Article

Demographic Differences in Disruptive Mood Dysregulation Disorder Symptoms in ADHD, Autism, and General Population Samples

Journal of Attention Disorders
2019, Vol. 23(8) 849–858

DOI: 10.1177/1087054716664409
journals.sagepub.com/home/jad
SAGE

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Abstract

Objective: *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*) disruptive mood dysregulation disorder (DMDD) is a controversial new diagnosis. No studies have investigated DMDD symptoms (irritable-angry mood and temper outbursts) and demographics in general population and psychiatric samples. **Method:** Maternal ratings of DMDD symptoms and diagnoses, age, gender, IQ, race, and parent occupation were analyzed in general population (n = 665, 6-12 years) and psychiatric samples (n = 2,256, 2-16 years). **Results:** Percentage of school-age children with DMDD symptoms were 9% general population, 12% ADHD-I, 39% ADHD-C, and 43% autism. Male, nonprofessional parent, and autism with IQ > 80 were associated with increasing DMDD symptoms, but demographics together explained only 2% to 3% of the DMDD score variance. **Conclusion:** Demographics contributed little to the presence of DMDD symptoms in all groups, whereas oppositional defiant disorder (ODD) explained most of the variance. Almost all children with DMDD symptoms had ODD suggesting that DMDD may not be distinct from ODD. *(J. of Att. Dis. 2019; 23(8) 849-858)*

Keywords

ADHD, autism, behavior regulation

The new *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.; *DSM-5*; American Psychiatric Association, 2013) diagnosis, disruptive mood dysregulation disorder (DMDD), has two symptoms (persistently irritable or angry mood and severe recurrent temper outbursts) in children between 6 and 18 years. These two symptoms are also two of the eight symptoms of oppositional defiant disorder (ODD). DMDD is a controversial diagnosis. It was introduced to the *DSM-5* without published validity studies (Copeland, Angold, Costello, & Egger, 2013; Roy, Lopes, & Klein, 2014), agreement between clinicians on a diagnosis of DMDD was poor in *DSM-5* field trials (Regier et al., 2013), and its validity as a diagnosis distinct from ODD is questionable (Axelson et al., 2012; Mayes, Waxmonsky, Calhoun, & Bixler, 2016; Mayes et al., 2015). Research on demographic correlates of DMDD symptoms is sorely needed. The *DSM-5* states that DMDD symptoms "generally become less common as children transition into adulthood" (American Psychiatric Association, 2013, p. 157), that "children presenting to clinics with features of DMDD are predominantly male," and that "among community samples, a male preponderance appears to be supported" (American Psychiatric Association, 2013, p. 158). These suppositions along with the possible influence of other demographic variables need to be tested empirically. It is not known what demographic differences exist between children with and without DMDD symptoms and whether these differences are the same for psychiatric and general population samples. Only one study investigating the relationship between DMDD symptoms and demographics was found in our literature search. In this study of 6-year-old community children (Dougherty et al., 2014), gender, race, and parent education were not significantly related to DMDD.

Other studies have focused on symptoms related to DMDD (i.e., negative mood and behavior problems) and their association with age, gender, socioeconomic status (SES), and race, but have not focused on DMDD specifically. In these studies, preschool children had greater negative

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mood (sadness, irritability, anger, or low frustration tolerance) than school-age children in a community sample (Copeland et al., 2013). Age was not related to irritability, tantrums, aggression, and oppositional behavior in a 6- to 16-year-old psychiatric sample (Mayes, Calhoun, Aggarwal, et al., 2012), in children with intellectual disability (Chadwick, Piroth, Walker, Bernard, & Taylor, 2000), and in children with autism (Lecavalier, 2006; Murphy, Healy, & Leader, 2009). However, oppositional behavior decreased with age in a cross-sectional community sample ages 9 to 17 years (Lahey et al., 2000).

Boys had more externalizing behavior problems than girls in general population samples aged 6 to 18 years (Achenbach, 1991; Bongers, Koot, van der Ende, & Verhulst, 2003; Carlson, Tamm, & Gaub, 1997). In one community study, gender differences in irritability, anger, and temper outbursts were not found in 6- to 18-year-olds (Stringaris et al., 2012), but other studies showed greater irritability in girls than in boys (Leadbeater & Homel, 2014; Leibenluft, Cohen, Gorrindo, Brook, & Pine, 2006). In other studies, boys with intellectual disability had more aggression than girls (McClintock, Hall, & Oliver, 2003) and boys with ADHD had more externalizing problems (Gaub & Carlson, 1997; Gershon, 2002) than girls. Girls and boys with autism did not differ in temper outbursts and irritability (Lecavalier, 2006), and aggression (Murphy et al., 2009).

Low SES was associated with greater externalizing problems (Keiley, Bates, Dodge, & Pettit, 2000) and antisocial behavior (Samaan, 2000) in community samples. In children with autism, low SES was linked with irritability, tantrums, and aggression (Mayes & Calhoun, 2011). One study of children with intellectual disability reported decreasing SES and increasing tantrums, irritability, and aggression (Koskentausta, Iivanainen, & Almqvist, 2007), and another study did not (Chadwick et al., 2000). Minority status was not associated with antisocial behavior in community children controlling for SES (Samaan, 2000) and explosive, oppositional, and aggressive behavior was not related to race in a psychiatric sample (Mayes, Calhoun, Aggarwal, et al., 2012).

Extensive data on the relationship between internalizing and externalizing symptoms and age and gender are found in behavior rating scale norms. Rating scale standard scores are typically calculated separately by age and gender because of differences. However, gender- and age-referenced standard scores remove gender and age effects, masking these differences. For example, a boy with a behavior problem *T*-score of 50 actually has more severe behavior problems based on parent and teacher ratings than does a girl with a *T*-score of 50 (Child Behavior Checklist, Achenbach, 1991; Pediatric Behavior Scale [PBS], Lindgren & Koeppl, 1987). Rating scales do not separate DMDD from other disorders, and ratings of irritable-angry mood and temper outbursts are embedded in broader items or subscales, such as ODD. No study other than ours has isolated the two DMDD symptoms using rating scale data.

Purpose

The purpose of our study is to determine which demographic variables contribute significantly and uniquely to the presence of DMDD symptoms in ADHD-Combined (ADHD-C), ADHD-Inattentive (ADHD-I), autism, and general population samples. Because of the known association between ODD and DMDD, our analyses also include ODD, as well as other diagnoses (ADHD-C, ADHD-I, autism, and intellectual disability), as concurrent predictor variables to determine if demographic variables contribute meaningfully to DMDD symptoms beyond ODD or other diagnoses.

Method

Diagnostic Procedure and Instruments

All children in the psychiatric sample underwent a comprehensive evaluation by a PhD licensed psychologist. The evaluation included a diagnostic interview with the parents, parent and teacher questionnaires and rating scales (PBS; Lindgren & Koeppl, 1987) completed by parents and teachers, review of records, psychological tests (IQ, achievement, attention, and neuropsychological), and clinical observations during psychological testing. The PBS is a 165-item behavior rating scale completed by parents and teachers. Several published studies have used the PBS to measure psychological problems and differentiate diagnostic groups (Conrad, Richman, Lindgren, & Nopoulos, 2010; Mayes, Calhoun, Aggarwal, et al., 2012; Mayes, Calhoun, Murray, Ahuja, & Smith, 2011; Mayes, Calhoun, Murray, & Zahid, 2011; Nichols et al., 2000; Wolraich et al., 1994). Scores on the PBS correspond well with the Child Behavior Checklist (Bixler et al., 2009) and objective measures of ADHD (Mayes, Gordon, Calhoun, & Bixler, 2014).

Samples

Demographic data for the psychiatric sample subgroups (ADHD-C, ADHD-I, and autism) and the general population sample are presented in Table 1.

ADHD. All children in the ADHD group were referred to our child diagnostic clinic, received a *DSM* diagnosis of ADHD, and fulfilled the following criteria: (a) symptoms of ADHD observed during psychological testing, (b) low scores on psychometric measures of attention and impulsivity that have empirical support in identifying ADHD (Mayes & Calhoun, 2002; Mayes, Calhoun, & Crowell, 1998, 2001), and (c)

Table 1. Demographic Data (*N* = 2,921).

		Age			IQ			Percentage			
Group	*n*	*M*	*SD*	Range	*M*	*SD*	Range	Preschool	Male	White[a]	Professional[b]
Psychiatric	2,256	7.5	3.1	2-16	96.7	22.4	9-149	25.5	74.9	91.5	36.1
Autism	1,251	6.8	3.1	2-16	91.8	24.9	9-149	38.7	80.3	91.5	33.6
ADHD-C	713	8.2	2.6	2-16	102.5	17.0	42-129	10.9	72.9	90.9	35.8
ADHD-I	292	9.0	2.7	2-16	103.1	16.9	38-142	4.5	56.2	92.8	47.9
ODD[c]	946	7.6	3.1	2-16	98.5	19.8	22-147	27.0	77.1	92.1	29.2
General population	665	8.7	1.7	6-12	106.5	12.9	71-147		52.6	80.5	48.9
ODD[c]	85	8.8	1.8	6-16	104.2	13.0	78-135		64.7	85.9	37.6

Note. ADHD-C = ADHD-combined; ADHD-I = ADHD-inattentive; ODD = oppositional defiant disorder.
[a]Psychiatric sample comprises 3.8% Black, 3.8% Hispanic, and 0.9% Asian; general population sample comprises 15.6% Black, 0.3% Hispanic, and 3.6% Asian.
[b]One or both parents have a professional or managerial occupation.
[c]Extracted from the psychiatric and general population samples.

ratings of short attention span or distractible as *often* or *very often* a problem on the PBS (Lindgren & Koeppl, 1987) by at least two raters (mother, father, and teacher). Children were classified with ADHD-C if the majority of the mother, father, and teacher impulsive or hyperactive ratings were *often* or *very often* a problem. Children were classified with ADHD-I if the majority of impulsive and hyperactive ratings were less than *often* a problem. These criteria have been used to identify children with ADHD in several publications (Mattison & Mayes, 2012; Mayes, Calhoun, Aggarwal, et al., 2012; Mayes, Calhoun, Mayes, & Molitoris, 2012; Mayes, Calhoun, Murray, Ahuja, & Smith, 2011; Mayes et al., 2014; Mayes et al., 2016; Mayes et al., 2015). Children with comorbid diagnoses, such as ODD, conduct disorder, anxiety disorder, depression, and learning disability, were not excluded, so that the sample is representative of referred children with ADHD. However, children with autism were only in the autism sample, and all children in the ADHD group had a score below the autism range on the Checklist for Autism Spectrum Disorder (CASD; Mayes, 2012).

Autism. Children in the autism group were referred to our child diagnostic clinic and had a clinical diagnosis of autism and a score in the autism range on the CASD (Mayes, 2012). The CASD is 30-item checklist normed and standardized on 2,469 children (1-16 years of age) with autism, other clinical disorders (e.g., ADHD), and typical development (Mayes, 2012). The CASD is normed on more than 800 children with autism aged 1 to 17 years with IQs of 9 to 146. The CASD differentiates children with autism from children with ADHD (99.5% accuracy) and from typical children (100% accuracy), is equally effective in identifying children with autism who have low and high IQs, has excellent congruence with *DSM* clinical diagnoses, and has high diagnostic agreement (93%-98%) with other autism instruments, including the Childhood Autism Rating Scale, the Gilliam Asperger's Disorder Scale, and the Autism Diagnostic Interview–Revised (Mayes & Calhoun, 1999, 2004; Mayes, Calhoun, & Crites, 2001; Mayes et al., 2009; Murray, Mayes, & Smith, 2011; Tryon, Mayes, Rhodes, & Waldo, 2006).

General population. General population children were elementary school students from an epidemiologic study of the prevalence of sleep disorders in children (Bixler et al., 2009). These children were from the same U.S. geographic region (comprising rural, urban, and suburban communities) as the psychiatric sample. Questionnaires were sent home to the parents of every elementary school student in four school districts (n = 7,312), with a 78.5% response rate. Using stratified random sampling so that the sample matched the original survey group on age, gender, race, and risk of sleep disordered breathing, a sample of children was invited for further evaluation in the sleep laboratory. Seventy percent of the invited families agreed to participate. Parent consent and child assent were obtained. Demographic data are in Table 1. The sample is representative of the general population. Therefore, children with possible psychiatric diagnoses were not excluded.

ODD. Children with ODD were the 946 children in the psychiatric sample and 85 children in the general population sample whose mothers rated four or more of the eight *DSM-5* ODD symptoms on the PBS as *often* or *very often* a problem, as specified by *DSM-5* ODD symptom criteria. ODD symptom criteria were met by 46.0% with autism, 47.4% with ADHD-C, 11.0% with ADHD-I, and 12.8% in the general population sample.

DMDD Symptoms

Mothers rated their children's behavior during the past 2 months (0 = *not at all or almost never* a problem, 1 = *sometimes* a problem, 2 = *often* a problem, and 3 = *very often* a problem) on the two *DSM-5* DMDD items on the PBS:

Table 2. DMDD Symptoms and Age (*N* = 2,921).

	% with DMDD symptoms by age group					DMDD score and age[a]
Sample	All ages	2-5	6-8	9-12	13-16	*r*
Psychiatric	38.7	45.9	37.4	34.4	35.7	−.01
Autism	44.0	45.7	43.2	42.1	43.6	.04
ADHD-C	40.4	52.6	40.6	36.0	40.4	−.02
ADHD-I	11.6	15.4	9.8	13.5	11.1	.06
ODD	86.3	94.1	85.0	81.5	81.6	−.01
General population	9.2		7.2	10.9		.05
ODD	65.9		58.8	70.6		−.03

Note. DMDD = disruptive mood dysregulation disorder; ADHD-C = ADHD-combined; ADHD-I = ADHD-inattentive; ODD = oppositional defiant disorder.
[a]School-age only.

"irritable, gets angry or annoyed easily" and "loses temper, has temper tantrums." These scores were combined to obtain the total DMDD score. Children were considered to have DMDD symptoms if irritable-angry mood and temper outbursts were both rated as *often* or *very often* a problem by mothers.

Data Analyses

Independent *t* tests, ANOVA, and Cohen's *d* were calculated to determine differences in DMDD raw scores between groups (e.g., male and female). Raw scores were used instead of *T*-scores, because *T*-scores mask gender and age effects. Pearson correlations and explained variance indicated the degree of relationship between DMDD scores, age, and IQ. Linear and binary regression analysis determined which of the independent variables (diagnosis, age, gender, IQ, race, and parent occupation) were significant correlates of the DMDD score and significant predictors of the presence or absence of DMDD symptoms. Regression analyses were performed for the school-age children only (consistent with the *DSM-5* stipulation that DMDD not be diagnosed in children younger than 6). Regression analyses were run twice, once using the ODD total symptom score (which by definition includes the two DMDD symptoms) and again replacing the ODD total symptom score with the PBS oppositional behavior score (that does not include the two DMDD symptoms).

Results

Diagnosis

The percentage of school-age children with DMDD symptoms in the general population sample was 9.2%. In the psychiatric sample, 11.5% with ADHD-I, 38.9% with ADHD-C, and 42.9% with autism had DMDD symptoms (Table 2). In the general population school-age sample, 65.9% with ODD had DMDD symptoms, and in the psychiatric sample, 83.4% with ODD had DMDD symptoms.

Age

In the psychiatric sample, 45.9% of preschool and 36.2% of school-age children had DMDD symptoms. Preschool children had significantly higher DMDD scores than school-age children ($t = 5.7$, $p < .0001$, $d = 0.3$). Preschoolers comprised 25.5% of the psychiatric sample and 30.3% of children with DMDD symptoms. Differences in DMDD scores among the school-age groups (6-8, 9-12, and 13-16 years) were nonsignificant in the psychiatric sample ($F = 0.0$, $p = .97$), as were differences between the two general population age groups, 6 to 8 years and 9 to 12 years ($t = 1.8$, $p = .07$). Correlations between age and DMDD scores for the school-age psychiatric groups and the general population sample were close to 0 and explained less than 0.4% of the variance. Age data for the ADHD-C, ADHD-I, autism, ODD, and general population groups are presented in Table 2.

IQ

The correlation between IQ and the DMDD score for general population children (who all had IQs > 70) was negative and significant but was small and explained only 1.4% of the variance (Table 3). IQ was not significantly related to DMDD symptoms in the school-age ADHD-C, ADHD-I, and ODD groups, but children who had autism and an IQ ≥ 80 had significantly higher DMDD scores than children with autism and an IQ < 80 (preschool $t = 3.1$, $p = .002$ and school-age $t = 3.5$, $p = .001$, $d = 0.3$).

Gender

Males had more DMDD symptoms than females in all subgroups, with the exception of school-age children with ADHD-I (Table 4). Gender differences in DMDD scores were significant for the total psychiatric school-age sample ($t = 3.4$, $p = .001$, $d = 0.2$) and the general population sample ($t = 2.1$, $p = .03$, $d = 0.2$). In the school-age psychiatric

Table 3. DMDD Symptoms and IQ (*N* = 2,921).

	% with DMDD symptoms				
	2-5 years		6-16 years		DMDD score and IQ[a]
	<80	≥80	<80	≥80	*r*
Psychiatric	36.9	49.3	33.2	36.7	.02
ADHD-C	25.0	54.1	35.4	39.3	−.01
Autism	37.7	49.2	35.8	45.2	.15**
ADHD-I	0.0	18.2	4.5	12.1	.01
ODD	92.3	94.6	85.6	83.0	−.07
General population			12.5	9.1	−.12*
ODD			NA	65.5	−.18

Note. DMDD = disruptive mood dysregulation disorder; ADHD-C = ADHD-combined; ADHD-I = ADHD-inattentive; ODD = oppositional defiant disorder.
[a]School-age only.
*p = .002. **p < .0001.

Table 4. DMDD Symptoms and Gender, Race, and Parent Occupation (*N* = 2,921).

	% with DMDD symptoms											
	2-5 years		6-16 years		2-5 years		6-16 years		2-5 years		6-16 years	
	Male	Female	Male	Female	White	Non-White	White	Non-White	Professional	Nonprofessional	Professional	Nonprofessional
Psychiatric	46.9	42.5	38.2	30.3	45.5	49.2	36.8	29.3	37.4	49.6	28.7	40.8
ADHD-C	54.5	47.8	40.4	34.7	54.5	41.7	39.7	30.2	33.3	61.1	32.5	42.6
Autism	46.1	44.1	43.5	40.3	45.1	51.1	43.5	35.6	39.4	48.2	34.2	47.9
ADHD-I	25.0	11.1	11.3	11.8	15.4	NA	11.6	9.5	12.5	20.0	10.6	12.2
ODD	94.5	92.6	84.5	79.8	93.9	96.2	83.2	85.7	96.6	93.4	77.4	86.1
General population			11.1	7.0			9.7	6.9			6.8	11.5
ODD			65.5	66.7			66.7	65.8			68.8	64.2

Note. DMDD = disruptive mood dysregulation disorder; ADHD-C = ADHD-combined; ADHD-I = ADHD-inattentive; ODD = oppositional defiant disorder.

sample, 74.2% of the children were male and 78.5% with DMDD symptoms were male. In the general population sample, 52.6% were male and 63.9% with DMDD symptoms were male.

Race

Race was not related to DMDD symptoms in any of the diagnostic groups (Table 4). Mean DMDD scores were similar for the White and non-White school-age children in the psychiatric and general population samples (t = 0.1 and 0.9, p > .35).

Parent Occupation

DMDD scores were higher for children in nonprofessional than professional families in the general population (t = 3.0, p = .003, d = 0.2) and total psychiatric preschool and school-age samples (t = 3.7 and 5.7, p < .001, d = 0.3), with higher DMDD percentages for all school-age diagnostic subgroups. In the school-age psychiatric sample, 61.9% had nonprofessional parents and 69.7% with DMDD symptoms had nonprofessional parents. In the general population sample, 51.1% had nonprofessional parents versus 63.9% of those with DMDD symptoms.

Multivariate Analyses

General population sample. When demographics (age, IQ, gender, race, and parent occupation) were entered simultaneously in regression analysis to predict DMDD scores, explained variance was only 3.4%. None of the demographic variables were significant in classifying children with and without DMDD symptoms and, together, did not improve classification accuracy beyond the sample base rate. The only variable significant in classifying children with and without DMDD symptoms was a diagnosis of ODD (94.9% overall classification accuracy, χ^2 = 241.1,

$p < .0001$). When the ODD total symptom score was considered with demographics in regression analysis, the only significant predictor of the DMDD score was the ODD score (explained variance 57.2%, $R = .76$, $F = 887.8$, $p < .0001$). When the ODD total symptom score was replaced with the oppositional behavior score (that did not include the two DMDD symptoms), the only significant predictor of the DMDD score was the oppositional behavior score (explained variance 47.9%, $R = .69$, $F = 609.4$, $p < .0001$).

School-age psychiatric sample. When demographics were entered in regression analysis, nonprofessional parent had the strongest association with the DMDD score ($R = .14$, $F = 32.0$, $p < .0001$), but explained variance was only 1.9%. The remaining demographic variables together increased explained variance by 1%. Nonprofessional was also the most significant contributor to the prediction of children with and without DMDD symptoms, but classification accuracy was only 63.8%, the same as the sample base rate.

When ODD was considered with demographics in regression analysis, only a diagnosis of ODD was significant in classifying children with and without DMDD symptoms, resulting in 88.0% classification accuracy ($\chi^2 = 1{,}050.9$, $p < .0001$). Classification accuracy increased by 0% when the remaining predictor variables (demographics and diagnoses of ADHD-C, ADHD-I, and autism) were considered. For children with ODD, 79.5% had DMDD symptoms. The percentage increased slightly to 82.5% for children who had ODD and the other variables significant in the univariate analyses (i.e., males with ODD, autism, IQ ≥ 80, and nonprofessional parents). Similarly, the ODD total symptom score was the strongest predictor of the DMDD score and explained 74.5% of the variance ($R = .86$, $F = 4{,}899.7$, $p < .0001$). The remaining variables increased explained by variance by <1%. When the ODD total symptom score was replaced with the oppositional behavior score (that did not include the two DMDD symptoms), the oppositional behavior score was the strongest predictor of the DMDD score and explained 44.8% of the variance ($R = .67$, $F = 1{,}361.0$, $p < .0001$). The remaining variables increased explained by variance by <3%.

School-age ADHD and autism subgroups. Results for the ADHD and autism subgroups analyzed separately were similar to each other and to those of the total psychiatric sample. For the ADHD sample, the ODD total symptom score was the strongest predictor of the DMDD score and explained 75.8% of the variance ($R = .87$, $F = 2{,}858.9$, $p < .0001$). The remaining variables (ADHD-C vs. ADHD-I and demographics) increased explained by variance by <1%. When the ODD total symptom score was replaced with the oppositional behavior score, the oppositional behavior score was the strongest predictor and explained 45.6% of the DMDD score variance ($R = .68$, $F = 762.8$, $p < .0001$). The remaining variables increased explained by variance by <2%. For the autism sample, the ODD total symptom score was the strongest predictor of the DMDD score and explained 71.6% of the variance ($R = .85$, $F = 1{,}925.7$, $p < .0001$). The remaining demographic variables increased explained variance by <1%. When the ODD total symptom score was replaced with the oppositional behavior score, the oppositional behavior score was the strongest predictor and explained 43.0% of the DMDD score variance ($R = .66$, $F = 576.8$, $p < .0001$). The remaining variables increased explained by variance by <1%.

Discussion

Findings for the general population and psychiatric subgroups (ADHD-C, ADHD-I, and autism) were strikingly similar, indicating that demographics contribute little to the presence or absence of DMDD symptoms and explained only 2% to 3% of the DMDD score variance. In contrast, oppositional behavior was a major DMDD correlate, and a diagnosis of ODD explained the majority of the variance.

Race

Race was not significantly related to DMDD symptoms in school-age children, similar to findings for antisocial behavior (Samaan, 2000) and behavior problems (Mayes, Calhoun, Aggarwal, et al., 2012).

Age

For school-age children, age was not associated with DMDD symptoms in the psychiatric and general population samples. However, DMDD symptoms were more common in preschoolers (46%) than in school-age children (36%) in the psychiatric sample. This is consistent with previous research showing that tantrums typically begin at ages 2 to 3 and cease by age 5 for most children (Osterman & Bjorkqvist, 2010). Our findings support the *DSM-5* stipulation that DMDD not be diagnosed below age 6 (because DMDD symptoms are common in preschoolers).

IQ

IQ was not related to DMDD symptoms in school-age children except that almost half with autism and an IQ ≥ 80 had DMDD symptoms, which was significantly more than those with autism and an IQ < 80. Other research has shown that anxiety and depression were more common in children with autism and an IQ ≥ versus < 80 (Mayes, Calhoun, Murray, & Zahid, 2011). DMDD symptoms, as well as anxiety and sadness, may be greater in children with autism who have high IQs because they may be more aware of their problems and differences than children with lower IQs, and because

they are more likely to be mainstreamed with typical peers, receive less individualized attention, and experience greater peer contact, social demands, academic expectations, and exposure to situations that are distressing for children with autism.

Gender

For school-age children in the general population and psychiatric subgroups (except ADHD-I), DMDD symptoms were greater in males than females. More behavior problems, aggression, and ODD are also reported in males than in females in general population studies (Card, Stucky, Sawalani, & Little, 2008; Lindgren & Koeppl, 1987; Maughan, Rowe, Messer, Goodman, & Meltzer, 2004) and in psychiatric samples (Carlson et al., 1997; Jensen, Martin, & Cantwell, 1997; Mayes, Calhoun, Aggarwal, et al., 2012). In our school-age psychiatric sample, the proportion of males in children with DMDD symptoms (78%) was similar to that of children with autism (73%), ADHD-C (76%), and ODD (77%). These conditions were all 3 to 4 times more common in males than in females. In the general population sample, twice as many males had DMDD symptoms as females. These findings support the *DSM-5* statement that males are more likely to have DMDD symptoms than females.

Parent Occupation

Strikingly, 50% of children in our psychiatric sample from nonprofessional families had DMDD symptoms and/or ODD (vs. 38% from professional families). The finding of more DMDD symptoms in children who have nonprofessional parents is consist with research showing that ODD symptoms are greater in lower than in higher SES families (Mayes & Calhoun, 2011; Mayes, Calhoun, Aggarwal, et al., 2012). Several factors may explain this relationship. Studies show that low SES mothers interact with their children in a more negative, rejecting, punitive, and inconsistent manner than higher SES mothers (Basic Science Task Force of the National Advisory Mental Health Council, 1996; Dodge, Pettit, & Bates, 1994; Samaan, 2000) and that this interaction style is related to child behavior problems and aggression (Dodge et al., 1994). Increasing psychosocial stress associated with low SES may directly increase the child's mood and behavior problems and decrease the parents' ability to effectively manage these problems. Parents who are genetically predisposed to mood and behavior problems may have difficulty in achieving professional occupations and may transmit mood and behavior problems that have a genetic component to their children (Mayes, Calhoun, Aggarwal, et al., 2012).

ODD

All of the demographic variables combined accounted for only 2% to 3% of the variance in DMDD symptoms. When a diagnosis of ODD was added to demographics in regression analysis, only ODD was significant and explained most of the variance in DMDD symptoms, suggesting that ODD is a robust predictor of DMDD symptoms.

Limitations and Directions for Future Research

The psychiatric sample consisted of children at a single site who had ADHD and autism, which limits the generalizability of our findings. Likewise, our general population sample was limited to children 6 to 12 years with IQs 71 or higher. Younger and older children and children with lower IQs need to be studied. Our analysis used maternal ratings of DMDD symptoms, which needs to be replicated using different sources and measures. Our study focused specifically on DMDD symptoms and not additional *DSM-5* DMDD diagnostic criteria, which should be considered in future research. Last, there are other environmental factors, such as parental warmth and parenting skills, which we did not investigate that may be related to DMDD symptoms. Although, the negligible association we found between demographics and DMDD symptoms suggest a biological basis for DMDD symptoms, this cannot be assumed without investigating other potential environmental correlates and conducting genetic research.

Conclusion

DMDD symptoms were more common in males than in females, in children of nonprofessional than professional parents, and in children with autism with an IQ ≥ versus < 80. However, demographic variables together explained little of the variance in DMDD symptoms, whereas ODD explained most of the variance. Our findings and those of others indicate that almost all children with DMDD symptoms have ODD (Axelson et al., 2012; Mayes et al., 2016; Mayes et al., 2015). In contrast, approximately one third of referred and community children with ODD do not have DMDD symptoms (Gadow & Drabick, 2012; Mayes et al., 2016; Mayes et al., 2015). In spite of this, children meeting criteria for DMDD are precluded by the *DSM-5* from being diagnosed with ODD. According to the *DSM-5*, children with ADHD-C can be diagnosed with DMDD, but for autism, DMDD is not diagnosed if the symptoms are better explained by the autism. It is not clear why DMDD can be diagnosed with some disorders but not others. Notably, ODD does not have the same *DSM-5* diagnostic restrictions. Because of the redundancy of DMDD symptoms with ODD and other concerns, the World Health Organization's International Classification of Diseases-11th Edition

(ICD-11) task force recommends that DMDD not be included in the 2017 ICD-11 as a separate disorder and that chronic irritability and anger should be an ODD specifier instead (Lochman et al., 2015). Our research supports this recommendation.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Dr. Waxmonsky has received research funding in the past from Janssen and Noven Shire, is on the Noven Shire advisory board, and is a member of the speaker's bureau for Quintiles. The remaining authors have no conflicts of interest.

Funding

The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This study was supported by National Institutes of Health grants RO1 HL063772, MO1 RR10732, and CO6 RRO16499.

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