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ORIGINAL ARTICLE

Temper Loss and Persistent Irritability in Preschoolers: Implications for Diagnosing Disruptive Mood Dysregulation Disorder in Early Childhood

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Abstract Disruptive Mood Dysregulation Disorder (DMDD) is a new and controversial child psychiatric disorder characterized by persistent irritability and frequent temper loss. Among the controversies surrounding DMDD is whether the age of onset criterion—that DMDD may not be diagnosed before age 6 years—is justified. This study examined DMDD symptoms and associated patterns of psychiatric comorbidity, behavioral, and family functioning in a sample of 139 preschoolers (ages 4–0 to 5–11 years) admitted to an early childhood psychiatric day treatment program. DMDD symptoms were common in this acute clinical sample, with 63 children (45.3 %) presenting with frequent temper outbursts and chronic irritability. As compared to children who did not present with DMDD symptoms, these children demonstrated more aggression and emotional reactivity and lower receptive language skills, with high rates of comorbidity with the disruptive behavior disorders. Findings contribute to an emerging literature on preschool DMDD, with implications for early childhood psychiatric assessment and clinical interventions.

Keywords Disruptive Mood Dysregulation Disorder (DMDD) · Preschoolers · Irritability · Temper loss · Comorbidity

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Introduction

Disruptive Mood Dysregulation Disorder (DMDD) is a child psychiatric disorder characterized by non-episodic irritability and frequent temper loss, with symptoms persisting for at least 12 months duration. Although recently incorporated into the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders [1], DMDD remains a controversial diagnosis, with continued questions surrounding its nature and developmental expression [2].

Central to the DMDD controversy is debate as to its diagnostic distinctiveness, and particularly whether the disorder is unique from other, closely related diagnoses, such as Oppositional Defiant Disorder (ODD) and Major Depressive Disorder (MDD). For example, in their study of DMDD symptoms in 6- to 12-year-old children drawn from the Longitudinal Assessment of Manic Symptoms (LAMS) study, Axelson et al. [3] found that DMDD was not clearly delineated from ODD or Conduct Disorder (CD). In addition, they found only modest diagnostic stability and, although youth with DMDD were rated as more functionally impaired, there was no association with new onset of mood or anxiety disorders over a 2-year follow-up period [3]. Conversely, Copeland et al. [4] have argued that, although frequently comorbid with other psychiatric diagnoses, DMDD may describe a unique group of children with severe clinical impairments in both mood and behavioral regulation. Drawing on data from three community-based study samples, they found that DMDD was frequently comorbid with other emotional or behavioral disorders, but that children who met criteria for DMDD evidenced significantly greater social impairments and higher rates of service utilization [4]. Other researchers have similarly reported increased clinical impairment and psychiatric co-morbidity in youth meeting criteria for

DMDD, with particularly high rates of co-occurrence with depressive, oppositional-defiant, and attention-deficit/hyperactivity disorders [5, 6].

Another controversy surrounding DMDD is whether the age of onset criterion—that DMDD may not be diagnosed before age 6 years—is justified. The rationale for this criterion was to restrict the use of the diagnosis to the age groups for which a research foundation had been established [1] and was based on published research on severe mood dysregulation (SMD), a related but not identical syndrome characterized by non-episodic irritability and hyperarousal that has been studied in a cohort of youth over the age of 7 years [7]. However, it is of note that the average age of illness onset within the SMD cohort was reported to be 4.9 years [7], suggesting that DMDD symptoms might become apparent during the preschool years. Further, a compelling argument for the inclusion of DMDD in the DSM-5 was the potential for decreasing rates of diagnosis of pediatric Bipolar Disorder [8], a diagnosis for which there is no age-related criterion and that has been increasingly applied to preschool-aged children [9–12].

We are aware of only two previous studies to date that have examined DMDD symptoms in a sample of children under the age of 6 years. Kessel et al. [13] examined DMDD symptoms in a longitudinal community sample of 3-year-olds and found that parent-reported DMDD symptoms at age three were associated with psychopathology and reward processing abnormalities at middle childhood. Specifically, children who presented with DMDD symptoms at age three demonstrated increased anxiety, ODD, and ADHD symptoms at age nine, as well as increased neural sensitivity to reward, offering support for the predictive validity of preschool DMDD [13]. In a study of the prevalence of DMDD in three community-based samples, Copeland et al. [4] presented data on DMDD symptoms in a sample of 2- to 5-year-old children from the Duke Preschool Anxiety Study. In this preschool sample, 58 children (3.3 %) were identified as meeting full criteria for DMDD and co-morbidity with all other common psychiatric disorders was high (92 %), with the highest rates of co-occurrence with oppositional defiant, attention-deficit/hyperactivity, and depressive disorders. These findings were largely consistent with those described for the study's two older samples (ages 9–13 and 9–17 years), suggesting that the age of onset criteria may be unjustified [4].

On the other hand, the assessment of DMDD in preschool-aged children poses a number of challenges, including the need to distinguish emergent DMDD symptoms from normative expressions of emotion dysregulation in early childhood (e.g., temper tantrums in young children), a lack of empirical data on the developmental stability of DMDD, and the extent to which DMDD symptom expression may be shaped by family context variables.

Indeed, the bidirectional associations between caregiver mental health, parental stress, family relationships and various forms of early childhood psychopathology, including depression and ODD, have been well established [14, 15]. In contrast, there is very limited research available on the family correlates of DMDD, although several studies have documented links between DMDD and parenting and family psychiatric history variables in school-aged samples [6, 16]. Of note, one study of early childhood predictors of DMDD found that several family variables—including parenting behavior, marital satisfaction, and parental psychopathology—were associated with DMDD symptoms at age 6 years [5], suggesting that a focus on family and caregiver factors may be particularly important to our understanding of the earliest manifestations of this disorder.

In summary, DMDD remains a controversial psychiatric diagnosis and there is a need for additional research to explore its prevalence, nature, and correlates. There is also a need to better understand the earliest developmental expressions of DMDD and to consider whether the diagnosis might be useful in understanding and describing serious mood and behavioral impairments in preschool–school aged children. In the present study, we examined modified diagnostic criteria for DMDD in an acute clinical sample of 4- to 5-year-old children admitted to a specialized early childhood psychiatric partial hospitalization program. We had three specific study aims:

1. To determine the frequency with which clinically referred preschool-aged children met modified diagnostic criteria for DMDD, including frequent temper loss (with tantrums occurring at least 3/week) and persistent irritability (with irritable mood present most days for at least 1 year). Given the clinical acuity of the study sample, we expected that a relatively high percentage of participating children would demonstrate irritability and temper loss symptoms, although with a smaller proportion of children meeting DMDD criteria for symptom frequency and duration.

2. To determine whether preschoolers who presented with DMDD symptoms demonstrated more impaired behavioral functioning, as compared to preschoolers who do not present with DMDD symptoms. We also examined patterns of co-morbidity between DMDD symptoms and other common psychiatric disorders, including depressive, oppositional defiant, attention-deficit/hyperactivity, post-traumatic stress, and anxiety disorders. Based on the literature on DMDD in school-aged children, we hypothesized that young children who presented with core DMDD symptoms would demonstrate high levels of behavioral impairment and

comorbidity with other psychiatric diagnoses, particularly depression, ODD, and ADHD.

3. To determine whether the mothers of preschoolers who presented with DMDD symptoms reported more difficulties in family functioning, including increased parenting stress, depressive symptoms, and family psychiatric problems, as compared to the mothers of children who did not present with DMDD. Given very limited previous research on DMDD as associated with family functioning and parental psychiatric history, we considered this research question to be exploratory in nature.

Methods

Participants

Participants were 139 children, ages 4-years–0-months to 5-year–11-months ($M = 60.22$ months, $SD = 7.01$), who presented to a hospital-based day treatment program for young children with severe emotional and behavioral problems. Children were referred to the day treatment program by community providers (including mental health providers and agencies, pediatricians, medical hospital emergency departments, and school/daycare programs) and presented with a wide variety of significant clinical concerns, including severe aggression, self-injurious behavior, out-of-control tantrums, anxiety and mood difficulties, and highly uncooperative and oppositional behavior. Consistent with the demographic makeup of the population served by the treatment program, 105 (75.5 %) of the participating children were male. Eight (5.8 %) of the participating children were African-American, 83 (59.7 %) were European-American, 13 (9.4 %) were Hispanic-American, and 35 (25.2 %) represented other or unspecified ethnic identities. Some participating families declined to provide information about family income and parent educational attainment; this information was available for 82 and 122 participating families, respectively. For the families who did provide this information, median yearly household income was reported to be $40,000, with 84 % of mothers having at least a high school education.

Procedures

The hospital's Institutional Review Board approved all study procedures and measures. A parent or guardian provided informed consent for child and family participation in the study. Study inclusion criteria were that the participating child was between 4–0 and 5–11 years of age, that the family was proficient in English, and that a parent or guardian completed modules for both Oppositional Defiant Disorder and Major Depressive Disorder from the Diagnostic Infant and Preschool Assessment (DIPA) [17]. Children who had been previously admitted to the treatment program were excluded from the present study, as were children who obtained a standard score below 70 on a test of receptive language skill (Peabody Picture Vocabulary Test; PPVT-IV) [18]. The DIPA, PPVT, and all other study measures were administered to participating children and families shortly after program admission, usually within 1 week.

Measures

Diagnostic Assessment of DMDD

Parents of participating children completed the Diagnostic Infant and Preschool Assessment (DIPA) [17], a semi-structured interview administered to caregivers of preschool aged children (under 7 years) by trained Master's level or Ph.D. interviewers. Most often, the participating parent was the biological mother (n = 93, 66.9 %) or both biological parents (n = 20, 14.4 %), although non-maternal caregivers (e.g., biological father only, adoptive parents) served as interview informants for 26 (18.7 %) of the participating children.

The DIPA assesses for 13 DSM-IV disorders, using self-contained modules, and takes approximately 2 hours to complete. Interviewers follow up each scripted question with probes for examples, in order to confirm that endorsed problems meet specific symptom criteria for each disorder. The DIPA has been shown to have acceptable test–retest reliability and criterion validity for commonly occurring DSM-IV diagnoses, including Oppositional Defiant Disorder, Attention-Deficit/Hyperactivity Disorder, and Separation Anxiety Disorder [17].

The DIPA was not designed to assess DMDD, however because DMDD criteria overlap with those of other child psychiatric disorders, we were able to assess for core DMDD symptoms, with modifications, as follows:

- Criteria A–B: Severe recurrent temper outbursts, inconsistent with developmental level, were assessed using the temper loss criterion ("does s/he either lose his/her temper or throw temper tantrums more than average, that is, screaming or crying when s/he doesn't get his/her way, throwing or breaking things when mad, or hitting people?") from the ODD module.
- Criterion C: Temper outbursts occur at least three times per week, on average, was assessed using the frequency of temper outbursts criterion from the ODD module.
- Criterion D: persistently irritable or angry mood was assessed using the irritability criterion ("has s/he been

more irritable than usual? I mean, made angry easily or had more frequent tantrums?") from the MDD module. With respect to frequency of irritable mood, we assessed for whether irritability was present at least 5 days per week, on average.

- Criterion E: Duration of symptoms A–D for at least 12 months was partially assessed. Specifically, we were able to evaluate the duration of irritability symptoms (but not temper loss symptoms), as the DIPA only queries for duration of ODD symptoms if the child meets for full diagnostic criteria. In contrast, duration of irritability is queried regardless of whether the child meets full diagnostic criteria for MDD.

- Criterion F: Impairment in multiple settings was not assessed, as the DIPA does not query for cross-setting impairment unless full diagnostic criteria are met. In other words, we were unable to determine whether children who presented with temper loss and irritability but who did *not* meet full criteria for another psychiatric disorder demonstrated impairment in multiple settings.

- Criteria G and H: Given our focus on preschool-aged children, age-related criteria (i.e., that the diagnosis is not made before age 6 years, with age of onset before 10 years) were not applied.

- Criteria I-K: In addition, given our interest in exploring patterns of comorbidity with other psychiatric diagnoses, we did not apply criteria involving exclusions for mania,[1] Major Depressive Disorder, or other psychiatric disorders. We did not assess for criteria related to substance use or underlying neurological or medical conditions.

Diagnostic Assessment of Other Psychiatric Diagnoses

In addition to the assessment of DMDD, the DIPA was used to assess for the other following psychiatric disorders, using DSM-IV criteria: MDD, ODD, ADHD, Anxiety Disorders (including Separation Anxiety Disorder, Generalized Anxiety Disorder, and Social Phobia), and Post-traumatic Stress Disorder (PTSD). In addition, the child's lifetime exposure to traumatic life events was assessed as part of the PTSD module of the DIPA. Parents/caregivers reported on the child's lifetime exposure to 11 different traumatic life events, including experiences such as serious accidents, physical or sexual abuse, and invasive medical procedures.

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[1] Information on mania/Bipolar Disorder symptoms (as assessed using the DIPA) was available for 126 children. These symptoms were very rare; only two children met criteria for Bipolar Disorder, one of whom also met our modified DMDD criteria.

Child Behavioral Functioning

Child behavioral functioning was assessed using the Child Behavior Checklist for Ages 1½–5 (CBCL/1½–5) [19], a widely used and well-validated measure of early childhood behavior problems. Mothers of 119 participating children completed the CBCL at the time of admission to the treatment program. The CBCL includes 99 problem items and yields standardized scores for child functioning on seven narrow-band scales, including Emotionally Reactive, Anxious/Depressed, Somatic Complaints, Withdrawal, Sleep Problems, Aggressive, and Attention Problems. Children also completed the Peabody Picture Vocabulary Test (PPVT-IV) [18], a measure of receptive vocabulary, with well-established age norms and demonstrated reliability and validity.

Family Functioning and Parental Psychiatric History

We assessed three areas of family and parental functioning: current maternal depressive symptoms, current maternal parenting stress, and mother-reported parental psychiatric history. Maternal depressive symptoms and parenting stress were assessed using Center for Epidemiological Studies Depression scale (CESD) [20] and the Parenting Stress Index—Short Form (PSI/SF) [21], completed by 116 and 120 mothers, respectively. These measures are widely used in both clinical and community samples, with good demonstrated reliability and validity [21–23]. The CESD includes 20 items, summed to create a total score, with scores above 16 considered to be clinically elevated. The PSI/SF includes 36 items, summed to form three scales (Parent Distress, Parent–Child Interactional Dysfunction, and Child Difficulty).

In addition, 82 mothers completed the Family History Screening (FHS) [24], a structured interview that assesses the psychiatric status of first- and second-degree relatives of the child and yields acceptable reliability and validity when compared to diagnoses based on direct interview [24]. For the purposes of this study, we focused on maternal self-reported psychiatric symptoms (i.e., total number of past and current symptoms endorsed for depression, mania, anxiety, substance use, schizophrenia, ADHD, and Conduct Disorders). In addition, 49 mothers reported on paternal psychiatric history.

Statistical Analyses

Descriptive statistics were used to examine the frequency with which participating children demonstrated each of the core symptoms of DMDD. A series of univariate analyses were then performed, comparing children who met modified diagnostic criteria for DMDD with children who did

not meet DMDD criteria. These analyses included independent samples t tests (for continuous variables), χ^2 tests (for categorical variables), and odds ratios (for comorbidity analyses). Given the very limited previous research on DMDD in preschoolers and the exploratory nature of the current study, we considered an increased risk of Type I error to be acceptable and did not adjust significance levels for multiple tests. Effect sizes (Cohen's d, Cramer's ϕ, or OR) were calculated for all tests.

Results

Descriptive Findings

The frequencies with which participating children met modified DMDD criteria are presented in Table 1. As shown, temper outbursts and irritability were common concerns in this acute clinical sample. When frequency and duration criteria were applied, a total of 63 children (45.3 %) were reported to demonstrate both temper outbursts (at least 3 days per week) and persistent irritability (at least 5 days per week), with irritability symptoms present for at least 12 months. For subsequent analyses, we considered these 63 children to meet our modified DMDD criteria (DMDD+).

We examined demographic characteristics of children who met modified DMDD criteria (DMDD+), as compared to children who did not meet DMDD criteria (DMDD−). There were no differences with respect to any of the demographic factors assessed, including child sex [73 % male (n = 46) for DMDD+ and 77.6 % male (n = 59) for DMDD−, χ^2 (1, N = 139) = 0.40, p = ns, ϕ_{Cramer} = .05], child age [M = 59.76 months (SD 6.86) for DMDD+ and

M = 60.61 (SD 7.16) for DMDD−, t (137) = 0.71, p = ns, d = .12], family annual income [M = \$59,100 (SD 46,715) for DMDD+ and M = \$56,234 (SD 60,344) for DMDD−, t (80) = 0.23, p = ns, d = .05], and maternal educational attainment [84.6 % (n = 59) completed high school for DMDD+ and 84.3 % (n = 44) completed high school for DMDD−, χ^2 (1, N = 139) = .002, p = ns, ϕ_{Cramer} < .01].

Child Behavioral Functioning and Psychiatric Comorbidity

We used independent samples t tests to examine the behavioral functioning of children who met criteria for DMDD, as compared to children who did not meet DMDD criteria. These analyses are presented in Table 2. As shown, children who met criteria for DMDD were reported by their mothers to be significantly more emotionally reactive and aggressive. These children also had lower receptive language skill scores. Effect sizes for these differences ranged from small to medium. The groups did not differ with respect to mother-reported anxiety/depression, somatic complaints, withdrawal, sleep problems, or attention problems.

Odds ratios were then used to evaluate the extent to which DMDD co-occurred with other common psychiatric disorders. As shown in Table 2, DMDD+ children had higher rates of ODD and ADHD but not increased rates of MDD, anxiety disorders, or PTSD. The groups also did not differ with respect to children's total lifetime exposure to traumatic events [M number of events = 1.24 (SD 1.24) for DMDD+ and M = 0.91 (SD 1.22) for DMDD−, t (137) = 1.57, p = ns, d = 0.27], although the DMDD+ group was more likely to have experienced at least *one* traumatic event [65 % (n = 41) for DMDD+ and 46 %

Table 1 Frequency of DMDD symptoms

	N (%)
Criteria A and B	
Severe recurrent temper outbursts, inconsistent with developmental level	128 (92.1 %)
Criterion C	
Temper outbursts occur at least 3x/week	118 (84.9 %)
Criterion D	
Persistent irritability	108 (77.7 %)
Irritability present 5+ days/week	94 (67.6 %)
Criterion E*	
Duration of irritability at least 12 months	77 (55.4 %)
Criteria A–E*	
Temper outbursts (3x/week) and irritability (5+ days/week), with duration of irritability at least 12 months	63 (45.3 %)

* Criterion E (duration of symptoms) applied to irritability only

Table 2 Child behavioral functioning and psychiatric comorbidities by Disruptive Mood Dysregulation Disorder (DMDD) status

	DMDD+		DMDD−		t	Cohen's d
	M	SD	M	SD		
Behavior problems (CBCL)						
CBCL: Emotionally reactive	71.98	9.32	67.15	10.69	2.59*	.48
CBCL: Anxious/depressed	66.57	11.55	63.58	11.26	1.42	.26
CBCL: Somatic complaints	58.72	8.62	57.41	8.66	0.82	.15
CBCL: Withdrawn	66.23	10.14	64.82	10.29	0.75	.14
CBCL: Sleep problems	65.11	13.10	63.83	13.95	0.51	.09
CBCL: Attention problems	67.49	7.79	65.26	9.00	1.43	.26
CBCL: Aggressive behavior	80.04	11.30	72.59	13.35	3.23**	.60
Receptive language skills (PPVT)						
PPVT: Picture vocabulary	98.14	14.93	103.42	13.82	2.16*	.37

	DMDD+		DMDD−		OR	95 % CI
	n	%	n	%		
Psychiatric diagnoses (DIPA)						
ODD+	52	82.5	50	65.8	2.46*	1.10–5.50
ODD−	11	17.5	26	34.2		
MDD+	20	31.7	21	27.6	1.22	0.59–2.53
MDD−	43	68.3	55	72.4		
ADHD+	42	66.7	38	50.0	2.00*	1.003–3.99
ADHD−	21	33.3	38	50.0		
Anxiety Disorder+	25	41.0	32	43.2	0.91	0.46–1.81
Anxiety Disorder−	36	59.0	42	56.8		
PTSD+	12	19.0	11	14.5	1.39	0.57–3.41
PTSD-	51	81.0	65	85.5		

DIPA Diagnostic Infant and Preschool Assessment, *CBCL* Child Behavior Checklist, *PPVT* Peabody Picture Vocabulary Test

* $p < .05$; ** $p < .01$

(n = 35) for DMDD−, χ^2 (1, N = 139) = 5.03, $p < .05$, $\phi_{Cramer} = 0.19$].

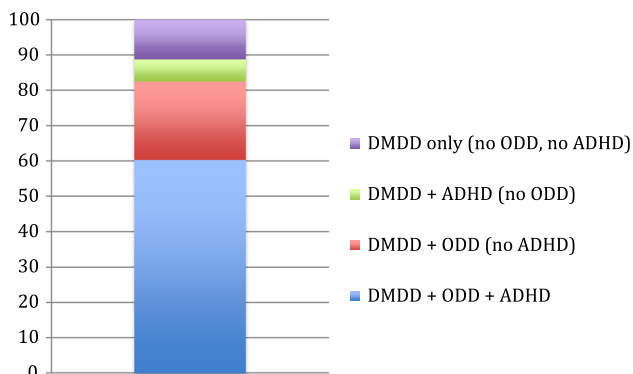The pattern of comorbidity with ODD and ADHD is depicted in Fig. 1. As shown, DMDD rarely occurred in isolation and commonly co-occurred with disruptive behavior disorders, including both ODD and ADHD. Of the 63 children who met criteria for DMDD, 52 (82.5 %) also met criteria for ODD, with 38 (60.3 %) of these children also meeting criteria for ADHD. Only 7 children met criteria for DMDD in the *absence* of a co-occurring disruptive behavior disorder.

Family Functioning and Parental Psychiatric History

With respect to family functioning (Table 3), there were no group differences in maternal depression (CES-D) or on most dimensions of maternal parenting stress (PSI), although mothers of children who met DMDD criteria reported their child's behavior to be more difficult and challenging to manage. DMDD+ children did not differ from DMDD− children on mother-reported maternal or paternal psychiatric history, as assessed using the FHS

Fig. 1 Co-occurring ODD and ADHD (%) in Children with DMDD (n = 63)

- DMDD only (no ODD, no ADHD)
- DMDD + ADHD (no ODD)
- DMDD + ODD (no ADHD)
- DMDD + ODD + ADHD

Table 3 Family functioning and parental psychiatric history by Disruptive Mood Dysregulation Disorder (DMDD) status

	DMDD+		DMDD−		t	Cohen's d
	M	SD	M	SD		
Maternal depressive symptoms (CESD)						
Maternal depression symptoms	19.96	10.33	19.50	13.47	0.20	.38
Maternal parenting stress (PSI)						
Parental distress	31.28	9.10	31.10	10.18	0.10	.02
Parent–child dysfunctional interaction	27.66	7.99	26.30	7.97	0.93	.17
Difficult child	43.08	7.03	39.63	8.75	2.33*	.43
Parental psychiatric history (FHS)						
Maternal depression	11.18	4.80	10.11	5.40	0.94	.21
Maternal mania	4.68	3.76	3.45	3.07	1.63	.36
Maternal anxiety	7.79	3.90	6.68	4.88	1.12	.25
Maternal substance use	1.42	2.82	0.86	3.05	0.85	.19
Maternal schizophrenia	0.39	1.02	0.23	0.77	0.84	.18
Maternal ADHD	11.28	8.59	10.09	8.53	0.63	.14
Maternal conduct disorder	0.97	1.44	1.02	1.80	0.14	.03
Paternal depression	9.45	6.16	6.89	5.99	1.47	.42
Paternal mania	5.72	4.18	5.00	5.62	0.50	.15
Paternal anxiety	4.05	4.51	2.92	4.44	0.87	.25
Paternal substance use	4.81	7.06	4.96	7.34	0.07	.02
Paternal schizophrenia	0.76	1.87	0.41	1.15	0.81	.23
Paternal ADHD	14.60	11.04	11.04	10.14	1.13	.34
Paternal conduct disorder	2.64	3.46	3.60	4.77	0.44	.23

CES-D Center for Epidemiological Studies Depression Scale, PSI Parenting Stress Index, FHS Family History Screen

* $p < .05$

(Table 3). There were no differences with respect to any parental psychiatric diagnoses assessed, including depression, mania, anxiety, substance use, schizophrenia, ADHD, and Conduct Disorder.

Exploratory Analyses

Copeland and colleagues (2013) [4] discussed the possibility of increasing frequency criteria to daily (from three times per week for temper outbursts and nearly every day for irritability) in order to diagnose DMDD in children younger than 6 years. To explore this possibility in our data, we computed alternative frequency threshold variables to reflect daily temper outbursts and irritability (i.e., symptoms present 7 days per week, on average). We found that when these more stringent criteria were applied, 107 children (77.0 %) were reported to demonstrate daily temper outbursts and 89 children (64.0 %) were reported to demonstrate daily irritability. Fifty eight children (41.7 %) demonstrated both symptoms daily, with irritability present for at least 12 months.

We then explored patterns of comorbidity, behavioral, and family functioning for the 58 children who met these more stringent DMDD frequency criteria. Findings were generally consistent with those reported for the original 63 DMDD+ children. Specifically, DMDD characterized by daily temper outbursts and irritability (DMDD+) was associated with increased rates of ODD (OR 2.40, 95 % CI 1.05–5.47, $p < .05$), with increased mother-reported emotional reactivity [CBCL Emotionally Reactive $M = 72.27$, SD 9.55 for DMDD+ and $M = 67.30$, SD 10.45 for DMDD−, t (117) = 2.64, $p < .01$, $d = .50$] and aggression [CBCL Aggression $M = 80.15$, SD 11.57 for DMDD+ and $M = 73.04$, SD 13.16, t (117) = 3.03, $p < .01$, $d = .57$], with increased parenting stress related to challenging child behavior [PSI Difficult Child $M = 43.42$, SD 7.02 for DMDD+ and $M = 39.64$, SD 8.60 for DMDD−, t (118) = 2.53, $p < .05$, $d = .48$], and with lower PPVT scores [$M = 97.59$, SD 13.75 for DMDD+ and $M = 103.49$, SD 14.64 for DMDD−, t (137) = 2.41, $p < .05$, $d = .42$]. Of note, when these more stringent DMDD criteria were applied, the rate of co-occurrence with ADHD was no longer significant (OR 1.77, 95 % CI 0.88–3.54, $p = $ ns). Consistent with findings from the original 63 DMDD+ children, there were no significant differences with respect to family psychiatric history.

Finally, while most children with DMDD also met criteria for ODD, approximately half of the children who met criteria for ODD did *not* meet criteria for DMDD, largely due to the absence of persistent irritability. As such, we compared children who met criteria for both ODD and DMDD (ODD+/DMDD+, n = 52) with children who met criteria for ODD but not DMDD (ODD+/DMDD−, n = 50) to determine whether these children differed on indices of behavioral and family functioning, or in their patterns of association with MDD, ADHD, and anxiety disorders. There were no differences with respect to any demographic, parent, or family variables (including the CESD, PSI, and FHS). With respect to child behavioral functioning, children who met criteria for both ODD and DMDD had higher CBCL Aggression scores [$M = 82.71$, SD 10.87 for ODD+/DMDD+ and $M = 77.41$, SD 11.49 for ODD+/DMDD−, $t (85) = 2.00$, $p < .05$, $d = .43$] and lower PPVT scores [$M = 98.13$, SD 14.35 for ODD+/DMDD+ and $M = 104.26$, SD 13.05 for ODD+/DMDD−, $t (100) = 2.25$, $p < .05$, $d = 0.45$]. There were no differences with respect to rates of co-occurrence with MDD, ADHD, or anxiety disorders.

Discussion

This study examined parent-reported DMDD symptoms in clinically referred preschool-aged children. Results suggest that core DMDD symptoms—recurrent temper outbursts and persistent irritability—can be identified in children as young as 4 years of age, and indeed, were very common presenting concerns for preschool-aged children referred for psychiatric partial hospitalization. In fact, temper loss and irritability symptoms were endorsed as problems for the majority children in this acute clinical sample, although application of frequency and duration criteria limited the overall DMDD prevalence rate to 45.3 % (63 children). This rate was reduced only slightly (to n = 58, 41.7 %) when more stringent frequency criteria (i.e., symptoms present daily) were applied. These findings suggest that although many clinically referred young children present with symptoms of irritability and temper loss, there appears to be an identifiable group of children for whom such symptoms impact daily functioning over an extended period of time.

To our knowledge this is only the third study to examine DMDD symptoms in children younger than 6 years of age (see also [4, 13]) and the only such study to focus on an acute clinical sample. In this regard, the relatively high rate of DMDD symptoms in our sample was unsurprising, given that young children referred for psychiatric partial hospitalization typically present with very serious problems in emotion and behavior regulation. However, even within this highly acute sample, children who presented with core DMDD symptoms were reported to be more aggressive, more emotionally reactive, and to present their caregivers with more challenging behaviors, as compared to children who did not present with DMDD symptoms. Moreover, these behavioral differences occurred in the absence of significant differences in demographic variables, including child age and sex, family income, and maternal education. In this way, it seems that the core DMDD diagnostic criteria can be applied to preschool-aged children and may effectively describe a constellation of symptoms that are highly impairing and disruptive to young children and their families. These findings would also seem to suggest, consistent with Copeland et al. [4], that restriction of the DMDD diagnosis to children older than 6 years may be unjustified.

We also examined patterns of comorbidity between DMDD and other common psychiatric disorders, including depressive, oppositional defiant, attention-deficit/hyperactivity, anxiety disorders, and PTSD. Most notably, we found that DMDD rarely occurred in isolation and commonly co-occurred with disruptive behavior disorders, including both ODD and ADHD, although the association to ADHD was attenuated when we focused only on children who evidenced daily DMDD symptoms or when we included only children for whom ODD was also present. These findings are consistent with several recent studies of DMDD suggesting particularly high rates of comorbidity with ODD [3–5, 25], with some studies also suggesting co-occurrence with ADHD [26]. Consistent with these findings, results of the present study suggest that young children who meet criteria for DMDD may present with a very complex clinical picture, characterized by a wide range of psychiatric symptoms and severe disruptions in behavioral functioning. Our findings are also consistent with recent research on the role of irritability and emotion dysregulation in the development and expression of disruptive behavior disorders, including both ODD and ADHD [27–29]. Moreover, it is likely that the associations between early mood dysregulation and disruptive behavior problems are bi-directional and mutually exacerbating, with irritability and emotional reactivity contributing to poor behavioral self-regulation and with frequent loss of behavioral control contributing to increasing feelings of frustration and distress.

In contrast, we did not find that children with DMDD demonstrated higher rates of co-occurring MDD, as has been reported in other studies, particularly those focusing on community and population samples of school-aged children [4, 5]. It is possible that children presenting with DMDD at age 4 and 5 have not yet developed a full constellation of depressive symptoms; longitudinal research will be necessary to describe the developmental trajectories

of these highly irritable and reactive young children, and to evaluate for emergent associations with depressive disorders across middle childhood and adolescence. Children with DMDD also did not differ with respect to rates of anxiety disorders, PTSD, or mean number of traumatic life event experiences, although children with DMDD were more likely to have experienced at least *one* traumatic life event. Such a finding suggests that it will be important for future research to consider the role of adverse life experience in the early development of DMDD symptoms. For example, exposure to stressful life events might interact with other child and family vulnerability factors in the early onset of DMDD, and indeed, such a possibility would be quite consistent with research on the role of stressful life events in the early development of depressive disorders [30].

The rates of comorbidity between DMDD and other psychiatric disorders are relevant to discussions of its diagnostic distinctiveness. In particular, the frequent rate of co-occurrence with ODD is central to debate as to whether DMDD is a distinct disorder or rather represents a subset of children with ODD for whom chronic irritability is a prominent clinical feature. Several researchers, have argued for this perspective, suggesting that severe irritability might be best represented as a course specifier for ODD as well as other diagnoses [25, 31, 32]. On the other hand, comorbidity in child psychopathology is common and the rates of overlap between DMDD and the other disorders assessed in this study are consistent with those reported in other studies of psychiatric comorbidity in young children [33]. It is also the case that irritability in particular is a symptom that cuts across multiple psychiatric diagnoses [16], such that the frequency with which DMDD co-occurs with other disorders is perhaps not surprising. Moreover, we found that even among young children who met criteria for ODD, the presence of DMDD symptoms was associated with more severe aggressiveness and decreased language competency, suggesting that the clinical problems and impairments associated with early DMDD cannot be fully explained by the presence of ODD only. Of note, early aggression and impaired language have also been identified as predictors of Conduct Disorder [34, 35], such that children presenting with both ODD and DMDD may also be at particularly high risk with respect to the development of more stable and serious conduct problems over time.

Yet regardless of whether conceptualized as a core feature of a distinct disorder or as a trans-diagnostic symptom associated with multiple psychiatric disorders, findings from this and other studies point to the importance of additional research on irritability in preschool-aged children. Indeed, several recent studies suggest that young children who present with irritability are at risk for a host of poor mental health outcomes, both concurrently and longitudinally [36]. Further, Cole and colleagues have argued that that an understanding of the role of emotions in the development of psychopathology will be enhanced by focusing not only on the presence or absence of negative affect, but also by its temporal and intensive features [37]. This perspective is consistent with our own clinical experience, as we often find that young children who are most impaired by their angry, irritable, and frustrated moods not only experience such moods intensely and frequently, but also struggle to recover from bouts of emotional upset and are less responsive to external regulatory support (e.g., caregiver efforts to soothe or distract). Moreover, that many children in our sample presented with irritability and temper outbursts but did not meet frequency and duration criteria for DMDD raises the possibility that DMDD in young children may be characterized less so by qualitative differences in mood and behavioral disruption and more so by quantitative differences in the intensity and persistence of such problems. Future longitudinal research will be critical to further exploring the dimensions and qualities of early irritability and temper loss and to evaluating the developmental course and stability of DMDD symptoms—including sub-threshold symptoms—over time.

This study had several limitations. Most importantly, this study was not designed to assess for DMDD and we instead adapted criteria from other DSM-IV diagnoses to retrospectively identify children who presented with core DMDD symptoms. Although this retrospective approach has been used in most DMDD studies to date, a particular concern is that this method may overestimate the degree of association with the diagnoses on which the DMDD criteria were based (i.e., MDD and ODD). Also, we were not able to confirm that DMDD symptoms occurred across multiple settings, although given the clinical acuity of the study sample, it seems likely that most children's difficulties in mood and behavior regulation were quite pervasive. In addition, because 56 of the 63 DMDD+ children also met criteria for ODD and/or ADHD, we were able to evaluate cross-setting impairment for these children using DIPA criteria from ODD and ADHD modules; all but two children were reported to demonstrate difficulties in more than one setting and most children demonstrated difficulties in multiple settings (e.g., home, school/daycare, community).

An additional study limitation was our reliance on parent-report of child psychiatric symptoms, behavioral impairment, and family functioning, such that associations between these variables might be inflated due to shared reporter variance. Although we incorporated a range of parent-report methods and measures—including a comprehensive diagnostic interview, a structured psychiatric screening interview, and well-validated rating scales—our data clearly reflect parents' *perceptions* of their child's

difficulties, and in this respect, the identified associations between children's DMDD status and reported behavioral functioning are perhaps unsurprising. Additional studies using non-parental reporters, observational measures, and longitudinal designs will be critical to more fully describe the emotional and behavioral functioning of young children presenting with DMDD symptoms and to evaluate the stability and continuity of the diagnosis over time. It was also the case that some mother-report data were not available (particularly with respect to family psychiatric history) such that the null findings pertaining to these data should be interpreted with caution.

In addition, we assessed a relatively narrow range of family factors that might be associated with DMDD symptoms in early childhood. For example, parent–child relationship problems and attachment-related difficulties have been implicated in the development of both internalizing and externalizing behavior problems [38–40], and for some young children, these relational experiences might manifest in symptoms quite consistent with DMDD. It will be important for future research on early childhood DMDD to incorporate additional measures of parenting, family relationship functioning, and attachment organization and to examine these factors as alternative explanations for early irritability and behavioral dysregulation in some young children. Such research will also be important to considering whether parenting and family-focused treatments that have demonstrated effectiveness in the treatment of other mood and disruptive behavior problems might be applied in the treatment of early DMDD.

Finally, it is important to note that this unique clinical sample—preschool-aged children admitted to a psychiatric partial hospital program—may be viewed as both a study strength and limitation. In some respects, young children referred for intensive psychiatric treatment may be the ideal population in which to study the early development of DMDD, as children presenting for this level of care are likely to demonstrate severe difficulties in mood and behavior—difficulties that may be well described and conceptualized by the DMDD diagnosis. Conversely, a focus on young children receiving psychiatric partial hospitalization treatment may preclude generalization of findings to children who are less severely symptomatic or clinically impaired.

Summary

The diagnosis and treatment of youth with recurrent temper outbursts and persistent irritability is an important concern for the field. Further research is needed to determine whether such difficulties are best characterized as a unique disorder or rather as a set of symptoms that contribute to functional impairment across multiple disorders. However regardless of our approach to the diagnostic classification of problems of temper loss and persistent irritability, attention to these problems in early childhood is critical. Findings of the present study suggest that these core DMDD symptoms can be identified in preschool-aged children and, consistent with research on older children, are associated with high rates of psychiatric comorbidity and behavioral impairment. Further, by extending the use of the DMDD diagnostic criteria to include preschool-aged children, there is the potential to facilitate research on early markers of DMDD (e.g., genetic, neurophysiologic, neuroimaging, behavioral) and to elucidate whether this is a stable and unique clinical construct. There is also the potential for the development of interventions to target the earliest expressions of DMDD, such that significant clinical and functional impairments at school age might be decreased or prevented.

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