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ORIGINAL PAPER

Incidence and comorbidities of disruptive behavior disorders diagnosed in Finnish specialist psychiatric services

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Abstract

Purpose Disruptive behavior disorders (DBD), including oppositional defiant disorder (ODD) and conduct disorder (CD), are some of the most common psychiatric conditions in childhood. Despite this, there has been limited research on DBDs. We examined the incidence, comorbidity and gender differences of DBDs diagnosed by specialist services.

Method This was a nationwide register study of 570,815 children and adolescents born in 1996–2005. The 7050 individuals diagnosed with DBD by specialist healthcare services were matched to 26,804 controls.

Results By the age of 15, the cumulative incidence of diagnosed DBDs was 3.5% for boys and 1.4% for girls. The yearly incidence rate increased for girls after 13 years of age, while the incidence for boys was relatively stable between 8 and 15 years of age. When we compared subjects born between 1996–1998 and 1999–2001, we found that by the age of 12, the cumulative incidence per 100 people had increased from 0.56 to 0.68 among girls and from 2.3 to 2.6 among boys. This indicated a minor increase in treated incidence. The parents of children diagnosed with DBDs had lower educational levels than the parents of controls. Children with DBD were also more likely to have been diagnosed with other psychiatric disorders.

Conclusion Although DBDs were 3.5 times more common among boys during the whole follow-up period, the yearly incidence during adolescence was fairly similar between boys and girls. DBD existed alongside various psychiatric disorders at a relatively young age and only a minor increase in treated incidence was found during childhood.

Keywords Register-based study · Oppositional defiant disorder · Conduct disorder · Disruptive behavior disorder · Co-morbidity

Abbreviations

CD	Conduct disorder
DBD	Disruptive behavior disorder
FHDR	Finnish Hospital Discharge Register
FCPR	The Finnish Central Population Register
HD	Hyperkinetic disorder
ICD	International Statistical Classification of Diseases and Related Health Problems
ODD	Oppositional defiant disorder
OR	Odds ratio
SES	Socioeconomic

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Introduction

Disruptive behavior disorder (DBD) can be characterized by different types of aggressive, disruptive, oppositional and anger-related behaviors. The two most studied forms are oppositional defiant disorder (ODD) and conduct disorder (CD). Conduct disorder is one of the most common psychiatric conditions in childhood, with an overall estimated prevalence of 3.2% [1]. DBD is more prevalent among boys

[2] and studies have strongly associated it with various adversities in later life [3, 4] A Finnish longitudinal population-based study of 6,000 children born in 1981 showed that conduct problems at the age of eight predicted a wide range of psychiatric disorders [5], suicides [6], substance abuse [7], criminality [8], poor physical fitness [9] and poor sense of coherence [10] in adulthood. Early recognition of conduct problems and comorbid conditions and multimodal interventions have been shown to improve the prognosis of DBD [11, 12]. Therefore, it is important to know the characteristics of the severe forms of DBD and acknowledge possible delays in diagnosis.

The population incidence of DBD is difficult to determine, as it has been reported that a large percentage of children with DBD do not use specialist services or even primary health care [13]. According to a face-to-face survey of more than 6000 people in the United States, people with more severe behavior disorders were likely to try to access treatment than those with milder forms, but only half of the patients with behavior disorders actually received treatment [14]. A large Danish register study [15] of 1.3 million subjects reported that 1.3% of boys and 0.5% of girls were diagnosed with CD or hyperkinetic CD by specialist centers before the age of 18. However, they did not assess the incidence of diagnosed mixed disorders of conduct and emotions.

The complex classification of disruptive behavior and conduct related disorders poses challenges when estimating the number of people with DBD who receive treatment and the number who have DBD as a comorbidity [16, 17]. Both ODD and CD are characterized by repetitive and persistent patterns of antisocial behaviors that fall outside socially accepted norms. These disorders partly share the same criteria, but CD is, by definition, a more severe form of DBD. Other disruptive behavior related disorders are hyperkinetic CD and mixed disorder of conduct and emotion. By definition, hyperkinetic CD meets the criteria for both CD and hyperkinetic CD, while mixed disorder of conduct and emotion meets the criteria of both CD and internalizing disorder [18].

In addition to the heterogeneous clinical presentations within DBDs, high rates of comorbidities for various mental disorders have been noted among subjects with DBDs [5, 19]. There is evidence that childhood onset CDs have higher psychiatric comorbidities and more persistent symptoms than adolescence onset CDs [20, 21]. It has also been shown that early onset DBD patients are less likely to respond to treatment in adolescence than those with later onset [22]. There have been a lack of studies that have separately examined hyperkinetic CD and mixed disorder of conduct and emotions and the results have been inconsistent [23, 24]. Gender differences in the prevalence, comorbidity and the age of the onset of CDs have been reported, but the results have also been inconsistent. It has been suggested that girls with CDs have a relatively higher risk for comorbid disorders than boys [25] and have relatively more adolescence onset conduct disorders [15]. However, it has also been shown that CD has been strongly associated with internalizing disorders in boys [26], and that childhood onset CD might be under-recognized in girls. [27]

In summary, current knowledge of DBDs suggests the need for early recognition and identifying the comorbid conditions for effective individual treatment plans. Therefore, it is important to study the distribution and age of diagnosis of DBDs in specialist centers.

The main objective of this study was to report the nationwide treated incidence and cumulative incidence and a possible time trend of DBD diagnoses by specialist centers of subjects aged 2–15 years of age born in Finland. There were three other objectives. The first was to report the distribution of different disruptive behavior disorders and comorbidities. The second was to study the overall associations between various sociodemographic factors and DBD, stratified by gender. The third was to examine whether the comorbidity and sociodemographic associations differed between CD and DBD by carrying out separate analyses for subjects with CD.

Methods

Data source

Data from the Finnish Hospital Discharge Register (FDRH) and the Finnish Central Population Register (FCPR), Finnish Medical Birth Register (FMBR) and Statistics Finland were used in the study. The FDHR was used to identify the children and adolescents diagnosed with DBDs or intellectual disabilities and to obtain data on potential confounders. The Register covers all medical diagnoses made for those receiving inpatient care in hospitals, health centers with wards, military wards, prisons and private hospitals. Hospital outpatient visits have also been covered since 1998. The Register includes the unique personal identity codes issued to every Finnish resident, admission and discharge dates, the primary diagnosis at discharge and any subsidiary diagnoses. The diagnostic classifications have been based on the International Classification of Diseases, Tenth Revision (ICD-10) since 1 January 1996. The FCPR contains the basic information about Finnish residents and foreign citizens living permanently in Finland. The data includes their name, address, personal identity code, citizenship, native language, family members and dates of birth and death. The FMBR contains detailed data on all pregnancies, births and neonatal periods until 7 days of age and data on maternal socioeconomic status. Statistics Finland contains information about yearly birth rates and people who have emigrated

to Finland and it was used to determine the risk population. Detailed information of these registers has previously been described [28]

Identification of cases and controls

The sample was based on all singleton children born live in Finland between 1 January 1996 and 31 December 2005 with an ICD-10 diagnosis F90.9, F91.x, and F92.x. To study if there is a certain time trend in incidence of DBD, the sample was split into three cohorts: 1996–1998, 1999–2001 and 2002–2005. The youngest cohort was chosen to be 1 year wider because of shorter follow up and hence fewer cases. The exclusion criteria for cases were ICD-10 diagnoses of F72.x and F73.x. The controls were identified from the FMBR and the aim was to find four controls for each case. They were matched by date of birth (±30 days), sex and place of birth. Controls were excluded if they had an ICD-10 diagnosis of F72.x, F73.x, F90.x, F91.x, or F92.x. All the cases and controls were observed from their date of birth to the end of study, which was 31 December 2011. We identified 7,050 individuals with DBD and there were 26,804 controls after the exclusion criteria were applied.

Grouping of disruptive behavioral disorders

The grouping for different DBDs was made by the ICD-10 diagnoses set in specialized centers. For the not mutually exclusive distribution we identified DBD diagnosis from FHDR separately for boys and girls and for the mutually exclusive groups of DBD we create four groups, as shown in Table 1. In one group were children who had been diagnosed with any DBD diagnosis and also both internalizing and hyperactive disorder. The diagnosis mixed disorder of conduct and emotion was by its definition intrinsically both internalizing and disruptive and hyperkinetic conduct disorder was both hyperactive and disruptive. The possible comorbid disorders for belonging internalizing group were examined by the ICD-10 diagnoses: Mood disorders (F30-F39) Neurotic, stress-related and somatoform disorders (F40-F48) and emotional disorders with onset specific to childhood (F93). Belonging to a hyperactive group was determined by presence of diagnosis F90.

Comorbidity analyses

The comorbid psychiatric diagnoses of the subjects were obtained from the FHDR according to ICD-10 (F10-F99). Psychiatric conditions with onset typically in adulthood and mental retardation (F70-F79) were excluded. The full list with diagnosis codes is seen in Table 1. The comorbidity analysis was restricted to the oldest cohort only due to a relatively young age of the subjects and the comorbid conditions being mainly disorders with onset in adolescence or adulthood.

Measures

Sociodemographic variables were obtained through linkage via the FCPR to the biological mother and data was obtained from the FMBR. Parental SES variable has been categorized into four classes; upper white collar (e.g., professional and administrative), lower white collar (e.g., office labourer), blue collar (manual labourer) and others (e.g., students, unemployed and entrepreneurs). Information on psychiatric disorders was obtained from FHDR. The list of these outcomes is presented in Tables 1–4.

Statistical analyses

To estimate the treated incidence and cumulative incidence of conduct disorder we used as the denominator population who was born alive in Finland and not emigrated at the end of 2011. The outcome was the diagnosis of DBD in specialized psychiatric services after 2 years of age and before the end of the follow up. First, the cumulative incidence was calculated for any DBD-diagnosis and for boys and girls separately adding the number of new DBD-diagnosis cases per 100 persons at risk for every cohort from age 2 to the end of the follow up. The age of onset was defined as the time from birth to the first register-based diagnosis of any DBD. Second, we examined the distribution of different DBD-diagnoses between boys and girls restricting to the oldest cohort. The age range was from 13 to 15. Separate analyses were conducted for cases with CD compared to the DBD group. The denominator when calculating the when calculating the incidence of the register-based diagnosed DBD (or CD) was the number of persons born in Finland and not diagnosed with DBD (or CD), dead or emigrated before the age in question. The cumulative incidences were calculated per 100 children, equaling 1 minus Kaplan–Meier estimate. Associations between socioeconomic level (SES), maternal education, marital status and psychiatric outcomes were analyzed with conditional logistic regression analysis. Results are presented as odds ratios (OR) with 95% confidence intervals. For testing, we used two-sided p-values at a 0.05 significance level. Statistical analyses were performed with SAS version 9.4 (SAS institute, Cary, NC, United States).

Results

Cohort characteristics

The source population of this study comprised 570 815 children. A total of 7050 children were diagnosed with DBDs

Table 1 Distribution and classification criteria for different DBD groups and comorbidity

Form of DBD	ICD-10 codes
Distribution analyses criteria for not mutually exclusive analyses of DBD	
Conduct disorder	F91
Family context	F91.0
Unsocialized	F91.1
Socialized	F91.2
Other or unspecified CD	F91.8 or F91.9
ODD	F91.3
Mixed disorders of conduct and emotions	F92
Hyperkinetic conduct disorder	F90.1
Distribution analyses criteria for mutually exclusive groups	
Internalizing and hyperactive disruptive disorder	(F91.0 OR F91.1 OR F91.2 OR F91.3 OR F91.8 OR F91.9 OR F92) AND (F30-F48 OR F93) AND (F90.1 OR F90.0 OR F90.8 OR F90.9) OR F92 AND (F90.1 OR F90.0 OR F90.8 OR F90.9) OR F90.1 AND (F93 OR F30-F48)
Internalizing disruptive disorder, without hyperactivity disorder	(F91.0 OR F91.1 OR F91.2 OR F91.3 OR F91.8 OR F91.9 OR F92.X) AND (F30-F48 OR F93) AND NOT (F90.1 OR F90.0 OR F90.8 OR F90.9) OR F92 AND NOT (F90.1 OR F90.0 OR F90.8 OR F90.9)
Hyperactive disruptive disorder, without internalizing disorder	(F91.0 OR F91.1 OR F91.2 OR F91.3 OR F91.8 OR F91.9) AND (F90.0 OR F90.1) AND NOT (F30-F48 OR F93 OR F92) OR (F90.1) AND NOT (F30-F48 OR F93 OR F92)
Conduct disorder, without internalizing disorder or hyperactivity disorder	(F91.0 OR F91.1 OR F91.2 OR F91.8 OR F91.9) AND NOT (F90.0 OR F90.1 OR F90.8 OR F90.9 OR F30-F48 OR F93 OR F92)
Oppositional defiant disorder only	F91.3 AND NOT (F91.0 OR F91.1 OR F91.2 OR F91.8 OR F91.9 OR F90.0 OR F90.1 OR F90.8 OR F90.9 OR F30-F48 OR F93 OR F92)
Criteria for comorbidity analyses	
Substance misuse	F10-F19
Psychotic	F2
Mania and bipolar	F30, F31
Depression	F32-F34
Anxiety	F4
OCD	F42
PTSD	F431
Eating disorders	F50
Sleep disorders	F51
Learning and coordination	F80-F83
Pervasive developmental disorders	F84
ADHD	F900
Other childhood onset disorders	F93-F94

DBD disruptive behavior disorder, *CD* conduct disorder, *ODD* oppositional defiant disorder, *OCD* obsessive–compulsive disorder, *PTSD* post-traumatic stress disorder, *ADHD* attention deficit hyperactivity disorder

between ages 2 and 15 years. Among them, 5503 (78%) were boys and 1547 (22%) were girls corresponding to a 3.5:1 ratio.

Figure 1 shows the incidence of DBDs diagnosed by specialist services and that boys had a higher incidence rate than girls. It also shows that the incidence for boys increased rapidly after 4 years of age and reached 0.41/100 people per year by the age of nine. After 12 years of age the incidence showed a slight decrease. The incidence for girls increased moderately until 13 years of age, to reach 0.13/100 people per year. By the time the girls had reached 14–15 years, they were displaying greater incidence rates than boys. At the age of 15 the incidence of diagnosed DBDs was 0.41/100 people per year for the girls and 0.29/100 people per year for the boys. Supplementary 5 shows the overall treated cumulative incidence, indicating

3.5% cumulative incidence for boys and 1.4% cumulative incidence for girls at the age of 15.

When the cumulative incidence of diagnosed DBDs was grouped by birth years, as shown in Fig. 2, it showed that the cumulative incidence up to the age of 12 was lower for the oldest cohort (1996–1998) compared to the last two cohorts (1999–2001 and 2002–2005). For example, the cumulative incidence at the age of 12 years was 0.56/100 for the girls born between 1996–1998 and 0.68/100 for the 1999–2001 cohort. The correspondingly rates for the boys were 2.3/100 and 2.6/100.

Analysis of sociodemographic factors

Table 2 shows that lower maternal SES was a significant risk factor for DBD. When they were compared to the children of mothers in the upper white collar group, the children in all the other SES groups had a 1.4–1.5 fold increased odds for a DBD diagnosis.

Parental education at birth was also a significant risk factor. Girls who were born to mothers with no secondary education had an OR of 3.9 for having a CD compared to girls whose mothers were educated to Master´s degree or PhD level when they were born. The equivalent OR for the boys was 3.1. Both ORs were statistically significant, but the difference between the genders was not. When we examined paternal education levels we found similar and statistically significant results compared to maternal education levels. Using the same comparative criteria produced ORs of 2.8 for girls born to less educated mothers and 3.0 for boys. The difference between the genders was not statistically significant.

Distribution of diagnoses and comorbidity

We restricted the distribution and comorbidity analysis to the oldest subgroup, which was born between 1996 and 1998 and this showed that 3,545 individuals had been diagnosed with DBD. Of these, 75.9% ($n=2689$) were boys and 24.1% ($n=856$) were girls corresponding a boy: girl ratio of 3:1.

When we inspected the not mutually exclusive distribution of DBD (Table 3), the majority of this subgroup, 2459/3545 (69.4%), had been diagnosed with mixed disorders of conduct and emotions, 366 (10.3%) with ODD, 1047 (29.5%) with CD and 646 (18.2%) with hyperkinetic conduct disorder diagnosis. The CD diagnoses were examined separately and most of the CD diagnoses were categorized as other or unspecified. Boys had significantly more hyperkinetic conduct disorder diagnoses than girls.

Because of the complexity of the combination diagnoses and simultaneous diagnoses, we also created distribution

Table 2 Sociodemographic factors at birth in the 1996–2005 cohort

	Boys					Girls				
	Cases (5503)	Controls (20,870)	OR	95% CI	*p*	Cases (1548)	Controls (5933)	OR	95% CI	*p*
Maternal SES at birth										
Upper white collar worker	420	3463	1			116	978	1		
Lower white collar worker	1845	8667	1.1	(1.0–1.2)	0.16	502	2453	1.0	(0.8–1.3)	0.84
Blue collar worker	1197	3311	1.4	(1.2–1.6)	<.0001	359	948	1.4	(1.1–1.9)	0.02
Other groups or missing[a]	2041	5429	1.5	(1.3–1.7)	<.0001	571	1554	1.5	(1.1–1.9)	0.008
Maternal education at birth										
Master/PhD	244	2541	1			67	758	1		
College/Bachelor	911	6161	1.2	(1.0–1.4)	0.11	268	1699	1.5	(1.1–2.2)	0.02
Secondary	2322	8995	1.5	(1.3–1.9)	<.0001	634	2599	1.8	(1.3–2.6)	0.001
Basic or no education[b]	2026	3173	3.1	(2.5–3.7)	<.0001	579	877	3.9	(2.7–5.7)	<.0001
Paternal education at birth										
Master/PhD	240	2471	1			73	735	1		
College/Bachelor	552	4386	1.1	(0.9–1.4)	0.17	152	1140	1.1	(0.8–1.5)	0.64
Secondary	2520	9799	1.8	(1.6–2.2)	<.0001	704	2827	1.7	(1.2–2.3)	<0.001
Basic or no education[c]	2191	4214	3.0	(2.5–3.6)	<.0001	619	1231	2.8	(2.0–3.9)	<0.001

ORs from multivariable conditional regression analysis between DBD diagnosed children and control group, bolding indicating statistical significance

OR odds ratio, *CI* confidence interval, *SES* socioeconomic status, *DBD* disruptive behavior disorder

[a]Number of missing maternal SES information for boys was 678 (2.6%) and for girls 197 (2.6%)

[b]Number of missing maternal education information for boys was 3 (<0.1%) and for girls 2 (<0.1%)

[c]Number of missing paternal education information for boys was 533 (2.0%) and for girls 174 (2.3%)

Table 3 Not mutually exclusive distribution of disruptive behavior diagnosis in the 1996–1998 cohort

	Total *n*	%	Boys *n*	%	Girls *n*	%
Conduct disorders	1047	29.5	789	29.3	258	30.1
Family context	217	6.1	162	6.0	55	6.4
Unsocialized	145	4.1	119	4.4	26	3.0
Socialized	147	4.1	100	3.7	47	5.5
Other or unspecified CD	696	19.6	528	19.6	168	19.6
ODD	366	10.3	264	9.8	102	11.9
Mixed disorders of conduct and emotions	2459	69.4	1885	70.1	574	67.0
Hyperkinetic conduct disorder	646	18.2	571	21.2	75	8.8

Classification criteria are shown in Table 1

ODD oppositional defiant disorder

Table 4 Mutually exclusive groups of disruptive disorders in the 1996–1998 cohort

	Total n	%	Boys n	%	Girls n	%
Internalizing and hyperactive disruptive disorder	897	25.3	791	29.4	106	12.4
Internalizing disruptive disorder, no hyperactivity disorder	1928	54.4	1344	50.0	584	68.2
Hyperactive disruptive disorder, no internalizing disorder	357	10.1	310	11.5	47	5.5
Conduct disorder, without internalizing or hyperactivity	278	7.8	197	7.4	81	9.4
Oppositional defiant disorder only	85	2.4	47	1.8	38	4.4
Total:	3545	100	2689	100	856	100

Classification criteria are shown in Table 1

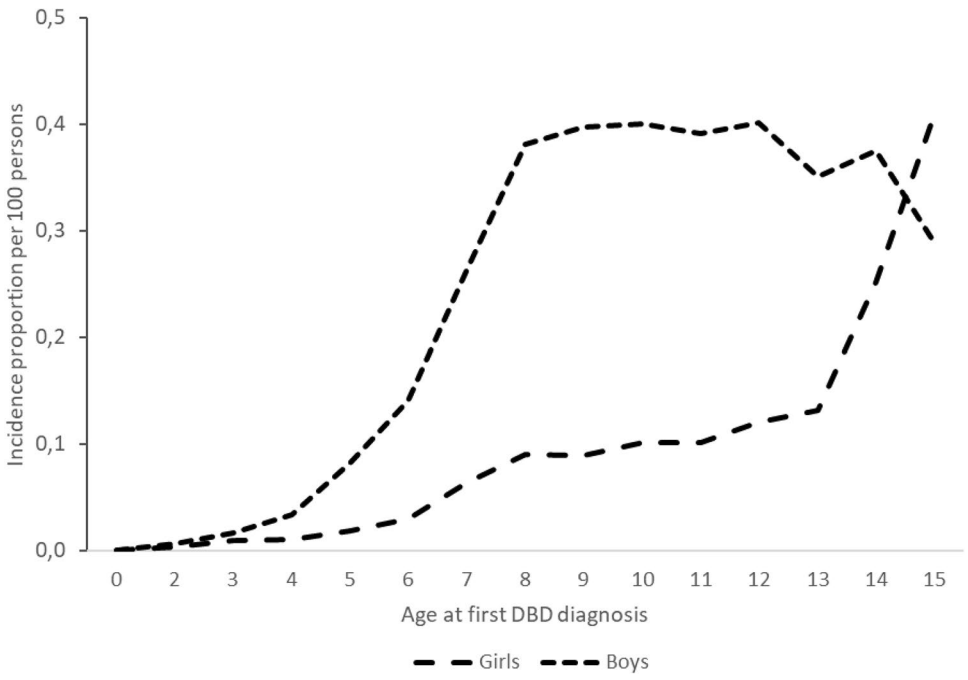

Fig. 1 Treated yearly incidence of disruptive behavioral disorders (DBD) by the age of the first DBD diagnosis among boys and girls born in Finland in 1996–2005

analyses for the mutually exclusive groups. Based on this classification, nearly eight put of 10 of the children and adolescents diagnosed with DBDs had simultaneous internalizing disorder or mixed disorder of conduct and emotions (Table 4). It was notable that only one out of 10 subjects only had an ODD or CD diagnosis without any internalizing, hyperactive or combination diagnosis. The proportions of internalizing disorders were similar between the genders, although boys had relatively more comorbid hyperactive disruptive behavior disorders (40.5% vs. 17.9%). Girls also had significantly higher percentages of pure conduct disorder diagnoses than boys ($p = 0.043$) and relatively more

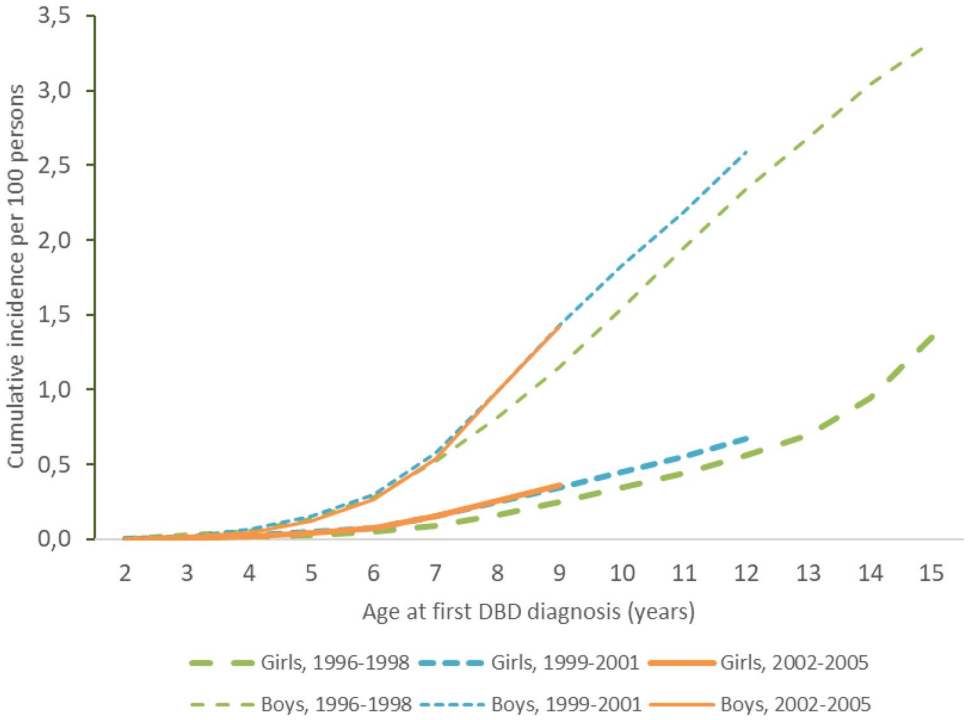

Fig. 2 Time trend of treated yearly cumulative incidence of disruptive behavioral disorders (DBD) by the age of first DBD diagnosis among boys and girls in Finnish population

conduct disorders without internalizing or hyperactive disorders ($p = 0.027$) and ODD ($p < 0.0001$).

As shown in Table 5, DBD diagnoses made in specialist centers were highly associated with a variety of different psychiatric diagnoses at a young age. Both boys and girls with DBD displayed strong associations with substance misuse, psychotic disorder, depression, attention deficit hyperactivity disorder and other childhood onset disorders, anxiety, post-traumatic stress disorder, sleep disorders, learning and coordination and autism spectrum disorders.

Table 5 Comorbidity of children diagnosed with DBD born in 1996–1998

	Boys					Girls				
	Cases (2689)	Controls (10,193)	OR	CI 95%	*p*	Cases (856)	Controls (3274)	OR	CI 95%	*p*
Substance misuse	44	19	4.9	2.3–10.5	< .0001	40	8	19.0	6.3–57.3	< .0001
Psychotic	60	9	14.9	5.6–39.5	< .0001	25	1	14.0	1.7–117	0.02
Mania & bipolar	34	7	4.8	1.4–16.4	0.012	10	1	2.7	0.3–27.9	0.40
Depression	473	102	13.7	10.2–18.4	< .0001	233	63	13.1	8.5–20.1	< .0001
Anxiety	106	71	2.0	1.3–3.0	0.002	79	34	2.6	1.4–4.9	0.003
OCD	42	17	2.1	0.9–5.0	0.079	28	6	5.9	1.9–18.4	0.002
PTSD	53	15	6.0	2.8–12.5	< .0001	35	10	6.3	2.1–19.4	0.001
Eating disorders	22	13	1.2	0.4–3.3	0.78	31	26	2.3	0.9–5.9	0.079
Sleep disorders	68	59	3.4	1.9–5.8	< .0001	18	20	2.7	1.0–6.7	0.04
Learning and coordination	812	688	2.9	2.4–3.4	< .0001	159	93	3.6	2.3–5.6	< .0001
Pervasive developmental disorders	293	112	2.8	2.0–3.9	< .0001	62	9	21.9	6.2–77.5	< .0001
ADHD	1034	222	18.6	15.0–23.0	< .0001	132	12	36.6	16.0–84.0	< .0001
Other childhood onset disorders	951	401	8.2	6.8.9.8	< .0001	337	94	12.4	8.7–17.6	< .0001

For the criteria of classification see Table 1. ORs are calculated using conditional logistic regression

OR odds ratio, *CI* confidence interval, *SES* socioeconomic status, *DBD* disruptive behavior disorder, *OCD* obsessive–compulsive disorder, *PTSD* post-traumatic stress disorder, *ADHD* attention deficit hyperactivity disorder

Additional analyses

We repeated the analyses by examining CD instead of DBD to show a possible difference in incidence rates or comorbidity in adolescence compared to the DBD group. The CD group was chosen due to most severe prognosis and a larger number of cases compared to other subgroups. The incidence rates among the CD group increased later and resulted in a higher median age at diagnosis. The median ages for a DBD diagnosis in the whole cohort were 9.7 for boys and 10.9 for girls. The median ages for a CD diagnosis were 10.9 for boys and 12.4 for girls. The treated incidences for CD are shown in Supplementary Figures 1 and 2. Cumulative incidence rates for pure conduct disorder by the age of 15 were 1.14% among boys and 0.48% among girls.

The additional analysis showed similar results for CD diagnoses and overall DBD, with wider confidence intervals in sociodemographic and comorbidity analyses. No significant interactions between DBD and CD were found with regard to sociodemographic factors or comorbidity, as seen in Supplementary Tables 1 and 2.

Discussion

The study had four main findings. First, DBD is a relatively common diagnosis in Finnish specialist services and there were notable gender differences in the age of peak incidences and the cumulative incidences by the age of 15 years. Second, the time-trend analysis showed a slight increase in treated incidence. Third, children with DBD were more likely to display a range of other disorders, including depression, psychotic disorders and substance abuse. Fourth, lower SES and parental educational level were associated with increased odds of DBD.

As well as finding that DBB was a relatively commonly diagnosis in Finnish children and adolescents seen by specialist services, we found that the cumulative incidence rates were higher among boys (3.5%) than girls (1.4%) by the age of 15. Our findings were in line with the treated incidence of CD and hyperkinetic conduct disorder in a Danish cohort study [15]. They showed that by the age of 15 the cumulative incidence rates for ODD or CD or hyperkinetic conduct disorder were 1.1% among boys and 0.3% among girls. However, they did not report mixed disorders of conduct and emotions. In our study cumulative incidence rates for pure conduct disorder by the age of 15 were 1.1% among boys and 0.5% among girls, showing exceedingly similar yearly incidences except in our sample the incidence peaked higher in early adolescence among girls.

The global prevalence of CD is estimated to be 3% [1, 2]. Our study showed that the treated cumulative incidence for CD in Finland at the age 15 years was less than 1%. This might indicate that there is an unmet need for access to the specialist services and delayed diagnoses. The incidence and prevalence rates for mixed disorder of conduct and emotions have not generally been reported at a population level, although high frequencies have been noted in many studies [11]. Our gender analysis showed that girls were diagnosed with DBD mostly in adolescence, while the treated incidence for boys was increasing until 8 years and then remained rather stable. The treated incidence for CD showed later onsets for both genders. The gap between the incidence rates peaked for girls and boys were notable. In our sample girls were generally diagnosed later in every studied DBD category. Previous studies have also questioned if the diagnostic threshold for girls with conduct problems should be lowered for greater sensitivity [27].

Our time-trend analysis showed slight increases in treated incidence between the oldest sub-cohort (1996–1998) and two youngest cohorts (1999–2001 and 2002–2005). From 2 to 7 years of age the incidence rates remained similar, but at 12 years of age the cumulative incidence rates were about 10% higher in the 1999–2001 sub-cohort compared to the 1996–1998 sub-cohort among both girls and boys. However, the incidence rates were similar between the last two cohorts and this showed that there were no changes in time-trends between 1999 and 2005.

Our mutually exclusive distribution showed that conduct disorders without hyperactivity or internalizing disorder accounted for just a fraction of all the children with DBDs diagnosed in specialist centers. This might be explained by the presence of comorbidities, but we should also question if access to services in childhood was driven by comorbid conditions. Our overall findings for later median ages and peak incidences for pure conduct disorder, compared to DBDs, support this view. Nevertheless, our findings showed that children diagnosed with DBD often had emotional and stress related problems that were above the diagnostic threshold. This should be taken into account when planning early interventions and preventions for DBD patients.

Children diagnosed with DBDs also had a higher risk for a variety of other psychiatric disorders when they were compared to the controls in the studied subgroup. Even relatively rare events in early adolescence, such as psychotic disorders, were highly and significantly associated with DBD. Comorbidity analyses showed no statistically significant differences between genders or between DBD and pure CD.

Analyses of sociodemographic factors showed significant associations between higher parental education or SES and a lower risk of CD or DBD in their offspring. Sociodemographic analyses showed similar risks for DBD and CD. The fact that we did not find any significant differences between CDs and other DBDs with regard to comorbidities or sociodemographic factors might indicate that the current classification of these conditions is vague. [16, 29, 30].

Strengths and limitations

The strengths of our nationwide study included the large number of subjects and the fact that we could link data between national registers. There were also some limitations that should be noted when interpreting our findings. First, the diagnoses were based on national Finnish registers and DBD diagnoses have not been validated in the Finnish Care Register for Health Care. However, several other psychiatric disorders including ADHD, [31] autism [32] and schizophrenia [28], have shown good validity in the Care Register. Second, because the diagnoses were made in specialist centers, we can presume that that children with relatively mild behavioral problems, and no comorbid conditions, did not access specialist care [13, 14]. This means that our results represent the treated incidence and cannot be interpreted as the population-based incidence. Third, the current Tenth Revision of the International Classification of Diseases is challenging when it comes to recognizing and studying comorbid conditions. Mixed disorders of conduct and emotions is already, by definition, a comorbid state that includes conduct disorder and depression and clinicians may not agree on diagnoses. Therefore, caution is needed when interpreting the results between different subtypes of CD and DBD, because the diagnoses were based only based on the registers. In addition, the current classification of diseases meant that we had no opportunity to study callous-unemotional traits.

Conclusions

This nationwide sample showed significant differences in the age when boys and girls were first diagnosed. These suggest under recognition or delayed onset among girls with CDs. DBD was also shown to be highly comorbid to various psychiatric disorders at a relatively young age. This finding supports the use of multimodal treatment plans that address several psychiatric conditions at the same time. Finally, time-trend analyses showed slight increases in DBDs diagnosed in childhood, which were probably due to improvements in early recognition over the course of the study period.

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Author contributions JU, LK, MG. DG, SH and AS designed the study. SH and EH carried out the statistical analyses. JU drafted the initial report. All the authors contributed to the interpretation of the data, drafted the manuscript and approved it for submission.

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Data availability The datasets analyzed during the current study are not publicly available, as a condition of the authorization and ethical approval of the study.

Compliance with ethical standards

Conflict of interests On behalf of all authors, the corresponding author states that there is no conflict of interest.

Ethics approval and consent to participate The study was approved by the ethics committees of the hospital district of Southwest Finland (111/180/2008) and the Finnish Institute for Health and Welfare.

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