivity disorder (ADHD); however, the current incidence and extent of this overlap remain unclear. We aimed to estimate the cumulative incidence of DBD diagnoses and their comorbidity with ADHD and the trends in the incidences over time.

Methods We used register data of live-born children from 2001–2005 (N = 282,773). The cumulative incidence of DBD diagnoses up to age 12 was studied. DBDs were defined by conduct disorder (CD, F91.x) and mixed disorders of conduct and emotions (F92.x), based on the 10th International Classification of Diseases. Concomitant ADHD (F90.x, F98.8) diagnoses were examined, and analyses were adjusted for perinatal and psychosocial factors.

Results The cumulative incidence of CD and mixed disorder of conduct and emotions diagnoses were 0.8% (2,208) and 1.5% (4,128) respectively in 269,490 study children followed up to 12 years. The cumulative incidence of DBDs varied by cohort and was higher in later-born cohorts. In boys, incidence increased from 2.8% in the 2001 cohort to 3.3% in the 2005 cohort, and in girls from 0.8% to 1.1% ($p < 0.0001$ and $p = 0.0007$, respectively).

Among 5,573 children with a DBD diagnosis (763 with both F91.x and F92.x diagnoses), 40.6% (n = 2,260) had comorbid ADHD. The DBD–ADHD comorbidity was more likely (adjusted odds ratio [95% Confidence Intervals]) among children whose mothers smoked during pregnancy (2.6 [2.4–2.9]), were single (1.8 [1.6–2.1]), were unemployed (1.2 [1.1–1.3]) or had a psychiatric disorder between pregnancy and the child's first four years (2.5 [2.2–2.8]), as well as among boys (6.8 [6.0–7.8]). Over the cohorts, ADHD diagnosis increased in boys with DBDs diagnosis ($p<0.05$), but not in girls ($p>0.05$).

Conclusions The cumulative incidence of diagnosed DBDs has varied over the years and is increasing modestly. The comorbidity with ADHD is common and increasing in boys, and higher odds for comorbidity associates with male sex and maternal psychosocial adversities.

BACKGROUND

Disruptive behaviour disorders (DBDs) and attention deficit hyperactivity disorder (ADHD) are common childhood externalising disorders, with reported pooled prevalence rates of 5.7% (95% Confidence Intervals, CI, 4.0–8.1) and 3.4% (2.6–4.5), respectively.[1 − 5] These conditions can negatively affect both school and family and even peer relationship settings.[5 − 9] They are associated with psychological and physical health problems, as well as with criminal behaviour, particularly when they co-occur and if combined with social or familial risk factors.[3,10 − 13] Both ADHD and DBDs, especially conduct disorder (CD), are diagnosed more often in boys than in girls in childhood, but the difference in the incidence of diagnoses between the sexes starts to disappear in adulthood.[1,8,14 − 17]

DBDs, CD, oppositional defiant disorder (ODD) and mixed conduct and emotions disorders overlap.[18 − 21] In diagnostic manual conduct disorder include different variants, like ODD that is often milder disorder than CD with and without antisocial behaviour. Mixed conduct and emotion disorders include i.e., depression.[18] DBDs also quite rarely exist as sole conditions, and diagnoses of DBDs frequently co-occur with ADHD, with comorbidity rates reaching up to 50% in children with ADHD, and about 14% of children diagnosed with a DBD also have ADHD.[17 − 18,22] Estimates of DBDs have been higher in community samples than in clinical (diagnosed) study samples,[1, 14, 16, 23] but the comorbidity with ADHD have been higher in clinical samples than in community samples.[4,12 − 13,22,24 − 26] Although the incidence of ADHD diagnoses in children has risen in recent years,[28 − 29] scholars have not investigated whether there have been changes in the comorbidity of other psychiatric conditions, such as behavioural disorders. A better awareness and recognition of ADHD could be associated with less adverse behaviour of child through increased use of psychosocial interventions and medication for ADHD.[30 − 35]

In Finland, the authors of a recent register-based study that included only secondary healthcare data reported a cumulative incidence of DBDs of around 3.5% for boys and 1.4% for girls by age 15.[17] However, not all children with oppositional, disruptive and antisocial symptoms might receive services from secondary healthcare.[36 − 37] Primary care is often the first point of contact for disruptive behaviours. Therefore, including primary and secondary care diagnoses may better capture service pathways and trends in the DBD diagnoses. Also, their comorbidity with ADHD could provide new information on aetiology, which can be used to plan healthcare services.

The aims of this study were to estimate the cumulative incidence of DBD diagnoses up to age 12 in total birth cohorts for 2001–2005, quantify comorbidity with ADHD while adjusting for maternal perinatal psychosocial conditions and child factors known to associate with externalizing disorders,[38 − 40] and analyse cohort trends in DBD diagnoses and DBD–ADHD comorbidity.

We hypothesised that the frequency of DBD diagnoses, CD and mixed disorder of CD and emotion, has increased in all children as externalizing disorders have been reported increasingly. But we hypothesized that increasing identification and management of ADHD in children may have led to changes in DBDs diagnosis, as to decrease in DBD–ADHD comorbidity. We also hypothesised that psychosocial conditions of mother and the sex of the child, could be risk factors for these disorders.

METHODS

Sources of data and ethical approval

This is a quantitative, retrospective study based on register data from the Finnish Institute for Health and Welfare (permission: THL/1826/14.06.00/2025). Registers that were used in this study were: Finnish Medical Birth Register, Finnish Hospital Discharge Register, and Register on Congenital Malformations. The legal basis for processing personal data was public interest and scientific research (EU General Data Protection Regulation 2016/679, Article 6(1)(e) and Article 9(2)(j); Data Protection Act, Sections 4 and 6). According to Finnish national regulations, a register-based study does not require ethical approval or the collection of informed consent. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) cohort study checklist was used as guidance for reporting this study. [36]

Participants

All live-born children (N = 282,773) born in Finland between 1 January 2001 and 31 December 2005 were included and followed until the day before they reached age 13. We had to assume a hypothetical birthday of July 1st for all children as we were provided with only the years of birth. We excluded infants who died within 7 days of birth, children with unclear or very low (< 32 weeks) gestational age, children with congenital malformations and syndromes classified as severe in the Register on Congenital Malformations, and those with severe, profound, other or unclear cognitive impairments defined with diagnosis codes F72.x − 73.x and F78.x − 79.x in the 10th International Classification of Diseases (ICD-10) due to the potential confounding effect on the studied outcome.

Assessment of DBDs and ADHD

Our data on the psychiatric morbidity of children consisted of diagnoses received through specialised healthcare since 1998 and primary healthcare since 2011. Diagnoses were made by physicians according to ICD-10 criteria. We used the diagnostic codes F91.0–91.9 ‘conduct disorders’, which include ODD, and F92.0–92.9 ‘mixed disorders of conduct and emotions’ to identify DBD diagnoses. We used the codes F90.x and F98.8 for ADHD. If a child had received both an ADHD and DBD diagnosis, this was classified as an instance of comorbidity of these disorders, DBD–ADHD comorbidity. The incidence of DBDs was studied in association with potential maternal psychosocial and child-related factors associated with the studied outcome. [38 − 43] Maternal perinatal psychosocial variables (self-reported smoking, relationship status, employment during pregnancy, earlier births and psychiatric diagnoses) and sex of child and gestational age were collected from the registers. A mother was considered to have a psychiatric disorder diagnosis (F00–99 in ICD-10) when she was diagnosed at any point in time between the year before delivery and the year the child reached the age of four.

Statistical analyses

We obtained cumulative incidences for DBDs, and ADHD by cohort and age by dividing the number of children in the cohort who had already received a diagnosis at the respective age by the number of children originally in the respective cohort. Given the full-population design, no standardisation or weighting was applied.

Trends were tested using the Cochran–Armitage test for trend. The chronology of DBD and ADHD diagnoses was assessed using a multinomial test of equal probabilities for ‘DBD first’, ‘same age’ and ‘ADHD first’. We used multinomial logistic regressions to study the likelihood of DBD-ADHD comorbidity (and to compare it with the likelihood of DBD respectively ADHD alone).

We used multinomial logistic regressions to study the likelihood of DBD-ADHD comorbidity and to compare it with the likelihood of DBD respectively ADHD alone. The regressors were the child’s sex and gestational age (moderate preterm status was defined with gestational age 32 − 36 weeks); the mother’s psychiatric morbidity, prenatal smoking status, employment status, cohabitation status, age and status as first-time mother; and the year of the birth cohort. Complete-case analysis was applied.

The analyses were carried out using the statistical software SAS for Windows version 9.4 (SAS Institute Inc., Cary, NC, USA). Two-sided p-values below 0.05 were considered statistically significant.

RESULTS

Participants

Of the births that occurred in the 2001–2005 period, 269,490 were eligible (please see Fig. 1).

Please see the characteristics of children and their mothers (N = 210,137) in Table 1. Mother was more often unemployed, lived without partner, smoked during pregnancy or had any psychiatric disorder diagnosis when child had received diagnoses of DBD or DBD—ADHD comorbidity compared to ADHD. Psychiatric diagnosis of mother was a

special risk factor for DBD diagnosis of child, please see also Table 3. Regarding the mother's psychiatric disorders, 7.0% (14,598) of mothers had received any diagnosis between one year before childbirth and the year the child reached the age of four. The most common diagnosis were mood or affective disorders (8,121, 3.9%) and anxiety and related disorders (7,308, 3.5%), please see Supplementary Table 1 for details.

Table 1. Background Characteristics of Study Children and their mothers.

	Children with DBD diagnosis (N = 5,573)	Children with ADHD diagnosis (N = 10,248)	Children with DBD—ADHD comorbidity (N =2,260)	Number of missing covariates in study children
	Mean or percentage (number of observations)			
Mothers				
Age (years)	27.6	27.9	27.2	0
First-time mother	46.8 (2,606)	46.6 (4,777)	46.7 (1,055)	192
Prenatal smoking	34.6 (1,884)	29.1 (2,920)	37.1 (821)	6,622
Single-parent household	16.9 (880)	13.5 (1,298)	17.8 (371)	13,054
Non-employed	28.7 (1,372)	25.5 (2,258)	29.3 (564)	33,013
Any psychiatric diagnosis	19.0 (1,061)	13.4 (1,375)	18.3 (413)	0
Children				
Gestational age (weeks)	39.7	39.7	39.7	0
Moderate preterm	5.1 (284)	5.9 (601)	5.4 (122)	0
Girls	23.2 (1,295)	18.6 (1,904)	13.7 (309)	0
Boys	76.8 (4,278)	81.4 (8,344)	86.3 (1,951)	0

Covariates that are measured or observed in health care are covered in 100%, but some covariates that have been asked from mothers during pregnancy are not covered fully (smoking habits and information about working status), number of missing is presented above.

The cumulative incidence of DBDs diagnoses

The cumulative incidence of CD (F91.x) diagnosis was 0.8% (2,208); 1.3% (1,713) in boys and 0.4% (495) in girls. Regarding mixed conduct and emotions disorders (F92.x), the cumulative incidence was 1.5% (4,128); 2.3% (3,181) in boys and 0.7% (947) in girls.

And 763 of children received both a F91.x and F92.x diagnosis. Peak incidence occurred at the age of nine for DBD diagnoses. In more detail, considering F91.x, the most of diagnoses were received at 8 (15.1%) in boys and at 12 (18.4%) in girls, and F92.x at 9 (17.2%) in boys and at 12 (17.9%) in girls.

The most of DBDs diagnoses were received in specialized health care, as 75% (1,906) of F91.x diagnoses were retrieved from secondary health care register and 25% (648) from primary health care register. And for F92.x diagnoses these were 91% (4,755) and 9% (461).

DBD–ADHD comorbidity

Of all the study children, 3.8% (10,248/269,490) received an ADHD diagnosis and 0.8% (2,260/269,490) received both a DBD and an ADHD diagnosis until the age of 12. Among 5,573 children with DBDs (F91.x and/or F92.x), 40.6% (2,260) also had ADHD; this occurred in 45.6% (1,951/4,278) of boys and 23.9% (309//1,295) of girls. In other way, of the children diagnosed with ADHD, 22.1% also received a DBD diagnosis (2,260/10,248), with higher rates observed in

boys (23.4%; 1,951/8,344) compared to girls (16.2%; 309/1904). There was no preferred chronological order at what age diagnoses of DBDs and ADHD were received, $p > 0.05$.

In more detail, of all the children in the study, 0.3% (909) received both a F91.x and an ADHD diagnosis. This represents 41.2% of children with a F91.x diagnosis (2,208) and 8.9% of children with ADHD diagnosis. And overall, 0.6% (1,690) of the study population were diagnosed with F92.x and comorbid ADHD. Of those with F92.x diagnosis, 40.9% also had ADHD, whereas 16.5% of children with ADHD had a co-occurring mixed disorder diagnosis. Of the children with F91.x diagnosis, 32% (295) had first ADHD diagnosis, and 33% (299) first F91.x and most (35%, 315) had received both diagnoses at same age. And regarding F92.x, these were 35% (586), 34% (571) and 32% (533).

Trends in the incidence of DBDs

The cumulative incidence of DBD diagnoses until age 12 and the comorbidity with ADHD in each birth cohort are presented in Table 2. The cumulative incidence of DBDs increased when first and last cohorts were compared. It rise from 2.8% in the 2001 cohort to 3.3% in the 2005 cohort in boys ($p = 0.0002$), and for girls from 0.8% in the 2001 cohort to 1.1% in the 2005 cohort ($p = 0.0014$). The incidence of DBDs and DBDs—ADHD comorbidity has fluctuated from year to another, please see Table 2, Figs. 2 and 3. DBDs' comorbidity with ADHD increased for boys from 43.3% in the 2001 cohort to 48.9% in the 2005 cohort ($p = 0.0004$). In girls the rise was statistically insignificant ($p = 0.08$).

Table 2

The cumulative incidence (n/N (%)) of DBD diagnoses and the comorbidity with ADHD diagnosis (n (%)) in all children in each birth cohort, separately for girls and boys

Birth cohort	All children		Girls		Boys	
	Cumulative incidence of DBD diagnoses	DBD–ADHD comorbidity	Cumulative incidence of DBD diagnoses	DBD–ADHD comorbidity	Cumulative incidence of diagnoses	DBD–ADHD comorbidity
2001	958/53,184 (1.8%)	374 (39.0%)	209/26,091 (0.8%)	50 (23.9%)	749/27,093 (2.8%)	324 (43.3%)
2002	1,077/52,733 (2.0%)	393 (36.5%)	262/25,743 (1.0%)	60 (22.9%)	815/26,990 (3.0%)	333 (40.9%)
2003	1,160/53,935 (2.2%)	464 (40.0%)	247/26,567 (0.9%)	48 (19.4%)	913/27,368 (3.3%)	416 (45.6%)
2004	1,160/54,962 (2.1%)	485 (41.8%)	284/26,806 (1.1%)	59 (20.8%)	876/28,156 (3.1%)	426 (48.6%)
2005	1,218/54,676 (2.2%)	544 (44.7%)	293/26,976 (1.1%)	92 (31.4%)	925/27,700 (3.3%)	452 (48.9%)

Each birth cohort (2001–2005) was studied for the cumulative incidence of DBD diagnoses; the analysis shown here is only for boys up to age 12.

Each birth cohort (2001–2005) was studied for the cumulative incidence of DBD diagnoses; the analysis shown here is only for girls up to age 12.

Perinatal and psychosocial factors

In the adjusted analyses, higher odds of receiving an ADHD diagnosis, a DBD diagnosis, or DBD–ADHD comorbidity were associated with male sex, maternal smoking during pregnancy, maternal psychiatric diagnosis during pregnancy and throughout the child's first four years of life, and maternal single status or unemployment during pregnancy. Male sex was more strongly associated with DBD–ADHD comorbidity than with DBD only. Maternal psychiatric disorder was more strongly associated with DBD only and DBD–ADHD comorbidity than with ADHD only. First-time motherhood was associated with reduced odds of comorbidity, whereas moderate prematurity was not associated with either DBD only or DBD–ADHD comorbidity, please see Table 3.

In multinomial logistic regression analyses, the odds of DBD–ADHD comorbidity were examined using either ADHD only or DBD only as the reference category (Table 3). When ADHD only was used as the reference, DBD–ADHD comorbidity was associated with male sex, maternal psychiatric disorder during pregnancy and during the child's first four years of life, maternal smoking during pregnancy, single parenthood, older maternal age, and later birth cohort. When DBD only was used as the reference, DBD–ADHD comorbidity was most strongly associated with male sex and was additionally associated with maternal smoking during pregnancy, later birth cohort, and slightly older maternal age, whereas children of first-time mothers had lower odds of DBD–ADHD comorbidity. Maternal psychiatric disorder and preterm birth were not associated with comorbidity in this comparison.

Table 3

Multivariable analysis of the association between prenatal and birth factors and the diagnosis of the child with disruptive behavior disorders (DBDs) and/or attention deficit hyperactivity disorder (ADHD).

Odds Ratio [95% Confidence intervals]	Children with DBDs N = 5.573	Children with ADHD N = 10,248	Children with DBD–ADHD comorbidity N = 2,260	Children with DBD–ADHD comorbidity, DBD only as a reference[]	Children with DBD–ADHD comorbidity, ADHD only as a reference[]
Smoking	2.2 [2.0–2.4]	1.9 [1.7–2.0]	2.6 [2.4–2.9]	1.2 [1.0–1.3]	1.4 [1.3–1.6]
Single parenthood	1.7 [1.5–1.9]	1.3 [1.2–1.4]	1.8 [1.6–2.1]	1.1 [0.9–1.3]	1.4 [1.2–1.6]
Non-Employed	1.3 [1.2–1.4]	1.1 [1.0–1.2]	1.2 [1.1–1.3]	0.9 [0.8–1.1]	1.1 [1.0–1.3]
Psychiatric disorder	3.1 [2.8–3.4]	1.8 [1.7–2.0]	2.7 [2.4–3.1]	0.9 [0.8–1.0]	1.5 [1.3–1.7]
First-time mother	1.0 [1.0–1.1]	1.0 [1.0–1.1]	1.0 [0.8–1.0]	0.9 [0.8–1.0]	0.9 [0.8–1.0]
Moderate preterm born	1.0 [0.8–1.2]	1.3 [1.2–1.4]	1.1 [0.9–1.4]	1.1 [0.9–1.5]	0.9 [0.7–1.1]
Boy	2.5 [2.3–2.7]	4.3 [4.0–4.5]	6.8 [6.0–7.8]	2.7 [2.3–3.2]	1.6 [1.4–1.9]
Extra year of age at birth	1.0 [1.0–1.0]	1.0 [1.0–1.0]	1.0 [1.0–1.0]	1.0 [1.0–1.0]	1.0 [1.0–1.0]
Cohort	1.0 [1.0–1.0]	1.1 [1.1–1.1]	1.1 [1.1–1.1]	1.1 [1.1–1.1]	0.9 [1.0–1.0]

[]Multinomial logistic regression for comorbidity of disruptive behavior disorders (DBDs) and attention deficit hyperactivity disorder (ADHD), using children with DBDs or ADHD diagnosis only as reference category.

DISCUSSION

Among 269,490 Finnish children born between 2001 and 2006, the cumulative incidence by age 12 was 0.8% for conduct disorder (F91.x) and 1.5% for mixed disorder of conduct and emotions (F92.x). The incidence of diagnosed DBDs varied by birth cohort and increased modestly between the earliest (2001) and latest (2005) cohorts examined. Overall, 0.8% of children received both DBD and ADHD diagnoses. Among children with diagnosis of DBDs, ADHD comorbidity affected 46% of boys and 24% of girls. The probabilities of DBD, ADHD, and DBD–ADHD comorbidity were estimated using maternal psychosocial characteristics, child sex, and gestational status as predictors. These findings suggest that DBD or ADHD alone, and DBD–ADHD comorbidity are associated with a distinct profile of demographic and familial risk factors.

Disruptive and disobedient behaviour is common symptom in children; however, diagnostic rates for DBDs vary by method, sample, age, sex, geography and time of the study. [1, 4, 12, 16, 41] For example, in Lithuanian structured diagnostic interview-based assessments, the prevalence of CD has been higher than in Norwegian surveys. In the Lithuanian study in question, 7.1% (5.7%–8.8%) of 7- to 10-year-olds and 6.0% (5.1%–7.1%) of 11- to 16-year-olds fulfilled the criteria of a CD diagnosis as defined by ICD-10.[45] In a Norwegian study based on the same methods, only 2.4% (1.8%–3.0%) of 8- to 10-year-olds met the diagnostic criteria for CD.[46]

The authors of a Danish register study found a lower cumulative incidence than above in diagnosed cases of CD (1.3% of boys and 0.5% of girls) to age 18 in specialist care,[47] which is consistent with our CD rates– 1.3% of boys and 0.4%

of girls had an F91.x diagnosis (including oppositional defiant disorder, ODD). The study data comprised diagnoses and visits from both primary and specialized health care. Nevertheless, the vast majority (> 90%) of DBD diagnoses were recorded in specialized health care, with DBD being only rarely diagnosed in primary health care.

We also included mixed disorders of conduct and emotions (F92.x) among DBD diagnoses and found that these disorders were more common than conduct disorders (F91.x), accounting for 65% and 35% of all DBD diagnoses, respectively. This distribution is consistent with findings from a previous Finnish register study.[17] In our study, the incidence of mixed disorders was 2.3% in boys and 0.7% in girls. The diagnosis requires the presence of both CD and an emotional disorder (e.g., depression or anxiety). Compared with CD alone, this group may be at increased risk of functional impairment and adverse outcomes, suggesting a greater need for intensive treatment.[48 − 49]. This mixed disorder category has received relatively little attention from previous research, and no comparable estimates were identified for comparison. These findings highlight the need for further studies examining the epidemiology and prognosis of this condition

Based on trend analysis of the birth cohorts, we found that diagnoses of DBDs varied but increased slightly if first (2001) and last (2005) birth cohorts were compared, in boys from 2.8% to 3.3% and in girls 0.8% to 1.1%, The increase in question is similar to that reported in a Finnish register study based on secondary healthcare diagnoses, which included also earlier cohorts (1996 to 2005).[17] Globally, the prevalence of DBDs in children and adolescents has slightly increased, i.e., in in Western Europe between 1990 and 2019, but declined in U.S. between 2013 and 2021 especially compared to increase in other conditions, such as anxiety and depression.[50 − 51] This pattern may be attributable to the fact that psychiatric disorders other than disruptive behavior disorders have been more extensively investigated and are thus more likely to be identified.[52] We found variation between birth cohorts, but reasons remain unknown and should be studied in further studies.

In the present study, 0.8% of all the children received DBD–ADHD comorbidity; this occurred in 46% of boys and 22% of girls with DBDs, as well as in 23% of boys and 16% of girls with ADHD. A recent systematic review and meta-analysis of comorbidity in children and adolescents (up to age 18) with an ADHD diagnosis showed higher DBD prevalence, as pooled estimates of ODD, behaviour disorder and CD were 34.7%, 30.7% and 10.7%, respectively. Disorders were mainly defined by DSM-5 criteria for community and clinical samples. [22] In clinical cohort study of 6 to 11 year old children that received ADHD diagnosis, 37.4% had ODD and 7.6% CD.[26] According to the authors, only 12 out of 121 studies reported estimates separately for both sexes; however, based on their analyses of five study samples, boys with ADHD had about twice the risk of CD compared to girls (11% versus 6%) (Odds ratio = 1.68, 95% Confidence Intervals: 1.18–2.39). In this present study, we had similar results, as 9.5% of boys with ADHD diagnosis had also CD (F91.x) diagnosis and 6.1% of girls. Nevertheless, girls received diagnoses of disruptive behavior disorders at a later stage than boys in our cohort, as most of F91.x and F92.x diagnoses were received at age 12, and boys had their peak at 8 to 9 years. Girls may present a higher risk for comorbid psychiatric conditions, with the exception of attention-deficit/hyperactivity disorder, which shows higher prevalence rates in boys.[53] We found that comorbidity with ADHD increased in boys, with DBDs from 43% in the 2001 birth cohort to 49% in the 2005 birth cohort. But in girls increase was statistically insignificant. Enhanced recognition of symptoms characteristic of disorders such as ADHD may partly explain this finding, or people might have better access to healthcare and specialists, which makes them receive diagnoses more easily than before.[27]

We found a slightly higher incidence (22%) of diagnosis of DBDs in children with ADHD than was found in a Danish register study covering only secondary healthcare (16.5%).[49] But lower than in an Iranian population-based study based on the age range 6–18, 31% of those with ADHD symptoms also had behavioral disorder symptoms.[50] Scholars have previously reported that ADHD symptoms may precede DBD symptoms; however, in our study, neither diagnosis consistently preceded the other.[54]

Cross-national comparisons are inherently challenging due to heterogeneity in practices across countries. In a 2018 cross-sectional study comparing identified and treated cases of CD at age 0–19, differences were found between four countries, including a 31-fold difference in the incidence between Denmark and Germany.[44] There were also remarkable differences in treatment, such as rates of hospitalisation and the use of antipsychotic drugs. Current Finnish care guidelines for CDs recommend parent management training, which may be enhanced by cognitive behavioural interventions; for adolescents, multimodal psychosocial interventions and medication may be used if needed. [53]

We had hypothesised that increasing ADHD diagnoses might reduce DBD diagnoses through better recognition and treatment of externalising symptoms; however, we observed a little increase in DBD diagnoses and higher ADHD comorbidity among boys with DBD. This may indicate that ADHD diagnoses have been identified and diagnosed more often in children, especially in boys, with behavioural disorders during 2001 − 2018. Medicalisation, diagnostic culture, and stigma may influence help-seeking and diagnostic pathways. ADHD may be perceived as less stigmatising due to neurodevelopmental framing and established treatments (including medication), which may shift pathways toward ADHD assessment, while DBDs can remain under-recognised.[32, 54 − 55] This should be studied in further studies, as it is important to recognise and treat co-occurring mental and behavioural disorders also as independent disorders to prevent problems later in life.[5, 22, 56 − 58] For example, sufficient treatment of ADHD symptoms may ease symptomology of comorbid condition.[35] The co-occurrence of DBDs and ADHD warrants special training or expertise for clinicians; it also requires more detailed evaluation and adapted treatment plans.[59] The treatment of DBDs is not as straightforward as that of ADHD, but interventions based on cognitive behaviour theory have exhibited good response rates with both conditions.[24, 33]

Although disruptive behaviour is a common reason for contacting primary health care.[69] However most DBD diagnoses in this study were recorded in secondary health care. This finding suggests that DBDs may be more readily identified in specialized services than in primary care and warrants further investigation to improve recognition and care also in primary health care. However, recent population-based data on externalizing symptoms in Finland are lacking, limiting our ability to assess the full spectrum of DBD symptoms in the general population.

In the present study, adverse family conditions were associated with DBD–ADHD comorbidity, which is consistent with prior research.[24] Perinatal stress and maternal mental health problems are linked to later externalising symptoms, and support for parental mental health and emotion regulation is clinically relevant in DBD care and prevention.[9,17,24,54, 60 − 61] Prenatal stress and adversities during pregnancy are known risk factors for externalising symptoms of the child.[62 − 65] The authors of a longitudinal study also found an indirect pathway in which parenting hostility mediated the relationship between maternal postnatal mental health problems and children's externalising symptoms at school age.[66] Parenting stress and negative life habits may be linked to each other and increase the risk of DBD in offspring.[45] In our analyses, co-occurring DBD and ADHD were most strongly associated with male sex and were additionally linked to maternal smoking during pregnancy, older maternal age, and later birth cohorts. Maternal psychiatric disorders and single parenthood distinguished children with comorbidity from those with ADHD alone, whereas maternal psychiatric disorders and late prematurity did not differentiate children with comorbidity from those with DBD alone. Prior research has suggested that children with DBD–ADHD comorbidity whose parents have difficulties in daily functioning should be prioritized for behavioral interventions, given their elevated risk of poor prognosis.[45] The presence of multiple co-occurring risk factors in children and families further indicates the need for tailored, individualized, and multisystem treatment approaches.[28, 67, 68]

Strengths and limitations

The main strength of this study is that it is based on the whole Finnish population over five years, considering all the diagnoses made in the public healthcare system. Furthermore, the study provides new information on DBD diagnoses in boys and girls, trends in diagnoses, and risk factors. This study is based on registered diagnoses and does not include undiagnosed symptomatic cases. ADHD was identified using multiple ICD-10 codes, including F90.1, which was classified as ADHD although the diagnosis incorporates both ADHD and disruptive behaviour. Because F90.1 was recorded in 657 children (6.4% of ADHD cases), some cases of ADHD–DBD comorbidity may not have been captured, potentially leading to a slight underestimation of comorbidity.

In addition, primary care data were only available from 2011 onwards, which constrained the identification of early childhood diagnoses among older cohorts and may have led to an underestimation of incidence of studied diagnoses in these groups. The absence of exact dates of birth prevented the use of time-to-event or survival-type analyses, which limited the ability to precisely model age-specific risk trajectories. Unfortunately, at time of this study, we had access of data of all study children only until age 12 and only with data of mothers. DBDs should be studied also at later ages and with data of both parents. Finally, diagnostic practices and thresholds are likely to have evolved over the study period, potentially influencing observed trends; however, these changes cannot be directly examined using the administrative data employed here, which capture only assigned diagnoses, without contextual information on clinical decision-making or diagnostic criteria.

CONCLUSIONS

Diagnoses of DBDs seems to be increasing modestly among children and commonly co-occur with ADHD. Male sex and maternal psychiatric disorders are associated with an increased risk of this comorbidity and maternal psychiatric morbidity especially with DBDs itself. Children with both ADHD and DBDs, particularly those exposed to adverse psychosocial conditions, require specialised and tailored multisystem interventions to prevent or mitigate poor outcomes.

Declarations

Availability of data The data that support the findings of this study are available from Finnish Social and Health Data Permit Authority (Findata) but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are, however, available from the authors upon reasonable request and with permission of Findata. Clinical trial number: not applicable.

Consent The legal basis for processing personal data was public interest and scientific research (EU General Data Protection Regulation 2016/679, Article 6(1)(e) and Article 9(2)(j); Data Protection Act, Sections 4 and 6). According to Finnish national regulations, a register-based study does not require ethical approval or the collection of informed consent. Human Ethics and Consent to Participate declarations: not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

All authors approved the final manuscript as submitted and agreed to be accountable for all aspects of the work. ML: Conceptualization; writing – original draft preparation;writing – review and editing; tables designing. MV: Conceptualization; writing – original draft preparation; writing –review and editing; figures creation; results visualization. BP: Conceptualization; writing – original draft preparation; writing – review and editing; data curation; formal analysis; software development; figures creation; results visualization. SLK: Conceptualization; writing –original draft preparation; writing – review and editing. TT: Conceptualization; writing – original draft preparation; writing – review and editing. MK: Conceptualization; writing – original draft preparation; writing –review and editing; funding acquisition; project administration; resource management. PR: Conceptualization; writing –original draft preparation; writing – review and editing; funding acquisition; project administration; resource management.

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68. Supplementary table 1. Mothers' psychiatric diagnoses in the studied period (from one year before childbirth to the year the child turned four).

Figures

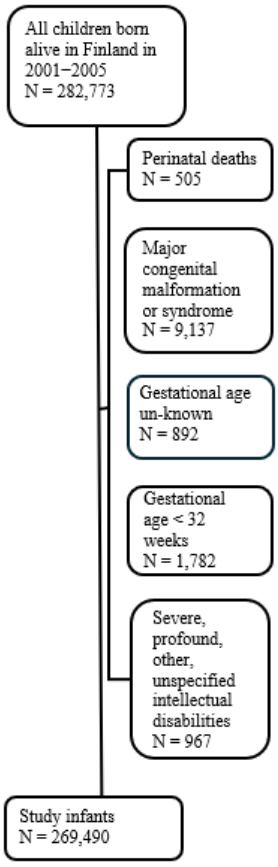


Figure 1

The flowchart of participants

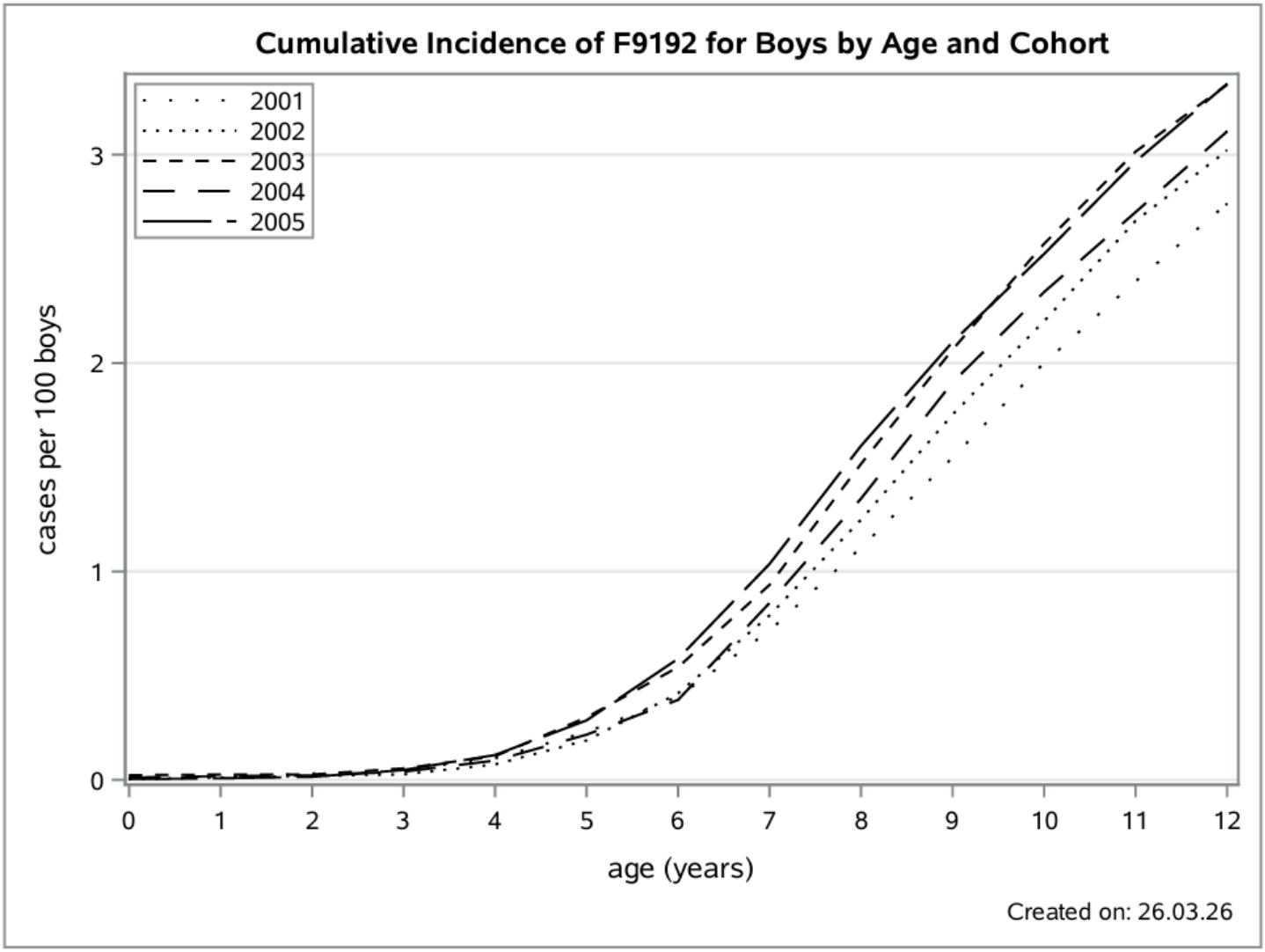


Figure 2

The cumulative incidence of DBD diagnoses in boys by birth cohort (2001–2005).

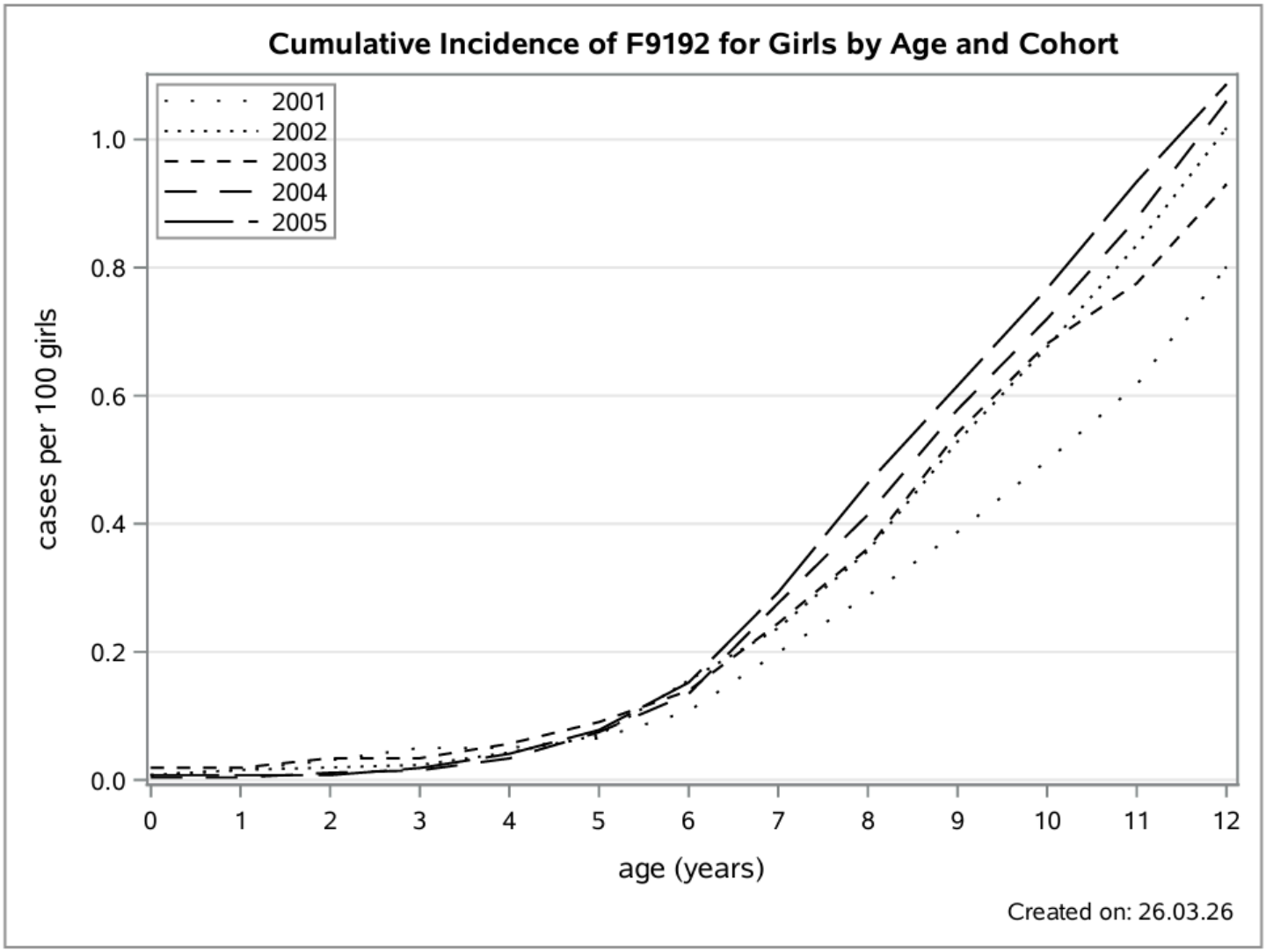


Figure 3

The cumulative incidence of DBD diagnoses in girls by birth cohort (2001–2005).