scientific reports

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Improving posttraumatic stress disorder assessment in young children: comparing measures and identifying clinically-relevant symptoms in children ages six and under

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Young children exposed to trauma are vulnerable to developing posttraumatic stress disorder (PTSD). Although experts agree on the importance of tailoring PTSD assessments to be developmentally-appropriate for young children, there is little research on which assessment methods best identify clinically significant symptomatology in this difficult-to-assess population. Two competing models for assessing PTSD have been proposed by the DSM-5 and ICD-11. This study compared a DSM-5 measure to an ICD-11 measure in young children (ages 1–6) exposed to a natural disaster. The measures identified similar rates of PTSD in children; however, diagnostic agreement between the measures was low (31–36%). Both PTSD measures were associated with actual and perceived life threat, functional impairment, and comorbid psychopathology. PTSD symptom and cluster endorsement rates were also binned by age and compared to functional impairment to identify commonly-reported and highly impairing symptoms in trauma-exposed young children, as potential candidates for inclusion in future revisions of diagnostic criteria. Across age ranges, increased clinginess post-trauma was the most commonly reported symptom and was associated with functional impairment. Arousal symptoms (startle, hypervigilance) and Re-experiencing symptoms (nightmares) also emerged as relevant for young children. Findings may contribute to efforts to improve assessment for PTSD in young children.

Trauma exposure is unfortunately common, even in young children (up to 6 years of age). An estimated 26% of children[1] experience trauma before age 4 and trauma exposure rates as high as 72% have been found in 3–5-year-old children in populations at heightened risk for community violence and poverty[2]. Furthermore, young children are also particularly susceptible to developing posttraumatic stress disorder (PTSD) following trauma exposure. A recent meta-analysis of 18 non-clinical samples found a pooled PTSD prevalence rate of 22% in preschool-age children[3], which is higher than what has been reported in older youth (16%[4]) and in adults (6–8%[5,6]).

Despite the high vulnerability for PTSD in young children, this population has been largely understudied compared to older youth and adults. This is partially due to the challenges associated with assessing for PTSD in young children who may have limited verbal and cognitive capabilities[7]. Although experts largely agree that criteria for PTSD must be tailored to be developmentally appropriate for this population[8], the optimal criteria for diagnosing PTSD in young children remains unclear and research evaluating which assessment methods work best for this population has been scarce.

A considerable degree of developmental changes occur during early childhood, which impact how PTSD symptoms may emerge and manifest. Infants are thought to develop nondeclarative or implicit memory by 8 or 9 months, develop declarative memory in conjunction with language abilities around 18 months, and can form coherent narratives around 36 months[9]. Infants under a year may have automatic distress reactions to stimuli reminiscent of the trauma, whereas a child's ability to recall a trauma may develop in conjunction with their

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verbal development[9]. Trauma-related symptomatology has been identified in very young infants[9], but manifestations of PTSD symptoms may change with age, as children's cognitive and socioemotional capacities undergo rapid development. To further complicate this picture, PTSD symptoms may evolve over time, both in relation to the time that has passed since the inciting traumatic experience and developmental changes across age[10]. Thus, when considering how to operationalize the construct of PTSD, attention must be paid to how symptoms manifest at different times and developmental stages.

In addition to the challenge of understanding how PTSD manifests developmentally in young children with scarce research on young children's trauma reactions, another barrier is the considerable controversy in the field on how to define PTSD more broadly. Numerous models of how to characterize trauma reactions and resultant symptomatology have been proposed, including reflective models in which PTSD is an underlying construct causing symptom variation, formative models where indicator symptoms cause the PTSD construct, and network models where the PTSD construct is a pattern of associated symptoms[10,11]. Furthermore, in the case of young children, parent-report is typically relied upon in practice, so diagnostic criteria that are clinically useful would involve symptoms that parents/caregivers can detect.

This complex body of research has led to several proposals of diagnostic criteria for PTSD from different groups, with varying levels of attention paid to the issue of developmental sensitivity. Currently, the most commonly utilized models of PTSD diagnostic criteria come from the 11th edition of the *International Classification of Diseases* (ICD-11) put forth by the World Health Organization and the 5th edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5) published by the American Psychiatric Association, which includes specific PTSD criteria for children ages 6 and younger. The ICD-11 criteria focus on the few symptoms considered central to PTSD, whereas the DSM-5 criteria has more symptoms with greater emphasis on heterogenous PTSD presentations[12]. The DSM-5 criteria modified for children ages 6 and younger places less emphasis on internalized, cognitively-sophisticated symptoms that may be difficult for caregiver reports to detect or beyond the cognitive capabilities of young children, and instead highlights externalized, behaviorally-focused symptoms. The DSM-5 criteria for children ages 6 and younger are similar in symptom cluster structure and symptom requirements to a model created specifically for young children, the *DC:0–5 Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood*; both of these models include symptoms that are more prevalent in young children, but that also may be indicators of many other childhood problems and may be less specific to PTSD (e.g., sleep problems, irritability). In contrast, the ICD-11 criteria were designed with less emphasis on developmental sensitivity and greater emphasis on capturing core symptoms theorized to be most closely tied to the underlying construct of PTSD[8,12].

A growing body of research has compared the ICD-11 and DSM-5 definitions of PTSD in older children and adolescents[13–17], and some studies have even done these comparisons using the DSM-5 PTSD criteria for children ages 6 and younger in older children and adolescents[18,19]. However, very little research has evaluated these models of PTSD in young children (i.e., age 6 and under). Only one study to date has compared DSM-5 and ICD-11 criteria for PTSD in young children. Vasileva and colleagues used a sample of children (ages 1–6) who were in foster care or who had a burn injury and found that DSM-5 criteria identified more children with PTSD and was more predictive of functional impairment than ICD-11[20]. While an important first look at how these major diagnostic models function in young children, this study was limited by a post-hoc methodology in which ICD-11 criteria were derived from a DSM-5 measure. No study to date has compared an ICD-11 measure to a DSM-5 measure for assessing PTSD in young children.

Given that young children are highly impacted by trauma and vulnerable to PTSD, further research on how to assess PTSD in this age range is warranted. This study contributes to addressing several major gaps in the literature. The purpose of the study is to investigate the utility of using DSM-5 versus ICD-11 criteria with young children (ages 1–6) by comparing a validated DSM-5 PTSD measure, the *Young Child PTSD Checklist* (YCPC[21]) to a newer ICD-11 PTSD measure, the Child and Adolescent Caregiver Version of the *International Trauma Questionnaire* (ITQ[22,23]). The YCPC is commonly used with children ages 1–6, whereas the ITQ has only been used with older children to date. This study investigates how the ITQ compares to the YCPC; findings from this study could indicate if further research that might validate the ITQ in younger children may be warranted. Since the PTSD symptom assessment in the ITQ is about a quarter the length of the YCPC PTSD symptom assessment, a shorter measure that still adequately captures the PTSD construct could be an attractive option for clinicians and researchers needing to reduce assessment burden.

In addition to using independent measures to compare DSM-5 versus ICD-11 models of PTSD, this study improves upon the currently available research on this topic in several ways. First, this study focuses on a single qualifying traumatic experience (exposure to a severe natural disaster) to reduce confounding variability, since trauma type and severity contribute to the largest variance in PTSD symptomatology[3,24]. Second, this study is the first to date to investigate the relationship between the DSM-5 versus ICD-11 models of PTSD and comorbid psychopathology in young children. Additionally, we examine how the DSM-5 versus ICD-11 symptom criteria relates to functional impairment and life threat, which are considered theoretically crucial to the underlying construct of PTSD[25,26]. Finally, this study explores age differences in PTSD symptom presentation. Although 1–6 is a relatively narrow age range and despite the typical grouping together of these children in research, a substantial degree of developmental change separates 1-year-olds from 6-year-olds[27]. This study presents data on commonly endorsed PTSD symptoms at different ages, and their association with overall impairment, to help inform future efforts to refine diagnostic criteria on trauma reactions in young children. The study aims are as follows:

Aim 1. Compare rates of PTSD using the YCPC to assess the DSM-5 model of PTSD versus the ITQ to assess the ICD-11 model of PTSD in young children. We hypothesized that the DSM-5 measure would yield higher rates of PTSD than the ICD-11 measure because of the DSM-5 emphasis on developmental sensitivity.

Aim 2. Evaluate diagnostic concordance for PTSD and symptom clusters between the DSM-5 and ICD-11 measures. We hypothesized low concordance between measures for PTSD and between symptom clusters, based on prior research comparing DSM-5 and ICD-11 models in children[17,20,28].

Aim 3. Determine each measure's relationship with variables well-established to have strong associations with the PTSD construct (functional impairment, life threat) as well as associations with comorbid conditions. We hypothesized that the DSM-5 measure would show stronger associations with impairment and comorbidity, due to the greater symptom overlap with other conditions in DSM-5. However, we hypothesized that the ICD-11 measure would show stronger associations with life threat, due to the ICD-11 emphasis on core symptoms of PTSD and the centrality of life threat to the PTSD construct.

Aim 4. Explore PTSD symptom patterns in different ages of young children. We hypothesized that younger children (i.e., 1–2-year-olds) would have fewer PTSD symptoms overall, as there is little research on trauma reactions in very young children so the measures may be less effective at capturing their trauma responses compared to older children. Additionally, we expected that younger children would be less likely to present with classic PTSD symptoms (i.e., core symptoms included in both the DSM-5 and ICD-11 models) and more likely to present with generalized symptoms (e.g., sleep problems, tantrums).

Methods

Participants

In September 2022, the study sample was exposed to Hurricane Ian, a Category 5 hurricane that caused record-breaking destruction and loss[29]. The hurricane was responsible for $113 billion in damages and is estimated to have resulted in at least 156 fatalities, making it one of the most destructive hurricanes on record[29]. In the following two to seven months after the storm, participants were recruited from the seven most affected counties in southwestern Florida (Lee, Highlands, Hardee, Sarasota, Collier, Charlotte, and Desoto). Parents (n = 57) of children ages 1–6 ($M = 3.77$, $SD = 1.57$) completed an online assessment battery about their child's psychological functioning and hurricane experiences. Sample demographic characteristics are presented in Table 1.

Procedures

This study was approved by the University of South Dakota Institutional Review Board. All study procedures were performed in accordance with relevant guidelines and regulations. Participants were recruited through informational flyers posted throughout seven eligible Florida counties and online through email listservs and targeted social media advertisements. Informed consent was obtained from all the study participants. After providing consent, parents completed a brief (15–20 min) online Qualtrics survey. Parents were eligible to participate if they resided in one of the impacted counties and were the parent/caregiver of a child under 18. As a safeguard against fraudulent or inattentive responses, additional checks were utilized to ensure consistent patterns of response (e.g., child's date of birth matching child's reported age) based on current recommendations[30]. After passing four of five checks in addition to providing a valid mailing address located in an eligible hurricane-afflicted county, they received a $5 gift card along with a coping workbook for their children.

Measures

DSM-5 PTSD: Young Child PTSD Checklist (YCPC)

The YCPC[31] was used to evaluate PTSD symptoms consistent with the DSM-5 diagnostic criteria. The YCPC is a commonly used measure to evaluate symptoms of PTSD in children ages 1–6 and has demonstrated good internal consistency and concurrent criterion validity when compared to the PTSD module of the Diagnostic Infant Preschool Assessment[32–35]. The YCPC is a parent/caregiver-report measure. Parent/caregiver reports of symptoms are typically necessary in this age range and has informed the advancement of assessment materials and diagnostic criteria for young children[36–39]. Parents/caregivers were asked to rate the frequency, on a 5-point Likert scale (0 = *Not at all* to 4 = *Everyday*), with which their child experienced various PTSD symptoms. All symptoms evaluated using the YCPC were anchored to the hurricane exposure. Of note, the YCPC contains 23 items assessing PTSD-related symptoms; 18 of these items map on to the DSM-5 PTSD criteria for young children and the other 5 items assess other related symptoms. Traditionally, the YCPC uses a cutoff score of 26 to determine "probable" PTSD. However, Vasileva and colleagues[20] proposed a diagnostic algorithm that uses only the 18 items that map onto current DSM-5 PTSD criteria for children ages 6 and younger. To allow for comparisons to other research, this study reports findings for both the traditional cutoff scoring method ("Cutoff") and the diagnostic algorithm ("Dx") used by Vasileva and colleagues[20]. Internal consistency for the YCPC in this sample was $\alpha = 0.96$.

ICD-11 PTSD: International Trauma Questionnaire (ITQ), Child and Adolescent Caregiver Version

Symptoms of PTSD consistent with ICD-11 diagnostic criteria were evaluated using the Child and Adolescent Caregiver Version of the ITQ[22,23]. The ITQ has several versions; the Caregiver Version is designed for parent/caregiver report on their child's symptoms[23]. The measure includes 6 items that correspond to the Re-experiencing, Avoidance, and Arousal symptom clusters (2 items per cluster). Parents rated how frequently their child experienced PTSD symptoms on a 5-point scale (0 = *Never* to 4 = *Almost Always*). All symptoms were anchored to exposure to the hurricane. Internal consistency for the ITQ in this study was $\alpha = 0.86$.

Functional impairment

To allow DSM-5 versus ICD-11 PTSD symptom criteria to be directly compared to a consistent measure of impairment, the impairment items from the ITQ were used. Five yes/no (1 = *yes*, 0 = *no*) items evaluate whether the child's PTSD-related symptoms have caused them impairment in daily functioning (e.g., caused problems

	Children (%)	Parents (%)
Sex		
Female	36	84
Male	64	16
Race		
White	80	84
Black	5	5
Asian	2	2
Middle Eastern/North African	2	2
American Indian/Alaska Native	2	0
Multiracial	9	7
Ethnicity		
Hispanic/Latine	14	16
School enrollment status		
Not enrolled	58	
Enrolled in school or preschool	42	
Parent education		
Did not complete high school		2
High school graduate/GED		12
Some college/Associates degree		28
Bachelor's degree		37
Graduate degree		21
Gross annual income		
< $25,000		3
$25,000–$50,000		25
$50,000–$75,000		30
$75,000–$100,000		23
> $100,000		19
Child peritraumatic factors		
Perceived life threat (child thought they might die)	16	
Child hit by debris during storm	11	
Child injured during storm	7	
Windows or doors breaking near child	21	
Flooding or water damage near child	39	
Seeing others injured during storm	16	
Needed to leave shelter due to damage during storm	11	
Pet injured or died from storm	12	
Child thought they would lose their home	46	

Table 1. Sample characteristics.

with their general happiness, things that are important to the child, getting along with family or friends). A summary score for functional impairment was computed by summing the associated numerical code for each item. Internal consistency for this study was $\alpha = 0.88$.

Comorbid psychopathology

Comorbid symptomatology was evaluated using the 17-item Pediatric Symptom Checklist (PSC-17[40]), which includes subscales for Internalizing, Externalizing, and Attention symptoms. The Internalizing subscale is comprised of 7 items that evaluate anxiety and depressive symptoms, including hopelessness, worry, unhappiness, negative self-concept, and anhedonia. The Externalizing subscale consists of 5 items that assess for conduct-related symptoms, such as defiance, conflict with others, bullying, and difficulties with sharing. The Attention subscale is comprised of 5 items that evaluate difficulties with attention and hyperactivity, including fidgeting, restlessness, and concentration difficulties. For all subscales, parents were asked to rate the frequency with which their child exhibits the symptoms on a 3-point Likert scale (0 = *Never* to 2 = *Often*). The PSC-17 has been validated for use in preschool samples[41]. Internal consistency across each subscale ranged from $\alpha = 0.72$ to 0.73 for this study.

Life threat

Actual and perceived life threat, constructs considered crucial to the development of PTSD, were evaluated using the Hurricane-Related Traumatic Experiences (HURTE-II[42]) questionnaire, a commonly used assessment tool that evaluates disaster-related experiences[43–46]. Perceived life threat refers to whether the child thought they might

die during the hurricane and was evaluated using a yes/no item. Actual life threat refers to objective exposure to potentially life-threatening situations (e.g., hurricane-related injury). Children's actual life threat was measured using eight yes/no (1 = *yes*, 0 = *no*) items evaluating a range of items assessing direct exposure to harm or danger during the hurricane (e.g., Did your child get hurt during the hurricane?).

Statistical analyses

Analyses were conducted primarily using IBM SPSS Statistics Version 29. Prior to analyses, data were cleaned and checked for outliers and normality. For Aim 1, exact McNemar's tests were used to compare diagnostic rates between DSM-5 and ICD-11 measures. DSM-5 criteria were assessed using the YCPC, which traditionally utilizes a cutoff score to determine "probable PTSD." This is the same measure as used by the only other study published on this topic to date; however, the prior study utilized a diagnostic algorithm to determine DSM-5 criteria from YCPC items[20]. In order to allow for comparisons with this prior study, we report findings for both the traditional cutoff score method typically used with the YCPC as well as the diagnostic algorithm methodology used by Vasileva and colleagues[20]. We refer to the formal scoring method as "DSM-5 Cutoff" and the latter method as "DSM-5 Dx" for the DSM-5 YCPC. ICD-11 criteria were assessed using the ITQ, using the standard scoring for that measure. For Aim 2, diagnostic concordance was evaluated using Cohen's kappa. For Aim 3, logistic regression was used to determine associations between PTSD-related variables (impairment, actual life threat, perceived life threat) and case status (1 = PTSD, 0 = No PTSD) as defined by the different PTSD models (DSM-5 Cutoff, DSM-5 Dx, ICD-11). These analyses were replicated with comorbid conditions (internalizing, externalizing, attention problems). The resultant odds ratios were compared across models; 95% confidence intervals that did not overlap were considered to be significantly different. For Aim 4, Python Matplotlib v3.2.2 was used to present symptom cluster and PTSD rates for DSM-5 and ICD-11 measure, binned by age group (1–2, 3–4, 5–6), for Fig. 1. Symptom endorsement rates from the YCPC and ITQ items were generated for each age group; symptoms reported by over half the sample were identified (if no symptoms were reported by over half the sample, the three most frequently endorsed symptoms were used). If a symptom was shared by both the DSM-5 and ICD-11 models and there were discrepancies in the endorsement rate across measures, the higher rate was used. The associations between these frequently-endorsed "top" symptoms and impairment was evaluated using linear regression within each age group. Additionally, top symptoms identified for any age group were evaluated for associations with impairment in the full sample using linear regression.

Results

PTSD rates and diagnostic concordance

The ICD-11 ITQ identified 11% of the sample as having PTSD. Using the traditional cut-off scoring for the DSM-5 YCPC, 19% of the sample was identified with PTSD. Although the DSM-5 YCPC cutoff rate was qualitatively higher than the ICD-11 ITQ rate, an exact McNemar's test determined that the ICD-11 and DSM-5 rates were not significantly different, $p = .180$. Using the DSM-5 diagnostic algorithm for the YCPC[20] resulted in 16% of the sample being identified with PTSD. This DSM-5 diagnostic algorithm ("DSM-5 Dx") rate also did not differ significantly from the ICD-11 rate, $p = .453$. Diagnostic concordance was fair between ICD-11 and DSM-5 Cutoff, with 31% agreement on case status. Diagnostic concordance was moderate between ICD-11 and DSM-5 Dx, with 36% agreement on case status. See Table 2 for more detail.

Percentages of the sample that met criteria for each PTSD symptom cluster are displayed in Table 2. PTSD symptom cluster rates ranged from 21 to 28% across cluster and across diagnostic models. The Re-experiencing cluster did not have differences in rates between DSM-5 and ICD-11 and exhibited substantial agreement between the two measures. Similarly, there were not differences in rates for the Avoidance cluster and there was substantial agreement between DSM-5 and ICD-11. The Arousal cluster had identical rates, but moderate agreement between DSM-5 and ICD-11.

Associations with PTSD-related variables and comorbidity

Each model of PTSD (DSM-5 Dx, DSM-5 Cutoff, ICD-11) was compared to variables well-established in prior research to be strongly associated with the theoretical construct of PTSD: functional impairment, actual life

			McNemar's test		Cohen's kappa	
	DSM-5 (%)	ICD-11 (%)	χ^2	*p*	κ	*p*
Re-experiencing	26	21	.571	.453	.662	< .001
Avoidance	21	26	.571	.453	.662	< .001
Arousal	28	28	.000	1.000	.479	< .001
PTSD						
Dx	16	11	.571	.453	.466	< .001
Cutoff	19	–	1.778	.180	.387	.002

Table 2. PTSD and symptom cluster rates and concordance. For DSM-5, "Dx" refers to the YCPC diagnostic algorithm for PTSD[20] and "Cutoff" refers to the YCPC cutoff score traditionally used to indicate probable PTSD. For ICD-11, the ITQ only uses a diagnostic algorithm (Dx) for scoring, which was compared to the DSM-5 Dx and DSM-5 Cutoff.

threat, and perceived life threat. All of these variables were related to all models of PTSD (see Table 3). Odds ratios for impairment ranged 1.66–2.40 across PTSD models, actual life threat ranged 1.81–3.57, and perceived life threat ranged 6.88–8.75 (all *p*s < .05). There was overlap between all confidence intervals, indicating no significant differences between these odds ratios.

A similar pattern emerged for comorbid conditions. Internalizing symptoms, externalizing symptoms, and attention problems were associated with all models of PTSD (see Table 3). Odds ratios were similar across comorbid conditions and PTSD models, with all falling within the narrow range of 1.41–1.61, except for the association between internalizing symptoms and DSM-5 Cutoff (*OR* = 2.37). However, overlapping confidence intervals indicated that there were no significant differences between odds ratios, meaning that all PTSD models were similarly associated with comorbid conditions.

PTSD symptomatology by age

Given the substantial developmental differences within the 1–6 age range, and the tendency of prior studies to group these ages together, Fig. 1 displays percentages of children who met the symptom cluster and PTSD diagnostic algorithms for DSM-5 and ICD-11, separated by age (1–2-year-olds, 3–4-year-olds, 5–6-year-olds).

	DSM-5 Dx			DSM-5 Cutoff			ICD-11		
	OR	95% *CI*	*p*	*OR*	95% *CI*	*p*	*OR*	95% *CI*	*p*
Related variables									
Impairment	1.66	1.14, 2.43	.009	1.69	1.17, 2.42	.005	2.40	1.34, 4.30	.003
Actual life threat	3.57	1.69, 7.55	< .001	4.05	1.80, 9.15	< .001	1.81	1.13, 2.91	.014
Perceived life threat	6.88	1.38, 34.36	.019	8.75	1.82, 42.00	.007	7.50	1.22, 45.96	.029
Comorbid conditions									
Internalizing	1.59	1.14, 2.22	.007	2.37	1.48, 3.79	< .001	1.61	1.11, 2.33	.012
Externalizing	1.42	1.10, 1.92	.021	1.48	1.10, 1.98	.009	1.53	1.07, 2.19	.021
Attention problems	1.41	1.04, 1.93	.029	1.46	1.08, 1.99	.015	1.42	1.00, 2.00	.049

Table 3. Associations of DSM-5 and ICD-11 measures with PTSD-related variables and comorbid conditions.

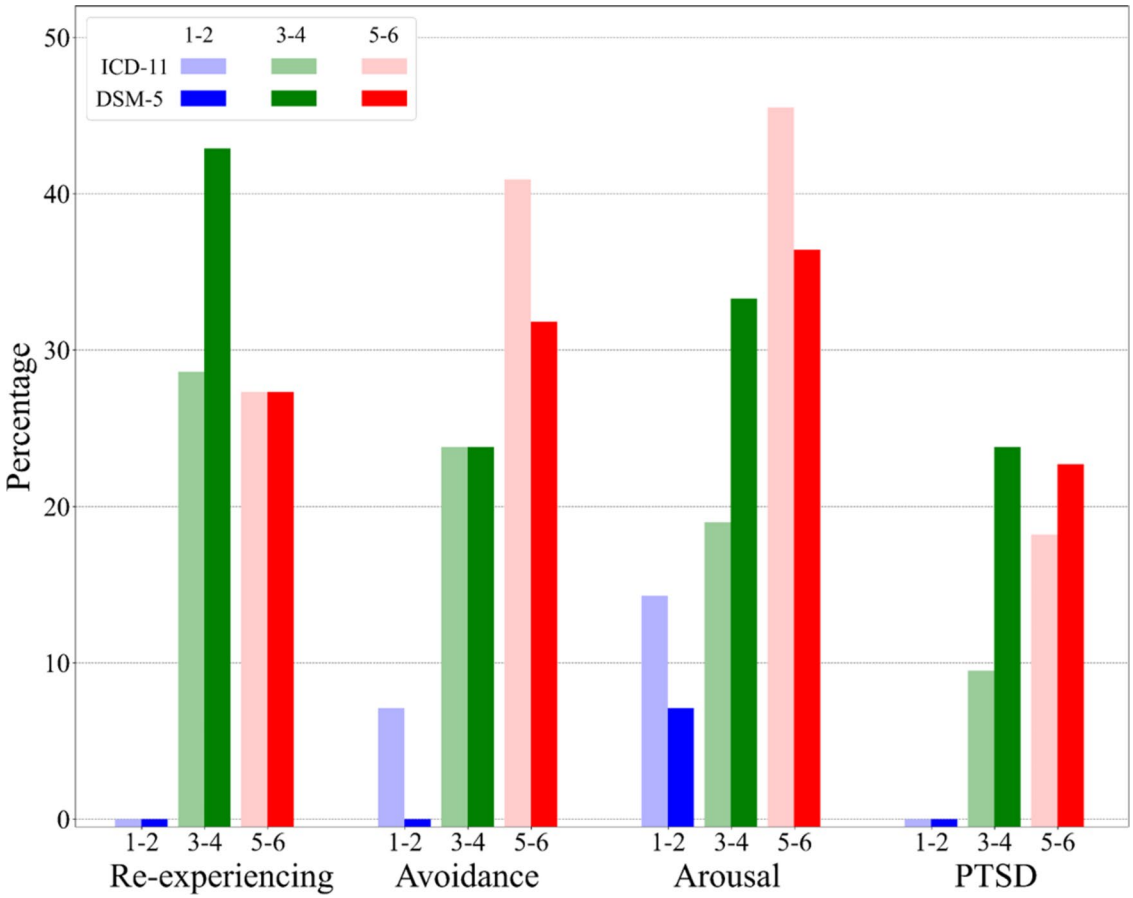

Figure 1. Percentages of children who met symptom cluster and PTSD criteria for DSM-5 and ICD-11, binned by age group.

Ages 1–2			Ages 3–4			Ages 5–6			Full Sample (Ages 1–6)		
Symptom	**%**	**β**	**Symptom**	**%**	**β**	**Symptom**	**%**	**β**	**Symptom**	**%**	**β**
Clinginess	29	0.364	Clinginess	67	-0.020	Clinginess	59	0.511*	Clinginess	54	0.300*
Tantrums	21	-0.176	Intrusive memories	62	0.272	Intrusive memories	59	0.413†	Intrusive memories	47	0.324*
Startle	21	0.385	**Nightmares**	57	0.385†	**Nightmares**	59	0.561**	**Nightmares**	42	0.386**
			New fears	52	0.164	**Startle**	59	0.659***	**Startle**	42	0.585***
						New fears	55	0.545**	New fears	42	0.326*
						Hypervigilance	55	0.691***	Sleep problems	42	0.333*
						Sleep problems	55	0.540*	**Hypervigilance**	39	0.465***
						Concentration	55	.496*	Tantrums	37	0.333*
									Concentration	35	0.425***

Table 4. Top symptoms for each age bracket and their relationship with impairment. Symptoms that are part of both the DSM-5 and ICD-11 models are in bold. ***$p < .001$, **$p < .01$, *$p < .05$, $^{\dagger}p < .09$.

As seen in Fig. 1, symptom cluster rates were very low for the youngest children and no 1–2-year-olds were identified with PTSD using the ICD-11 or DSM-5 models. The older children (ages 3–6) were largely driving the symptom cluster and PTSD rates in the sample.

Symptoms for future consideration

Given the challenges with accurate assessment in very young children, symptoms that are most common post-trauma and highly impairing may be strong candidates for future consideration in developing diagnostic models of PTSD. Table 4 displays symptoms endorsed by over half the sample for each age bracket and their associations with functional impairment. For the 1–2-year-old age group, no symptoms were reported by over half the sample, so the three symptoms with the highest endorsement rates are presented. The overall prevalence of these symptoms and associations with impairment in the full sample (ages 1–6) are also reported in Table 4.

Across each age bracket, the most frequently endorsed symptom was increased clinginess since the disaster (for the 5–6 age group, clinginess tied with intrusive memories, nightmares, and startle as the top symptom). Next, tantrums were frequently endorsed for the 1–2-year-olds, but were not a top symptom for the 3–4 or 5–6 age groups. Startle was also a prominent symptom for the 1–2 and 5–6 age groups. Among the 3–4 and 5–6 groups, intrusive memories and nightmares were commonly endorsed symptoms.

Table 4 also presents the associations between the most frequently endorsed symptoms and functional impairment, for each age bracket and for the full sample. In the full sample, all top symptoms were positively associated with functional impairment. However, these significant associations seemed largely driven by the 5–6 age group, which showed a similar pattern. There were not associations between top symptoms and impairment that reached statistical significance ($p < .05$) in the 1–2 or 3–4 age groups.

Discussion

The purpose of this study was to compare a DSM-5 PTSD measure, the YCPC, to an ICD-11 PTSD measure, the ITQ, in young children (ages 1–6). In this disaster-exposed sample, the DSM-5 measure identified a few more children with PTSD than the ICD-11 measure. This pattern was consistent with the only other study on this topic, which found higher rates of PTSD when applying a DSM-5 algorithm to the YCPC than when applying an ICD-11 algorithm in 1–6-year-old children who were in foster care or had a burn injury[20]. However, in the present study, DSM-5 rates (using both the YCPC cutoff scoring method and the DSM-5 diagnostic algorithm) did not significantly differ from the ICD-11 rates yielded by the ITQ.

Despite the similarity between the DSM-5 and ICD-11 rates, there was only 31–36% agreement in PTSD case status and fair to moderate diagnostic concordance. Of note, concordance was higher when using the diagnostic algorithm method than it was with the cutoff method. This finding is consistent with other studies that revealed low to moderate agreement between DSM-5 and ICD-11 in youth[13–15,47]. The symptom clusters demonstrated better concordance, with moderate concordance for the Arousal cluster and substantial concordance for the Re-experience and Avoidance clusters between DSM-5 and ICD-11. Since the ICD-11 criteria has substantially fewer symptoms in these clusters than DSM-5, the substantial concordance suggests that certain ICD-11 symptoms also in the DSM-5 (e.g., nightmares) may be most relevant for the children meeting symptom cluster criteria.

Functional impairment and life threat (perceived and actual) are well-established as key constructs that occur with PTSD symptomatology[25,26]. In our study, these theoretically important variables were related to both the DSM-5 and ICD-11 measures, supporting the argument that both measures adequately identify children with substantial trauma exposure whose symptoms are interfering with daily functioning. Although none of the odds ratios were significantly different from one another, the relative strength of the associations was not in line with our hypotheses. Since the prior young child study found that DSM-5 had higher predictive power for functional impairment than ICD-11[20], we expected stronger associations between DSM-5 and functional impairment. However, ICD-11 had a stronger relationship with functional impairment than both DSM-5 models in our sample. Conversely, we expected ICD-11 to show a stronger association with life threat because the theoretical underpinning of the ICD-11 criteria is an emphasis on symptoms firmly anchored to the traumatic event (e.g., flashbacks), whereas the DSM-5 takes a broad approach inclusive of non-specific symptoms (e.g.,

concentration problems)[12,48]. However, the opposite was true in our results: both DSM-5 models had stronger associations with actual life threat than ICD-11. This may be a result of the flexibility of the DSM-5, allowing for a wider range of reactions in acutely trauma-exposed children to be captured by the measure. For perceived life threat, the ICD-11 model showed a stronger association than the DSM-5 diagnostic algorithm but not as strong as the DSM-5 cutoff scoring method. However, all three models had high upper limits to their 95% confidence intervals, and these differences may not be meaningful. It was clear that all three models exhibited the strongest associations with perceived life threat, which is considered to be a particularly robust predictor of PTSD in children and has outperformed other predictors, including objective trauma exposure[49]. Thus, it is promising that both DSM-5 and ICD-11 measures demonstrated strong relationships with this important PTSD-related construct in young children.

ICD-11 and DSM-5 models were all associated with comorbid conditions (i.e., internalizing symptoms, externalizing symptoms, and attention problems). Most associations were of similar strength, with the exception of a stronger association between DSM-5 (cutoff scoring method) and internalizing symptoms. This result is consistent with expectations since DSM-5 PTSD includes symptoms that are shared with other internalizing disorders (e.g., sleep problems, concentration problems, negative emotions). Further, the YCPC includes relevant symptoms beyond the DSM-5 criteria (e.g., clinginess, developing new fears), so the cutoff scoring method incorporating these additional symptoms would be expected to have the strongest relationship with internalizing problems. The relationship with comorbid symptoms observed in this young child sample has also been observed in older youth and adults[47,50]. The extent to which symptom overlap between disorders is advantageous in diagnostic criteria is a theoretical controversy in the field[51].

Another purpose of this study was to present data on how PTSD symptom patterns may vary by age, given that young children undergo dramatic developmental changes. Although 1 to 6 is a relatively narrow age range, children within this range may present quite differently. For instance, a 1-year-old may not be able to walk or talk, whereas a 6-year-old may be capable of basic reading and writing. Thus, it is expected that PTSD symptom presentations may also differ within this age range[52]. Consistent with hypotheses, it was largely the 3–6-year-old children meeting symptom cluster and diagnostic criteria for both DSM-5 and ICD-11. No 1–2-year-old children met the Re-experiencing cluster (for either DSM-5 or ICD-11), and subsequently, none were identified with PTSD. Instead, the Arousal symptom cluster was most relevant for the 1–2-year-old group. This is consistent with a study of children exposed to intimate partner violence that identified Arousal symptoms as the most commonly reported for this age group[53]. It may be that Arousal symptoms are more externally observable and, therefore, easier for parents to report in very young children.

We also investigated which symptoms were most frequently reported in each age bracket and their associations with impairment. Since caregiver reports are typically relied upon for symptom assessments in young children, and because caregivers are limited in what they can detect in children, it is helpful to identify which symptoms are relatively easy for caregivers to observe and report on. High-frequency symptoms that emerge or worsen post-trauma and cause substantial problems in the child's daily functioning may be candidates for future consideration as part of PTSD diagnostic models.

The most frequently reported symptom across age groups was increased clinginess since the hurricane; this symptom was also associated with greater functional impairment. Interestingly, this symptom is not part of the DSM-5 or ICD-11 PTSD criteria, despite being commonly associated with child behavior and functioning after exposure to a traumatic event[54]. A study of 1–6-year-old children with burn injuries also identified increased clinginess as the most commonly experienced symptom[55]. Clinginess was also identified as a prominent symptom in 0–6-year-old children after the 9/11 attacks[56]. Clinginess may be an element of PTSD in young children that has thus far been neglected in existing diagnostic models. Clinginess and other social behaviors represent important components of posttraumatic profiles in young children who cannot always articulate the internal effects of trauma exposure[57]. However, one notable addition to the DSM-5 PTSD criteria for children ages six and younger is social withdrawal, which could be argued to be a symptom presentation opposite of clinginess. Socially withdrawn behavior was a low-frequency symptom in this sample. Instead of withdrawing from others, most children were doing the opposite and showed increased clinginess after the hurricane. Although not currently part of a PTSD model, clinginess is considered a fear-based reaction in young children and has been strongly linked to anxiety and post-traumatic responses[52,54,55,58]. These findings indicate that this symptom may be worthy of consideration for possible inclusion in future iterations of PTSD diagnostic criteria for young children.

Exaggerated startle response was another symptom that appeared to perform well across a broad age range. Startle was a frequently endorsed symptom among 1–2-year-olds as well as 5–6-year-olds. In the full sample, startle showed the most robust relationship with impairment of any of the PTSD symptoms. This symptom is part of both the DSM-5 and the ICD-11 diagnostic criteria and is an essential component of PTSD in adults[59]. Our findings indicate that startle is observable by parents even in very young children and is a strong differentiator of child impairment.

A particularly notable finding was the absence of Avoidance symptoms from the top symptoms list. Parents rarely reported that their children were avoiding reminders of the hurricane. One possible explanation may be the nature of this trauma type, as hurricanes have widespread impacts (e.g., damage to the home and broader community), and it may be difficult to avoid such pervasive reminders. However, this explanation seems unlikely as similar problems with assessing Avoidance symptoms in young children have been reported for samples exposed to other trauma types[20,60,61]. For example, in a sample of young children in foster care, excluding Avoidance symptoms from PTSD diagnostic criteria increased associations with functional impairment[20]. There are several reasons that avoidance of trauma reminders may be a problematic symptom for young children. For instance, young children may not have sufficient autonomy to engage in active avoidance behaviors, as parents or caregivers typically dictate the daily activities of young children. Additionally, avoidance behaviors may require some degree of foresight, in which the individual thinks about a future scenario and predicts an adverse reaction, which

may be too cognitively advanced for young children. It also may be the case that avoidance manifests differently in young children. As previously discussed, increased clinginess post-trauma was a noteworthy symptom that emerged in our sample as well as in other research[55,56]. Qualitative research on parental descriptions of children's post-trauma reactions identified clingy behavior as a mode of avoiding trauma reminders[62]. It may be that clinginess could be conceptualized as a developmentally-specific manifestation of avoidance in young children, who may cling to their caregivers as a way to avoid uncertain situations; this possibility warrants further research.

Given the concerns about including avoidance in diagnostic criteria for young children, a major modification of the DSM-5 PTSD criteria for young children was to deemphasize avoidance symptoms by allowing that cluster to be met through the child exhibiting negative alterations in cognition or mood instead[63]. However, in our sample, these Cognition/Mood symptoms that allow a diagnostic alternative to Avoidance symptoms were also low-frequency. Thus, consistent with other researchers who have found problems with Avoidance symptoms in youth[20,60,61], these findings suggest that the Avoidance cluster may be a continued target for improvement when refining PTSD diagnostic criteria in young children.

When considering the utility of using the ITQ and the ICD-11 criteria more broadly with young children, several key findings from this study should be highlighted. Consistent with the prior study comparing the ICD-11 model to DSM-5 model[20], the ITQ did not outperform the YCPC in young children in this study. Nevertheless, the ITQ did identify a comparable number of children with PTSD, and those cases were associated with heightened life threat and impairment. Since the ITQ is a much shorter measure (about a quarter the length of the YCPC), there may be contexts where a briefer assessment is advantageous for screening for PTSD risk, as these findings suggested that the ITQ performed adequately in identifying impaired young children. Of the 6 symptoms that make up the measure, half were high-frequency symptoms reported by caregivers of young children: nightmares, startle, and hypervigilance. Further, these symptoms showed the strongest associations with impairment. This indicates that the ICD-11 Arousal cluster (which consists of startle and hypervigilance) is likely appropriate for use with young children. Young children are also able to meet the Re-experiencing cluster through the presence of nightmares, although the other ICD-11 Re-experiencing symptom (flashbacks) is less likely to be observable by caregivers. In contrast, the Avoidance symptoms may be a concern, as previously discussed; thus, it may be beneficial to relax this requirement for young children.

Both the YCPC and ITQ identified distressed children who experienced life threat and had impairing symptomatology, although the measures identified different groups of children (about a third agreement). For maximum inclusivity, researchers and clinicians might consider using both DSM-5 and ICD-11 models to ensure that no children needing treatment are overlooked. However, it is recognized that assessment burden can be a major constraint in some contexts, and so this may not always be feasible. Further research is needed to optimize assessment methodologies for PTSD in young children and particular attention should be paid to developmentally-sensitive manifestations of symptoms for the youngest children.

A significant strength of this study is comparing PTSD assessment methods using independent DSM-5 and ICD-11 measures in trauma-exposed young children, a difficult-to-access and largely understudied population. However, several limitations exist that are inherent to working with this population, including the reliance on caregiver reports as opposed to self-report, the scarcity of gold-standard assessment methods, and the wide range of developmental differences within narrow age ranges. Although this study contributes to addressing the substantial gaps in this area of research, some important limitations should be noted. A larger sample size would have allowed for more fine-tuned investigations into how symptom patterns change across development. Our sample size is comparable to other studies of PTSD symptom criteria in young children[35,64,65], but was underpowered to perform more complex statistical analyses (e.g., confirmatory factor analyses) or to do further analysis within developmentally-comparable age brackets. These would be worthwhile directions for future research that is able to obtain larger sample sizes of trauma-exposed young children. Additionally, although sample demographics were consistent with Census demographic data from the eligible counties, this sample was predominantly White. As PTSD research has previously identified differential symptom presentations among racially and ethnically diverse populations[66], future research should prioritize the recruitment of diverse samples to illuminate what individual factors contribute to symptom profiles and risk for PTSD development in young children. Additionally, research on the psychometric properties of the measures used in this study (the PTSD measures as well as functional impairment, comorbid psychopathology, and life threat) is limited in 1–6-year-old children, particularly on the younger end of that age range. It is plausible that the low endorsement rates in the 1–2-year-old group were due to the measures not matching their developmental presentations of psychopathology. This will be an important area of attention for future research.

Finally, as is made clear by both the developers of the YCPC and the ITQ, neither of these measures is capable of diagnosing PTSD. Questionnaire measures can identify cases with a higher likelihood of PTSD and are frequently used for this purpose in research and clinical practice. The scope of this study is to aid researchers' and clinicians' understanding of how measure selection will impact the cases identified with probable PTSD. However, studies incorporating clinician-administered clinical interviews would be needed to understand how DSM-5 versus ICD-11 criteria impact diagnosis, which would be an important area for future research. Additionally, future research should evaluate other models of PTSD, such as the DC: 0–5 criteria, which may be more developmentally-sensitive than DSM-5 or ICD-11. In general, more research is needed to identify appropriate measures to assess for clinically significant PTSD symptomatology in young children who are vulnerable to adverse post-trauma reactions.

Data availability

The data that support the findings of this study are available from the corresponding author (B.D.) upon reasonable request.

Received: 31 January 2024; Accepted: 5 August 2024
Published online: 19 August 2024

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Acknowledgements

This research was supported by general funds from the University of South Dakota. We wish to thank the participants for their time, and the many research team members who worked on this project.

Author contributions

B.D. conceptualized the study, provided project oversight, directed data collection, conducted statistical analyses, interpreted the results, and drafted and revised the manuscript. E.K and J.K. collected data, conducted literature review, and drafted and revised the manuscript.

Competing interests

We have no conflicts of interest to disclose.

Additional information

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