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Mheen, M. van der; Zijlmans, J.; Doelen, M. van der; Klip, H.; Lans, R.M. van der; Ruisch, I.H.; ... ; Polderman, T.J.C.

NEW RESEARCH

Patterns of Mental Disorders in a Large Child Psychiatric Sample (N = 65,363): A DREAMS Study

Malindi van der Mheen, PhD,* Josjan Zijlmans, PhD,* Daniël M. van der Doelen, MSc, Helen Klip, PhD, Rikkert M. van der Lans, PhD, I. Hyun Ruisch, MD, PhD, Ymkje Anna de Vries, PhD, Jacintha M. Tieskens, PhD, Marleen Wildschut, PhD, Jan K. Buitelaar, MD, PhD, Pieter J. Hoekstra, MD, PhD, Ramón J.L. Lindauer, MD, PhD, Arne Popma, MD, PhD, Robert Vermeiren, MD, PhD, Emma M. Broek, MSc, Tycho J. Dekkers, PhD, Andrea Dietrich, PhD, Irma M. Hein, MD, PhD, Marjolein Luman, PhD, Maaike H. Nauta, PhD, Lucres M.C. Jansen, PhD, Lian Nijland, PhD, Sara Pieters, PhD, Wouter Staal, MD, PhD, Tinca J.C. Polderman, PhD

*Malindi van der Mheen and Josjan Zijlmans are co–first authors of this work.

Objective: To provide a comprehensive overview of the prevalence and comorbidity patterns of mental disorders in a large child and adolescent psychiatry sample.

Method: Data on *DSM* diagnoses were retrieved from medical records of children (0.5-18 years old) who received care at a DREAMS center between 2015 and 2019. DREAMS is a consortium of 4 academic centers for child and adolescent psychiatry in the Netherlands that provide both outpatient and inpatient care. Diagnoses were assigned in regular clinical practice.

Results: Between 2015 and 2019, 65,363 children received care at a DREAMS center (mean [SD] age at admission = 10.8 [4.1] years; 60.7% male). Of these children, 46,762 (71.5%) had a registered *DSM* disorder. The most prevalent primary diagnoses were autism (34.6%), attention-deficit/hyperactivity disorder (24.6%), and trauma and stressor-related disorders (8.4%). Approximately half of all children (47.2%) had at least 1 comorbid diagnosis, of which intellectual disabilities were the most prevalent (29.5%).

Conclusion: Diagnostic patterns across sex and age as well as comorbidity patterns were generally consistent with previous research, but the prevalence of autism and attention-deficit/hyperactivity disorder was higher than in other studies. Real-world diagnostic information such as presented here is essential to understand the use of *DSM-5* in clinical practice, put differences between contexts and countries into perspective, and ultimately improve our diagnostic protocols and treatments.

Plain language summary: This study analyzed data from the medical records of 65,363 children who received psychiatric care in the Netherlands between 2015 and 2019. The authors found that 71.5% of these children had a registered mental disorder, with the most common being autism (34.6%), followed by attention-deficit/hyperactivity disorder (ADHD) (24.6%) and trauma-related disorders (8.4%). In addition, nearly half of the children had at least one other co-occurring diagnosis, with intellectual disability being the most prevalent (29.5%). These diagnostic findings are essential in clinical practice, placing differences between contexts and countries into perspective, and ultimately improving our diagnostic protocols and treatments.

Key words: adolescent psychiatry; child psychiatry; comorbidity; diagnosis; prevalence

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Mental health problems are a leading cause of disability in children and adolescents (hereafter referred to as children), associated with significant impairment on both the individual and the societal level.[1] Comorbidity adds to this burden, as the co-occurrence of multiple mental disorders has even more negative implications for quality of life, prognosis, and functional outcomes. For example, children with attention-deficit/hyperactivity disorder (ADHD) and a comorbid mental disorder are more likely to have higher symptom severity, greater impairment, and poorer academic and behavioral outcomes (eg, delinquency) than children with ADHD alone.[2–4] Similarly, comorbidity with an anxiety disorder has been associated with lower quality of life, a higher risk of recurrence, suicidality, longer duration of the disorder, more impairment, and decreased treatment response.[5–8] In other mental disorders, similar negative implications of comorbidity have been found (eg, [9–12]).

In addition, comorbidity can be relevant to what type of treatment is most appropriate.[8,10,13,14] Therefore, from a clinical perspective, gaining insight into comorbidity of mental disorders in children is crucial. Doing so is also

fundamental from an epidemiological perspective to inform policies on general (nationwide) interventions, educational needs, protecting vulnerable groups, or clinical care. As most mental disorders emerge in childhood or adolescence,[15,16] understanding the epidemiology of comorbidity in children may also provide information on the etiology of mental disorders. Comorbidity patterns of mental disorders may be an indication of overlapping risk factors or shared etiology and may as such also inform potential shared treatment options.

Meta-analytical reviews show that mental disorders are somewhat common in children (13%-16% are estimated to have at least 1 diagnosis) and lead to shorter life expectancy, particularly when combinations of diagnoses are present.[17–19] In the past decades, studies examining specific mental disorders have shown that comorbidity rates are high.[20] For example, in autism spectrum disorder (ASD), reported prevalence rates of comorbidity of mental disorders in children vary from 41% to 92%, with the most frequently reported comorbid diagnoses being ADHD; anxiety disorders; intellectual disabilities; and disruptive, impulse-control, and conduct disorders. In ADHD, comorbidity rates are approximately 70%, mainly accounted for by disruptive, impulse-control, and conduct disorders; learning disorders; and anxiety and depressive disorders.[21,22] In other mental disorders, comorbidity also appears to be the rule rather than the exception. This seems to be more apparent in female participants than in male participants, and rates increase with age.[23] That is, comorbidity is more often seen in older children than in younger children.

Although previous studies have examined comorbidity in general population samples and selected samples with specific mental disorders, studies providing a comprehensive overview of comorbid mental disorders in a large clinic-referred sample of children who receive psychiatric care are lacking. Furthermore, comorbidity patterns vary widely among studies, and sample sizes generally are limited.[6,11,20,24–26] Therefore, the current study aimed to provide a comprehensive and ecologically valid overview of the prevalence and co-occurrence of mental disorders in a child and adolescent psychiatry sample that is large (N = 65,363), covers a period of multiple years (ie, 5 years), and represents large parts of the Netherlands. In addition, we aimed to examine differences in co-occurring mental disorders between age groups (ie, 0-12 years old vs 13-18 years old) and between male and female participants.

By providing a comprehensive overview of patterns of mental disorders in a large sample of children referred for psychiatric care, this study aids assessment of which expertise is needed in clinical practice, which educational needs should be addressed, and which policy changes may be useful to enhance efficiency of care. This study aims to provide insight into the complexities of mental diagnoses by assessing primary diagnoses, their associations with comorbid diagnoses, and their variation by age and sex in a large clinical child and adolescent sample. Ultimately, this study can be used to compare diagnoses across countries and, as such, feed the discussion on the use of *DSM-5* in clinical practice; put differences between contexts in perspective; and, in the long-term, help improve diagnostic protocols.

METHOD

Study Population

The current study used data from the DREAMS consortium. DREAMS is a consortium of 4 academic centers for child and adolescent psychiatry in the Netherlands: Accare, Karakter, Levvel, and LUMC Curium. There are a total of 7 Dutch academic centers for child and adolescent psychiatry. The 4 DREAMS centers mainly provide specialized care in both an outpatient and an inpatient setting to children with varying mental health problems in the north, east, and west of the Netherlands. Children can be referred to these centers by general practitioners, medical specialists (eg, pediatricians), and community mental health providers. Of all children (0-20 years old) in the Netherlands, approximately 90% live in the catchment area of a DREAMS center, covering both urban and rural regions.[27] More specifically, 2 centers are situated in generally urban areas, and 2 centers are situated in generally rural areas. We used data from electronic health records of all children (ages 6 months to 18 years at time of admission) who received care at a DREAMS center between 2015 and 2019 and merged the summary statistics of each DREAMS center for this study.

As data were retrieved from medical records, this study was not subject to the Dutch Medical Research Involving Human Subjects Act, as confirmed by the Medical Ethical Committee of the Amsterdam UMC. Patients and their legal caregivers were informed that data collected within the framework of regular care could be used for scientific research.

Diagnosis of Mental Disorders

DSM-IV-TR and DSM-5 Diagnoses. Diagnoses of mental disorders (ie, *DSM* codes) were retrieved from electronic health records. Mental disorders were classified by licensed child and adolescent psychiatrists and clinical psychologists according to *DSM-IV-TR*[28] or *DSM-5*[29] criteria following standard diagnostic procedures. That is, diagnoses were made in regular clinical practice following diagnostic procedures using semistructured interviews, structured diagnostic interviews, observations, or questionnaires at the discretion of the psychiatrist or psychologist. In general, in

2015 and 2016, mental disorders were diagnosed according to *DSM-IV-TR* criteria. From 2017 through 2019, *DSM-5* criteria were used. However, if a child had only a *DSM-5* diagnosis in 2015 or 2016 or had only a *DSM-IV-TR* diagnosis in 2017 through 2019, we used the available diagnosis. For *DSM-IV-TR*, we included only Axis I, II, and IV to exclude general medical conditions as well as the global functioning scale, which does not exist in *DSM-5*.

Primary and Comorbid Diagnoses. We distinguished between primary and comorbid diagnoses. According to *DSM-5*, the primary diagnosis concerns the mental health problems that are the main focus of clinical attention. We defined comorbid diagnoses as all nonprimary diagnoses registered in a patient's electronic health record between 2015 and 2019.

In general, mental health professionals explicitly defined in a child's electronic health record which diagnosis was the primary one. The DREAMS centers use different electronic health record systems, and one of the systems did not allow for differentiation between primary and comorbid diagnoses. In this case, if a child had more than 1 diagnosis, we considered the diagnosis listed first to be the primary one, as per *DSM-5* guidelines.

If more than 1 primary diagnosis was registered for a child, we selected the most recently registered primary diagnosis. We labeled the other diagnosis or diagnoses as comorbid. If 2 or more primary diagnoses were registered for a child on the same date, a computer algorithm randomly selected one of these diagnoses as primary. Again, we labeled the other diagnosis or diagnoses as comorbid.

Harmonizing *DSM-IV-TR* and *DSM-5* Diagnoses

To harmonize *DSM-IV-TR* and *DSM-5* diagnosis codes, we categorized all diagnoses following *DSM-5* diagnostic classes. First, all *DSM-IV-TR* and *DSM-5* diagnoses were recoded into more generic *DSM* diagnoses to exclude subtypes and specifiers (see step 1 in Table S1, available online, for an example). Subtypes refer to mutually exclusive subgroups within a diagnosis (eg, recurrent major depressive disorder vs single episode of major depressive disorder). Specifiers are not mutually exclusive and provide more information on descriptive features of a diagnosis, such as onset and severity (eg, early onset, severe, with atypical features).

Second, we recoded the diagnoses into broader *DSM-5* diagnostic classes (see step 2 in Table S1, available online, for an example). Considering the high prevalence of neurodevelopmental disorders in children and adolescents, we divided the *DSM-5* diagnostic class into the following subclasses: intellectual disabilities, ASD, ADHD, and other neurodevelopmental disorders (ie, communication disorders, specific learning disorder, motor disorders, and other neurodevelopmental disorders). Of note, "other mental disorders" refers to the *DSM-5* diagnostic class (ie, including the diagnoses other mental disorders, other specified mental disorder due to another medical condition, unspecified mental disorder due to another medical condition, other specified mental disorder, and unspecified mental disorder).

Third, we removed duplicate *DSM-5* diagnostic classes for the same patient as it was unclear whether duplicates represented actual comorbidity (eg, multiple specific phobias for the same patient), were due to changes in an individual's mental health problems over time (eg, major depressive disorder vs major depressive disorder in remission), were due to changes in diagnostic view of a mental health professional (eg, ADHD hyperactive-impulsive type vs ADHD combined type), or were due to registration errors.

Fourth, we constructed an overview of primary and 5-year (ie, 2015 through 2019) comorbid *DSM-5* diagnostic classes. For privacy reasons, we included only primary *DSM-5* diagnostic classes that occurred at least 50 times in our sample.

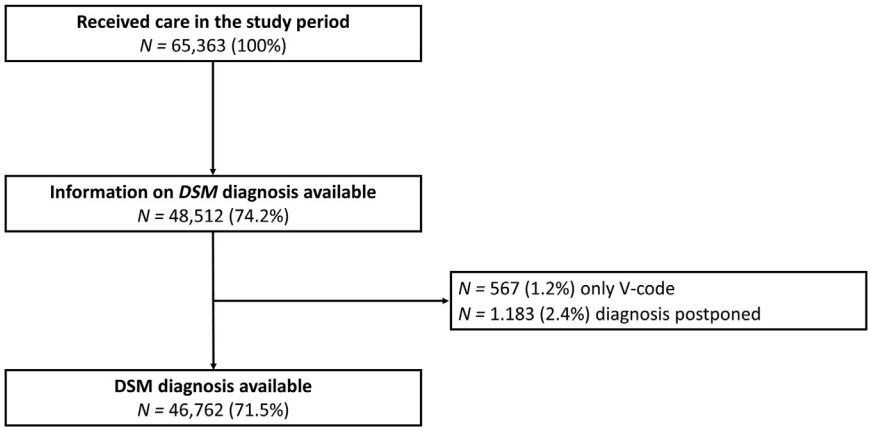
RESULTS

Sociodemographic Characteristics

A flowchart of the study sample is presented in Figure 1. Between 2015 and 2019, 65,363 children ages 0.5 to 18 years received care at a DREAMS center. Information on *DSM* disorders was available for 48,512 children (74.2%). Information on *DSM* disorders was missing due to lack of requirement of registration and administrative errors. Of these 48,512 children, 567 (1.2%) had only a registered V-code in their medical record (ie, other conditions that may be a focus of clinical attention, such as relational or educational problems). Furthermore, in the medical records of 1,183 children (2.4%), it was registered that the *DSM* diagnosis had been postponed (ie, the clinician did not have sufficient information yet to assign a diagnosis). Therefore, 46,762 of 65,363 children (71.5%) had a registered *DSM* disorder. The mean (SD) age was 10.8 (4.1) years at time of admission (range 0.5-17.9 years), and 61.9% were male. At time of admission, mean (SD) age of male participants was 10.0 (3.9) years (range 0.6-17.9 years), and mean (SD) age of female participants was 12.2 (4.0) years (range 0.5-17.9 years). Sociodemographic characteristics of the study sample are presented in Table 1.

To examine group differences in sociodemographic characteristics between children with a registered *DSM* diagnosis and children without a registered *DSM* diagnosis,

FIGURE 1 Study Sample Flowchart



Note: *All reported percentages represent the proportion of the total population that received care in the study period 2015-2019 (ie, N = 65,363).*

we conducted a *t* test for the continuous variable age and χ^2 tests for categorical variables (ie, sex, birth country, and degree of urbanization). As shown in Table 1, all group differences were statistically significant. However, the effect sizes indicated negligible differences between the groups.

Primary and Comorbid Diagnoses

Total Sample. Figure 2 shows the prevalence of primary and comorbid diagnoses in the total sample. The complete numbers behind Figure 2 can be found in Table S2, available online. The most prevalent primary diagnoses were ASD (34.6%), ADHD (24.6%), and trauma and stressor-related disorders (8.4%). Primary diagnoses that occurred <50 times in our sample and that were not included in the results were bipolar and related disorders, dissociative disorder, medication-induced movement disorder, neurocognitive disorder, paraphilic disorder, sexual dysfunction, and sleep-wake disorder (n = 133).

As mentioned in "Methods," if more than 1 primary diagnosis was registered for a child within the study period, we selected the most recently registered primary diagnosis and labeled the other diagnosis or diagnoses as comorbid. More than 1 primary diagnosis was registered for 4,820 children (10.3%). We performed a sensitivity analysis to assess if there were substantial differences in diagnoses when excluding these children. We found no substantial differences between groups. See Table S3, available online, for details. Furthermore, the electronic health record system of 1 site did not allow for differentiation between primary and comorbid diagnoses. Of all children with a registered *DSM* classification, 4,031 children (8.6%) received care at this center. We performed a sensitivity analysis to assess if there were substantial differences in diagnoses when excluding this center. We found no substantial differences between groups. See Table S4, available online, for details.

Approximately half of the children (47.2%) had 1 or more comorbid diagnoses. Of all children, 32.3% had 1 comorbid diagnosis, 11.3% had 2 comorbid diagnoses, and 3.6% had 3 or more comorbid diagnoses. Furthermore, 28.2% had at least 1 V-code in addition to a mental disorder diagnosis (see Table S2, available online). The most prevalent comorbid diagnoses were intellectual disabilities (29.5% of children with at least 1 comorbid diagnosis vs 14.0% of total sample), ADHD (24.7% vs 11.6%), and other neurodevelopmental disorders (16.0% vs 7.6%). Table S5, available online, provides the number of comorbid diagnoses per primary diagnosis.

Primary diagnoses of a personality disorder were most often accompanied by a comorbid diagnosis (Figure 2). Only 22.6% (see Table S5) of children with a personality disorder did not have any comorbid diagnosis. Depressive disorders were the most prevalent comorbid diagnoses in children with a personality disorder (29.7%). Of note, personality disorders were not often registered as a comorbid diagnosis for other primary diagnoses (n = 520; 2.4% of children with at least 1 comorbid diagnosis vs 1.2% of the total sample) and were not very prevalent primary diagnoses (n = 195; 0.4%).

As stated, overall, intellectual disabilities were the most prevalent comorbid diagnoses. Intellectual disabilities were particularly prevalent as comorbid diagnoses in children with a primary diagnosis of a schizophrenia spectrum and other psychotic disorder (30.7%). Also, a primary diagnosis of substance-related and addictive disorders with comorbid

TABLE 1 Sociodemographic Characteristics of Study Sample

Sociodemographic variable	Total sample (N = 65,363; 100%)		*DSM* diagnosis available (n = 46,762; 71.5%)		No *DSM* diagnosis available (n = 18,601; 28.5%)		Test statistic[a]	Effect size[b]
Sex, n (%)							χ^2 = 112.3**	ϕ = 0.041
Male	39,654	(60.7)	28,967	(61.9)	10,687	(57.5)		
Female	25,695	(39.3)	17,786	(38.1)	7,909	(42.5)		
Missing	14	(0.0)	9	(0.0)	5	(0.0)		
Age at admission[c]							*t* = 2.3**	*d* = 0.020
Mean (SD)	10.8	(4.1)	10.8	(4.1)	10.8	(4.2)		
Median (IQR)	10.7	(7.0)	10.7	(6.9)	10.7	(7.1)		
Missing, n (%)	0	(0.0)	0	(0.0)	0	(0.0)		
Patient's country of birth, n (%)[d]							χ^2 = 10.3*	ϕ = 0.016
Western	41,861	(64.0)	26,389	(56.4)	15,472	(83.2)		
Non-Western	533	(0.8)	372	(0.8)	161	(0.9)		
Missing	22,969	(35.2)	20,001	(42.8)	2,968	(16.0)		
Mother's country of birth, n (%)[d]							χ^2 = 167.4**	ϕ = 0.059
Western	46,605	(71.3)	31,590	(67.6)	15,015	(80.7)		
Non-Western	1,757	(2.7)	1,448	(3.1)	309	(1.7)		
Missing	17,001	(26.0)	13,724	(29.3)	3,277	(17.6)		
Father's country of birth, n (%)[d]							χ^2 = 326.0**	ϕ = 0.094
Western	35,106	(53.7)	21,650	(46.3)	13,456	(72.3)		
Non-Western	1,741	(2.7)	1,447	(3.1)	294	(1.6)		
Missing	28,516	(43.6)	23,665	(50.6)	4,851	(26.1)		
Degree of urbanization, n (%)[e]							χ^2 = 268.9**	*V* = 0.067
Not urbanized	13,508	(20.7)	8,862	(19.0)	4,646	(25.0)		
Hardly urbanized	12,419	(19.0)	8,472	(18.1)	3,947	(21.2)		
Moderately urbanized	11,954	(18.3)	8,310	(17.8)	3,644	(19.6)		
Strongly urbanized	13,813	(21.1)	10,116	(21.6)	3,697	(19.9)		
Extremely urbanized	8,972	(13.7)	6,609	(14.1)	2,363	(12.7)		
Missing	4,697	(7.2)	4,393	(9.4)	304	(1.6)		

Note: *IQR = interquartile range.*

[a]*Tests examine between-group differences in sociodemographic characteristics between children with a registered* DSM *diagnosis and children without a* DSM *diagnosis.* *p < .005; **p < .001.

[b]*Effect sizes:* φ *= phi (*φ *= 0.1 small;* φ *= 0.3 medium;* φ *= 0.5 large; provided for 2 × 2 contingency tables);* d *= Cohen* d *(*d *= 0.2 small;* d *= 0.5 medium;* d *= 0.8 large);* V *= Cramér* V *(*V *≤ 0.2 small; 0.2 <* V *≤ 0.6 medium;* V *> 0.6 large; provided for non–2 × 2 contingency tables).*

[c]*If a patient was admitted more than once to the same center within the study period, we used their age at the time of the first admission.*

[d]*We categorized countries of birth into Western or non-Western following the definition of Statistics Netherlands.*[70] *Western countries were defined as all countries in Europe (except for Turkey), North America and Oceania, and Indonesia and Japan. Non-Western countries were defined as all countries in Africa, South America, and Asia (except for Indonesia and Japan) and Turkey.*

[e]*We defined urbanization as address density of the square kilometer surrounding a patient's postal code area. Data on address density were obtained from Statistics Netherlands.*[71] *Following the definition of Statistics Netherlands,*[72] *we distinguished 5 categories of urbanization: not urbanized (ie, <500 addresses per square kilometer); hardly urbanized (ie, 500-1,000 addresses per square kilometer); moderately urbanized (ie, 1,000-1,500 addresses per square kilometer); strongly urbanized (ie, 1,500-2,500 addresses per square kilometer); extremely urbanized (ie, ≥2,500 addresses per square kilometer). If a patient moved to a different postal code area during the treatment period, we used their most recent postal code to determine degree of urbanization.*

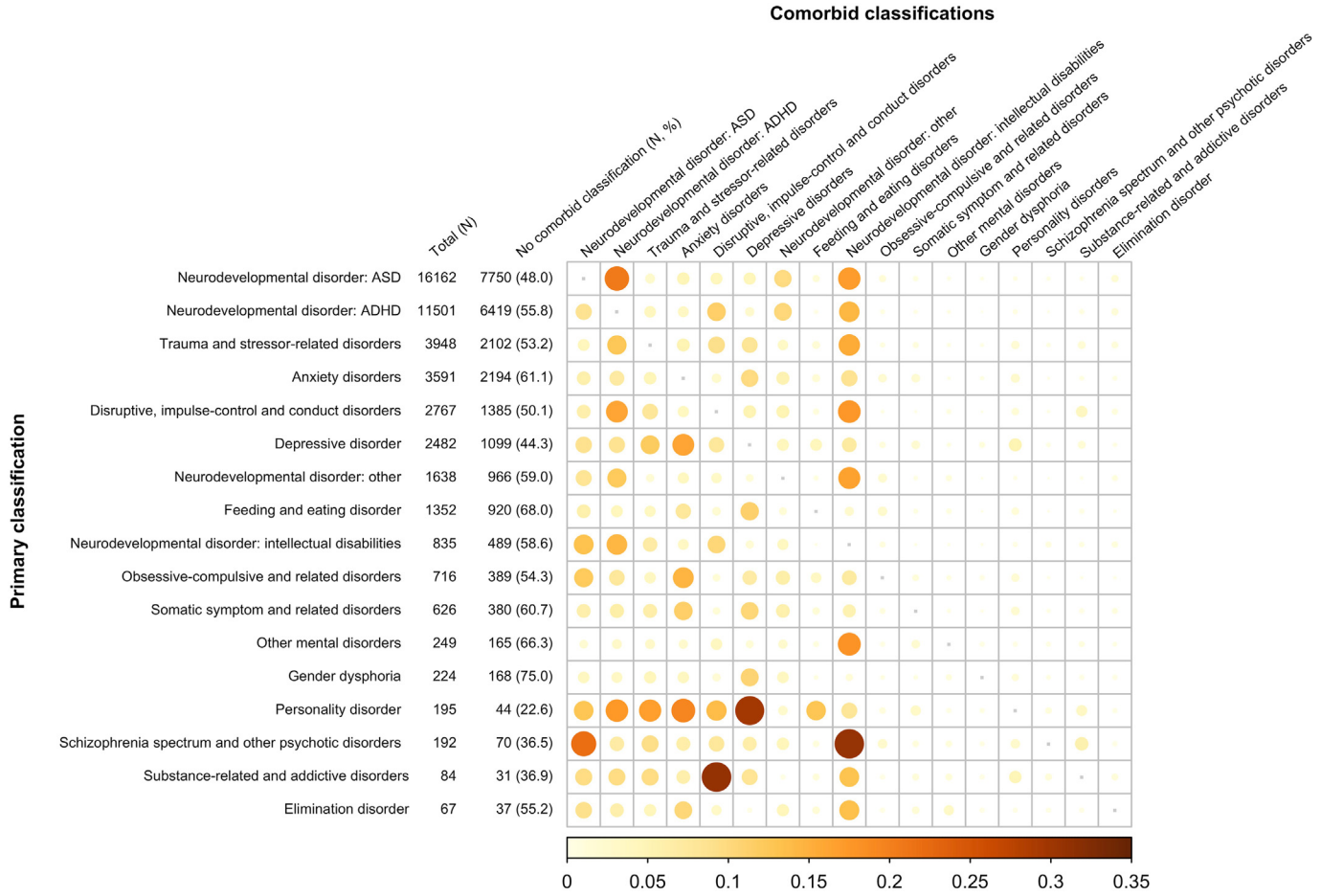
disruptive, impulse-control, and conduct disorders was relatively prevalent (31.0%).

Of note, comorbidity patterns were not symmetrical. For example, a comorbid diagnosis of ADHD in children with a primary diagnosis of ASD was more prevalent (20.7%) than comorbid ASD in children with ADHD (8.5%).

Sex-Specific Results

Figure 3 shows the prevalence of primary and comorbid diagnoses for male and female participants separately. The complete numbers behind Figure 3 can be found in Tables S6 and S7, available online. In male participants (n = 28,967), the most prevalent primary

FIGURE 2 Primary and 5-Year Comorbid *DSM-5* Diagnoses in the Total Child and Adolescent Psychiatric Sample (N = 46,762)



Note: Primary diagnoses are listed in order of prevalence. The size and color intensity of the circles correspond to the prevalence of a comorbidity for a particular primary diagnosis. Prevalence rates in the color key range from 0% to 35%. For privacy reasons, only primary diagnoses that occurred >50 times in the sample are shown. ADHD = attention-deficit/hyperactivity disorder; ASD = autism spectrum disorder.

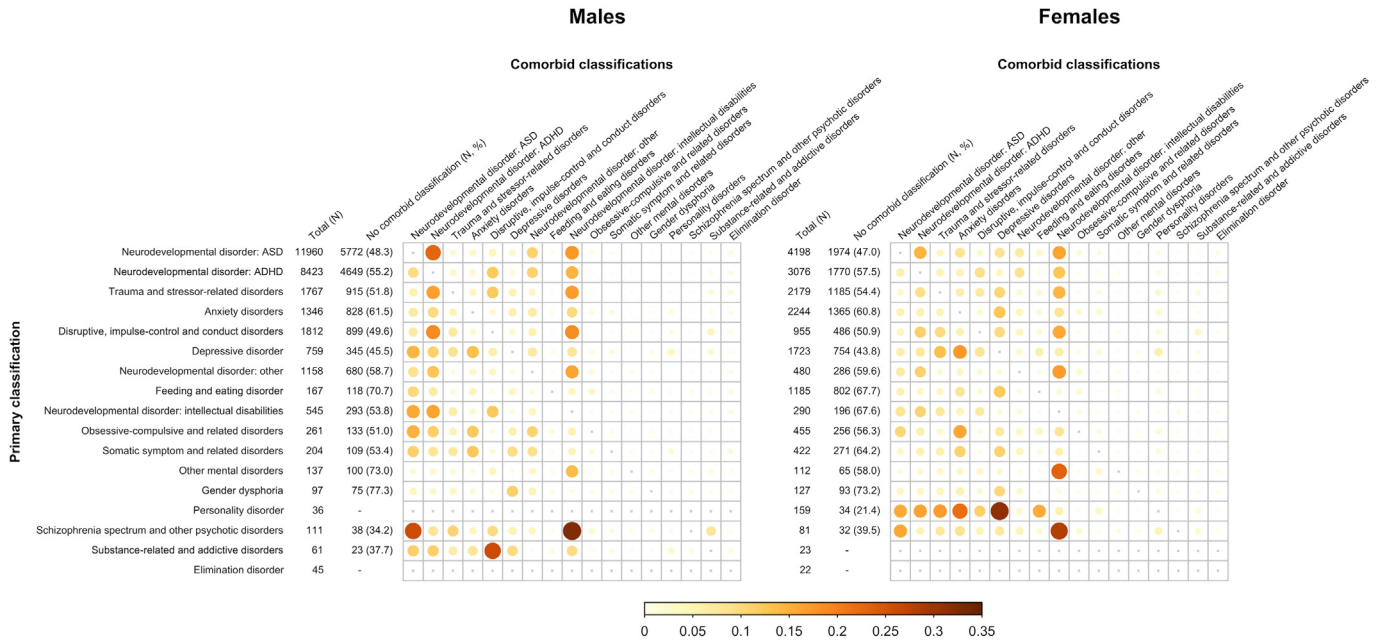
diagnoses were ASD (41.3%); ADHD (29.1%), disruptive, impulse-control and conduct disorders (6.3%); and trauma and stressor-related disorders (6.1%). In female participants (n = 17,786), the most prevalent primary diagnoses were ASD (23.6%), ADHD (17.3%), trauma and stressor-related disorders (12.3%), and anxiety disorders (12.6%).

Though ASD and ADHD were the most prevalent primary diagnoses in both male and female participants, there were differences in prevalence patterns of primary diagnoses. First, in male participants, ASD and ADHD accounted for 70.4% of primary diagnoses. In female participants, ASD and ADHD accounted for a smaller proportion of primary diagnoses, 40.9%. Second, several primary diagnoses were more prevalent in female than in male participants. For example, trauma and stressor-related disorders accounted for 12.3% of primary diagnoses in female participants and for 6.1% in male participants. The same was true for anxiety disorders (female participants 12.6% vs male participants 4.6%), depressive disorders (female participants 9.7% vs male participants 2.6%), feeding and eating disorders (female participants 6.7% vs male participants 0.6%), obsessive-compulsive and related disorders (female participants 2.6% vs male participants 0.9%), somatic symptom and related disorders (female participants 2.4% vs male participants 0.7%), and personality disorders (female participants 0.9% vs male participants 0.1%).

Regarding comorbidity, 48.0% of male participants and 45.9% of female participants had at least 1 comorbid diagnosis. In female participants, primary diagnoses of a personality disorder were often accompanied by a comorbid diagnosis (77.4%). In male participants, these findings were not shown as fewer than 50 male participants had a primary diagnosis of a personality disorder.

In both male and female participants, intellectual disabilities were the most prevalent comorbid diagnoses (male

FIGURE 3 Primary and 5-Year Comorbid *DSM-5* Diagnoses by Sex (Males: n = 28,967; Females: n = 17,786)



Note: *The size and color intensity of the circles correspond to the prevalence of a comorbidity for a particular primary diagnosis. Prevalence rates in the color key range from 0% to 35%. For privacy reasons, only primary diagnoses that occurred >50 times in the overall sample are listed. Data on prevalence rates of comorbidities are presented only for primary diagnoses that occurred >50 times in the subsample. ADHD = attention-deficit/hyperactivity disorder; ASD = autism spectrum disorder.*

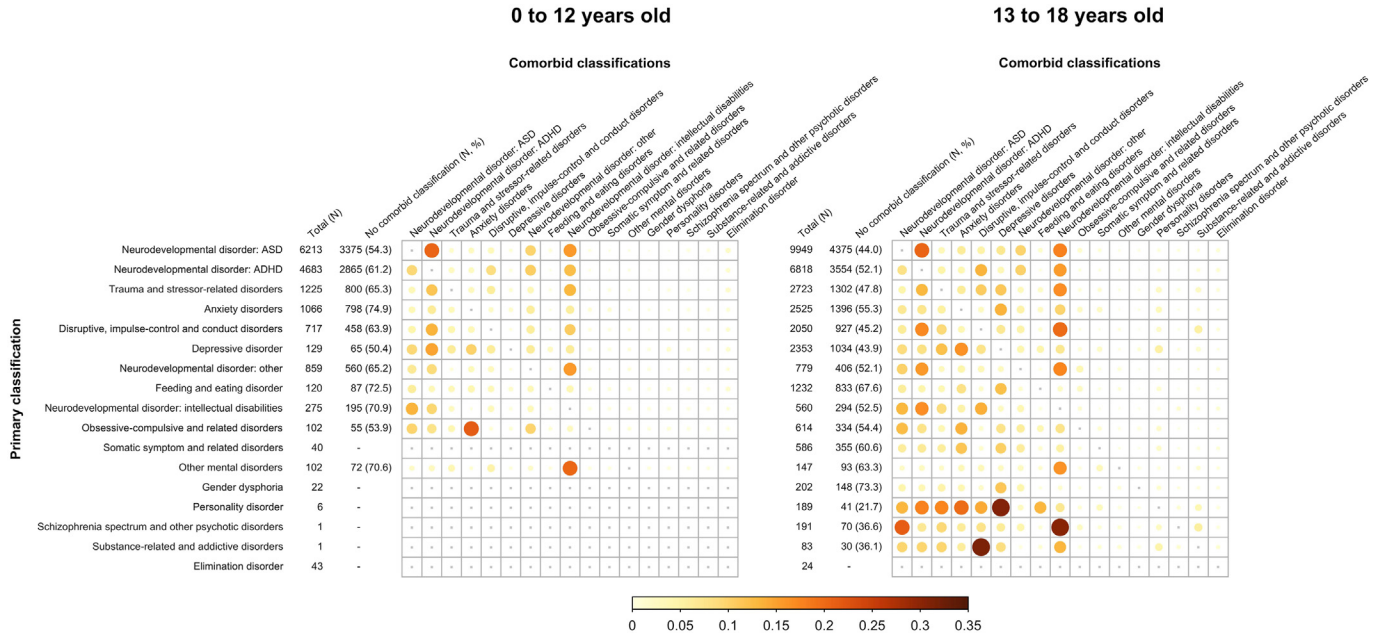
participants: 32.0% with at least 1 comorbid diagnosis vs 15.4% of all male participants; female participants: 25.4% vs 11.7%). Intellectual disabilities were particularly prevalent in children with a primary diagnosis of schizophrenia spectrum and other psychotic disorders (male participants: 32.4%; female participants: 28.4%). in male participants were ADHD (28.9% of participants with at least 1 comorbid diagnosis vs 13.9% of all male participants) and other neurodevelopmental disorders (19.0% vs 9.1%). The other most prevalent comorbid diagnoses in female participants were depressive disorders (17.7% of participants with at least 1 comorbid diagnosis vs 8.1% of all female participants) and ADHD (17.5% vs 8.0%).

Age-Specific Results

Figure 4 shows the prevalence of primary and comorbid diagnoses by age at time of diagnosis. The complete numbers behind Figure 4 can be found in Tables S8 and S9, available online. In children who were 0 through 12 years old at time of diagnosis (n = 15,646), the most prevalent primary diagnoses were ASD (39.7%), ADHD (29.9%), and trauma and stressor-related disorders (7.8%). In children who were 13 through 18 years old at time of diagnosis (n = 31,116), ASD (32.0%), ADHD (21.9%), and trauma and stressor-related disorders (8.8%) were the most prevalent primary diagnoses as well, although ASD and ADHD accounted for a smaller proportion of primary classifications in older children. Another noticeable difference was that 0.8% of children 0 through 12 years old had a primary diagnosis of a depressive disorder vs 7.6% of children 13 through 18 years old. Moreover, several diagnoses, including schizophrenia spectrum and other psychotic disorders, personality disorders, and substance-related and addictive disorders, were nearly entirely absent in children 0 through 12 years old.

Of all children 0 through 12 years old, 39.7% had at least 1 comorbid diagnosis. In children 13 through 18 years old, this percentage was higher, 51.0%. Primary diagnoses of a personality disorder were most often accompanied by a comorbid diagnosis in older children (78.3%), particularly with a comorbid depressive disorder (30.7%). In younger children, these data were not shown as fewer than 50 young children had a primary diagnosis of a personality disorder. In both age groups, intellectual disabilities were the most prevalent comorbid diagnosis (younger children: 32.8% of younger children with at least 1 comorbid diagnosis vs 13.0% of all younger children; older children: 28.3% vs 14.4%), followed by ADHD (younger children: 28.5% vs 11.3%; older children: 23.2% vs 11.8%) and other

FIGURE 4 Primary and 5-Year Comorbid *DSM-5* Diagnoses by Age at Time of Primary Diagnosis (0 Through 12 Years Old: N = 15,646; 13 Through 18 Years Old: N = 31,116)



Note: *The size and color intensity of the circles correspond to the prevalence of a comorbidity for a particular primary diagnosis. Prevalence rates in the color key range from 0% to 35%. For privacy reasons, only primary diagnoses that occurred >50 times in the overall sample are listed. Data on prevalence rates of comorbidities are presented only for primary diagnoses that occurred >50 times in the subsample. ADHD = attention-deficit/hyperactivity disorder; ASD = autism spectrum disorder.*

neurodevelopmental disorders (younger children: 21.0% vs 8.3%; older children: 14.1% vs 7.2%). In older children, intellectual disabilities were particularly comorbid with a primary diagnosis of a schizophrenia spectrum and other psychotic disorder (30.4%). Another common specific comorbidity in older children was a primary diagnosis of a substance-related and addictive disorder with a comorbid disruptive, impulse-control, and conduct disorder (31.1%). Data on schizophrenia spectrum and other psychotic disorders and substance-related and addictive disorders were not shown for younger children ($n < 50$). In younger children, the most common specific comorbidities were a primary diagnosis of obsessive-compulsive disorder with a comorbid anxiety disorder (21.6% vs 13.5% in older children), ASD with comorbid ADHD (20.7% in both younger and older children) and the *DSM-5* class other mental disorders (eg, other specified mental disorder due to another medical condition) with a comorbid intellectual disability (20.6% vs 16.3% in older children).

Figures S1 and S2 and Tables S10 through S13, available online, show the prevalence of primary and comorbid *DSM-5* diagnoses by sex and age at time of diagnosis.

DISCUSSION

The aim of the current study was to provide a comprehensive overview of the prevalence of 5-year primary and comorbid mental disorder diagnoses in a large sample of children who received psychiatric care. Of these children, 71.5% had a registered *DSM* disorder in their electronic health record. ASD and ADHD were the most prevalent primary diagnoses, accounting for 59.2% (ASD 34.6% and ADHD 24.6%). Approximately half of all children had at least 1 comorbid diagnosis.

Regarding sex, we found that ASD and ADHD were the most prevalent primary diagnoses in both male and female participants. We also observed substantial differences between male and female participants, in terms of both primary diagnoses and comorbid diagnoses. Of all male participants, 70.4% had a primary diagnosis of ASD or ADHD vs 40.9% of female participants. Primary diagnoses of trauma and stressor-related disorders, anxiety disorders, depressive disorders, feeding and eating disorders, personality disorders, obsessive-compulsive and related disorders, and somatic symptom and related disorders were more prevalent in female participants than in male participants, consistent with previous reports.[30–33] Also, though a similar proportion of male and female participants had at least 1

comorbid diagnosis (male participants: 48.0%; female participants: 45.9%), the type of comorbid diagnoses that were most prevalent differed between sexes, which is in line with the literature.[34,35]

Studies of the past few years show consistent sex differences in ADHD[36] and in ASD presentation, especially in camouflaging behaviors.[37] Certain studies also highlight that female participants with ASD, despite equivalent or poorer social communication skills, exhibit less autistic social behavior than male participants.[38] A large study indicates that, indeed, female patients on average are diagnosed with more alternative disorders than male patients before they receive an ASD diagnosis.[39] The implication for our study is that the actual number of ADHD and ASD diagnoses in our sample might be higher than we report now, and the comorbidity pattern might be slightly altered.

Regarding age at time of diagnosis, primary diagnoses of ASD and ADHD were more prevalent in children 0 to 12 years old (69.6%) than in children 13 to 18 years old (53.9%), and comorbidity was more prevalent in children 13 to 18 years old (51.0%) than in children 0 to 12 years old (39.7%). These differences between age groups are consistent with the literature.[23,40,41]

Of note, 28.5% of the children in our sample did not have a registered *DSM* diagnosis in their electronic health record. In some records, it was registered that the diagnosis had been postponed (2.4%) or only a V-code was available (1.2%). In the remaining records (24.9%), no information on *DSM* diagnosis was available. In the Netherlands since 2015, costs of psychiatric care for children are covered by municipalities.[42] As such, the formal registration of a *DSM* diagnosis is not a requirement for financial coverage of care. Therefore, clinicians may have assigned a *DSM* diagnosis, but may not have registered this diagnosis in the electronic health record. Alternatively, following a transdiagnostic or stepped diagnosis approach, clinicians may have not assigned a *DSM* diagnosis.[43,44] It should also be noted that in the electronic health records of 10.5% of children, more than 1 primary diagnosis was registered within the study period. Though this may reflect initial misdiagnosis,[45] it may also be indicative of a change in treatment priority.

Regarding primary diagnoses, previous studies generally have found substantially lower prevalence rates of ASD and ADHD in youth referred for psychiatric care.[10] First, this difference may be due to the fact that, in the Netherlands, children with ASD or ADHD are often referred to centers for child and adolescent psychiatry, whereas these children are more often treated by a pediatrician in other countries.[46] Second, this difference may reflect a discrepancy in prevalence rates between countries. In a different sample of children referred for psychiatric care in the Netherlands (N = 1,402), Jansen *et al.*[26] also found relatively high prevalence rates for ASD (35.1%) and ADHD (33.6%). Our findings are in line with the observation that population-based prevalence rates of ASD differ widely across geographical areas, which may be due to sociocultural and socioeconomic determinants.[47] Third, this difference may be explained by methodological differences between studies. That is, previous studies conducted semistructured clinical interviews to assess diagnostic criteria, whereas the current study used data on diagnoses determined by mental health professionals following standard diagnostic procedures in clinical practice.

Although prevalence rates of comorbidity of mental disorders vary widely in the literature (approximately 40%-90%), the prevalence of comorbidity seemed to be lower in the current study than generally found.[11,20,24,25,48–51] Previous research has shown that mental health professionals tend to overlook comorbid mental disorders,[52,53] which may have resulted in a lower prevalence of comorbidity in the current study compared with studies that used standardized structured assessment methods. Furthermore, the current study reported on comorbidity only between diagnostic classes (eg, an anxiety disorder with a depressive disorder), which will have lowered our rates of comorbidity compared with studies that include all types of comorbidity (eg, an anxiety disorder with another anxiety disorder). In the current study, it was not possible to include all types of comorbidity as it was not clear whether comorbidity within the same diagnostic class represented actual comorbidity or noise in diagnostic or registration procedures. These explanations may also account for the fact that we found comparable overall rates of comorbidity in male and female participants, whereas previous studies observed more comorbidity in female participants.[54]

In line with previous research, patterns of comorbidity were not symmetrical in our sample,[55,56] suggesting that some classifications are more likely to be seen as primary, while others are more likely to be seen as secondary to other problems. For example, ASD with comorbid ADHD (20.7%) was more prevalent than ADHD with comorbid ASD (8.5%). Of note, *DSM-5* is the first edition allowing mental health professionals to classify comorbid ADHD in individuals with ASD and vice versa. Previous research has also found an asymmetrical comorbidity pattern regarding ASD and ADHD.[57–61]

Some results regarding comorbidity might be explained by the diagnostic system rather than by diagnostic symptoms. For instance, a primary diagnosis of a personality disorder was most often accompanied by a comorbid diagnosis, whereas intellectual disorders were most often registered as comorbid diagnoses. This may be

due to the multiaxial system of the *DSM-IV-TR*. In this system, personality disorders and intellectual disabilities were classified on Axis II. Doing so required a diagnosis of at least 1 mental health disorder on Axis I, which may have resulted in these high comorbidity rates. Alternatively, this may also be reflective of challenges in diagnostic procedures for these disorders—especially in children—or complications in differentiating between different diagnostic options.

Contrary to what the nosology of *DSM* suggests,[29] the comorbidity rates found in the current study seem to indicate that diagnostic classes are not discrete entities. The separation and dichotomization of psychopathology in *DSM* has been frequently critiqued.[62–65] Furthermore, it has frequently been argued that *DSM* categorizes psychopathology into too many distinct diagnostic classes,[64–66] which our results seem to confirm considering the high comorbidity rates. Additionally, *DSM* is based on science and clinical knowledge originating from psychiatry, neurology, and epidemiology, but has limited etiological validity.[67] This is relevant, as previous studies have shown that comorbidity of mental disorders results from shared genetic and environmental risk factors.[64] Alternative diagnostic frameworks for psychopathology that may overcome these shortcomings are the Hierarchical Taxonomy of Psychopathology (HiTOP)[66,67] and the Research Domain Criteria.[65,68] HiTOP is a dimensional diagnostic system that is based on state-of-the-art scientific evidence. In contrast to the dichotomous view of *DSM*, HiTOP considers psychopathology to be a continuum. Moreover, HiTOP allows mental health professionals to classify psychopathology at multiple levels. This may offer a solution for the issues regarding comorbidity and high variability in the presentation of *DSM* diagnoses. Similar to HiTOP, Research Domain Criteria conceptualizes mental disorders on a continuum. However, in contrast to *DSM* and HiTOP, the Research Domain Criteria framework considers the etiology of mental disorders.[65,68] Although both frameworks also come with disadvantages,[64] it would be useful to further examine the clinical and scientific value of these frameworks.

The current study has several strengths. We provided a comprehensive overview of primary and comorbid mental disorders in a substantial sample of children who received psychiatric care in the Netherlands over a 5-year period. We included data from 4 academic centers for child and adolescent psychiatry representing large regions of the Netherlands, which enhances the generalizability of our results. Furthermore, all diagnoses were determined by mental health professionals, enhancing ecological validity. However, it should also be noted that diagnostic procedures differ between clinical centers and mental health professionals. Also, in interpreting the results of this study, it should be considered that most children included in the study were referred to specialized psychiatric care, and from the current data alone, we cannot assess to what extent this generalized to children receiving mental health care more broadly. In the same vein, only 1.3% of children were born in a non-Western country. In comparison, of all children in the Netherlands ages 0 to 15 years, 3.7% were born in a non-Western country.[69] However, in our sample, missing data on country of birth was high (ie, 35%), and children born in non-Western countries may be overrepresented in the missing data.

Another limitation is that the DREAMS centers use different electronic health record systems, which complicated harmonizing the data. More specifically, in 1 DREAMS center, the electronic health record system did not allow for mental health professionals to explicitly define which diagnosis was the focus of clinical attention. Therefore, as per *DSM-5* guidelines, if a child had more than 1 registered *DSM* diagnosis, we considered the diagnosis listed first to be the primary one. Moreover, due to privacy legislation, we were unable to identify individual patients. Therefore, there is a possibility that a small number of children have received care at more than 1 site during the study period. Finally, the data were retrieved from electronic health records, which may have included registration errors and were not always unambiguously interpretable. For this reason, we did not present comorbidity patterns within the same diagnostic class (eg, specific phobia with comorbid panic disorder).

In sum, we provided a comprehensive overview of the prevalence of primary and 5-year comorbid mental health disorders in a large sample of children who received psychiatric care. Diagnostic patterns were generally in line with previous research, but the prevalence of ASD and ADHD was higher than in other studies. Real-world diagnostic information such as presented here is essential to understand the use of *DSM-5* in clinical practice, put differences between contexts and countries into perspective, and ultimately improve our diagnostic protocols and treatments. This study aimed to provide information on which expertise is needed in clinical practice, which educational needs should be addressed, and which policy changes may be useful to enhance efficiency of care. However, our study is a first step in this endeavor; to assess this thoroughly, more extensive and specifically targeted studies are needed. Ultimately, this study can be used to compare diagnoses across countries and, as such, feed the discussion on and future research into the use of *DSM-5* in clinical practice, put

differences between contexts in perspective, and, in the long-term, help improve our diagnostic protocols.

CRediT authorship contribution statement

Malindi van der Mheen: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Josjan Zijlmans:** Writing – review & editing, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Daniël M. van der Doelen:** Writing – review & editing, Data curation, Conceptualization. **Helen Klip:** Writing – review & editing, Conceptualization. **Rikkert M. van der Lans:** Writing – review & editing, Data curation, Conceptualization. **I. Hyun Ruisch:** Writing – review & editing, Data curation. **Ymkje Anna de Vries:** Writing – review & editing, Visualization. **Jacintha M. Tieskens:** Writing – review & editing, Conceptualization. **Marleen Wildschut:** Writing – review & editing. **Jan K. Buitelaar:** Writing – review & editing, Conceptualization. **Pieter J. Hoekstra:** Writing – review & editing, Conceptualization. **Ramón J.L. Lindauer:** Writing – review & editing, Conceptualization. **Arne Popma:** Writing – review & editing, Conceptualization. **Robert Vermeiren:** Writing – review & editing, Conceptualization. **Emma M. Broek:** Writing – review & editing. **Tycho J. Dekkers:** Writing – review & editing. **Andrea Dietrich:** Writing – review & editing. **Irma M. Hein:** Writing – review & editing. **Marjolein Luman:** Writing – review & editing. **Maaike H. Nauta:** Writing – review & editing. **Lucres M.C. Jansen:** Writing – review & editing. **Lian Nijland:** Writing – review & editing. **Sara Pieters:** Writing – review & editing. **Wouter Staal:** Writing – review & editing, Conceptualization. **Tinca J.C. Polderman:** Writing – review & editing, Supervision, Methodology, Investigation, Conceptualization.

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Malindi van der Mheen, Josjan Zijlmans, Ramón J.L. Lindauer, Arne Popma, Tycho J. Dekkers, Irma M. Hein, Lucres M.C. Jansen, and Tinca J.C. Polderman are with Amsterdam UMC and Amsterdam Public Health Research Institute, both Amsterdam, the Netherlands. Malindi van der Mheen, Ramón J.L. Lindauer, Arne Popma, Tycho J. Dekkers, Irma M. Hein, Marjolein Luman, and Tinca J.C. Polderman are also with Levvel, Amsterdam, the Netherlands. Marjolein Luman is also with Vrije Universiteit, Amsterdam, the Netherlands. Daniël M. van der Doelen, Helen Klip, Jan K. Buitelaar, Sara Pieters, Wouter Staal, and Tinca J.C. Polderman are with Karakter, Nijmegen, the Netherlands. Jan K. Buitelaar and Wouter Staal are also with Radboudumc, Nijmegen, the Netherlands. Sara Pieters is also with Radboud University, Nijmegen, the Netherlands. Rikkert M. van der Lans, Jacintha M. Tieskens, Robert Vermeiren, Emma M. Broek, Lian Nijland, and Tinca J.C. Polderman are with LUMC Curium, Leiden, the Netherlands. Rikkert M. van der Lans and Tycho J. Dekkers are also with the University of Amsterdam, Amsterdam, the Netherlands. Robert Vermeiren is also with Youz, Parnassia Group, The Hague, the Netherlands. I. Hyun Ruisch, Ymkje Anna de Vries, Marleen Wildschut, Pieter J. Hoekstra, Tycho J. Dekkers, Andrea Dietrich, Maaike H. Nauta, and Tinca J.C. Polderman are with Accare Child Study Center and University of Groningen, University Medical Center Groningen, both Groningen, the Netherlands. Tinca J.C. Polderman is also with Vrije Universiteit, Amsterdam, the Netherlands.

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Correspondence to Malindi van der Mheen, PhD, Meibergdreef 5, 1105AZ Amsterdam, the Netherlands; e-mail: m.vandermheen@levvel.nl

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