Post-Trauma Response in Children and Adolescents: Prevalence of Acute Stress Symptoms and how these Predict Chronic Post-Traumatic Stress

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Abstract

A significant minority of children and adolescents experience symptoms of acute stress following exposure to a traumatic event, some of whom will meet criteria for Acute Stress Disorder (ASD) within the first month post-trauma. Current estimates of ASD prevalence vary greatly. In order to reach a more reliable estimate, a meta-analysis of ASD prevalence was conducted which comprised of 17 studies. The impact of moderators, including trauma type and method by which ASD was assessed, provided significant. Results are discussed within the context of the relatively small number of studies that met inclusion criteria, high levels of heterogeneity, and risk of bias. Many children and adolescents who have ASD will experience a period of natural recovery in the months that follow. However, previous research has identified that for a minority of youth, ASD symptoms will remain persistent beyond the first month; meeting criteria for Post-Traumatic Stress Disorder (PTSD). The trajectory to either recovery or PTSD in youth who met criteria for ASD was explored, based upon their initial symptom profile. Of youth who met full ASD criteria, sleeping difficulties in the acute phase were associated with later PTSD. However, when using subthreshold ASD criteria, two additional symptoms showed an association. These findings are discussed with relation to the screening and assessment of children and adolescents, as well as early selective interventions, following exposure to a traumatic event.

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Acute Stress Disorder in Children and Adolescents: A Meta-Analysis of Prevalence Following Exposure to a Traumatic Event

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Abstract

The aim of this meta-analytic review was to reach a reliable estimate of the prevalence of Acute Stress Disorder (ASD) in children and adolescents in the one month following exposure to a traumatic event. Potential moderators of prevalence including the method by which ASD was assessed, demographic characteristics and trauma variables were identified through the literature. Seventeen studies were identified as meeting inclusion criteria, comprising 2,918 participants. Studies were assessed for risk of bias by the first author and a second researcher. Prevalence estimates varied greatly across studies, ranging from 1.1 to 56.2%, with significant differences observed between subgroups. Findings are discussed in the context of the relatively small number of studies that met inclusion criteria, high levels of heterogeneity, and risk of bias. While a significant minority of trauma-exposed youth meet criteria for ASD, this review highlights how prevalence rates may depend on moderators such as the method of assessment. This has implications for future research and clinical practice in ensuring that youth with significant symptoms of acute traumatic stress are accurately identified.

Keywords: Meta-analysis; Child; Adolescent; Stress; Acute; Trauma; Posttraumatic

Highlights

- Prevalence of ASD ranged greatly between studies
- Higher prevalence reported in studies which assessed ASD via interview
- Studies where youth were victims of interpersonal violence reported higher prevalence

Introduction

Acute Stress Disorder

The diagnosis of Acute Stress Disorder (ASD) is intended to identify those who experience significant traumatic stress in the first one month following exposure to a traumatic event (Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition [DSM-IV]; American Psychiatric Association, 1994). The original version of ASD in the DSM-IV required specified clusters of symptoms to be present during this acute stage to reach a diagnosis. This consisted of three from five dissociative symptoms, one from four re-experiencing symptoms, one from two avoidance symptoms, and one from six arousal symptoms, in addition to distress or impairment in functioning. However, the release of Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2013) has seen a change in the way in which ASD is diagnosed, with the cluster-based algorithm now replaced by a threshold of nine or more acute symptoms. Previous research had suggested that the requirement of three or more dissociative symptoms in DSM-IV led to many distressed children and adolescents not meeting the threshold for diagnosis (Kassam-Adams & Winston, 2004; Meiser-Stedman, Yule, Smith, Glucksman, & Dalgleish, 2005).

Initially intended as a way of predicting later Post-Traumatic Stress Disorder (PTSD; Bryant, 2017), in recent years there has been less emphasis placed on this function of ASD due to its relatively poor ability to do so (Bryant, Salmon, Sinclair, & Davidson, 2007; Dalgleish et al., 2008). Although the use of DSM-5 criteria has demonstrated an improvement in predictive power (Bryant et al., 2015; Meiser-Stedman et al., 2017), the diagnosis of ASD is currently best used to identify individuals with severe stress reactions post-trauma who may benefit from additional support or intervention in the acute stage (Bryant, 2017).

Demographics and Acute Stress Symptoms

Previous studies involving child and adolescent participants have found mixed evidence as to the impact of age on prevalence of acute stress symptoms. Whereas some have found that younger children are more at risk of experiencing prominent acute stress symptoms (Doron-LaMarca, Vogt, King, King, & Saxe, 2010; Le Brocque, Hendrikz, & Kenardy, 2010), others have found no evidence of this (Bryant, Mayou, Wiggs, Ehlers, & Stores, 2004; Haag, Zehnder, & Landolt, 2015). Studies of post-traumatic stress in youth have demonstrated that girls are at greater risk of developing both acute (Holbrook et al., 2005; Liu et al., 2010) and persistent symptoms (Trickey, Siddaway, Meiser-Stedman, Serpell, & Field, 2012) when compared to boys. It has been suggested that symptoms of post-traumatic stress are more likely in females following interpersonal trauma (Alisic et al., 2014) and through coping via rumination (Hampel & Petermann, 2005). Ethnicity has not been shown to be predictive of ASD (Ostrowski et al., 2011).

Trauma characteristics and acute stress symptoms

Studies suggest that youth are more likely to have severe symptoms of acute stress following exposure to a violent interpersonal trauma when compared to accidental injury or illness (Hamrin, Jonker, & Scahill, 2004; Holbrook et al., 2005), with this also found in youth with PTSD (Alisic et al., 2014). It has been posited that exposure to interpersonal trauma results in self-blame and other maladaptive cognitive strategies (Tolin & Foa, 2006) that may result in decreased coping in the aftermath when compared to non-interpersonal trauma (Gunaratnam & Alisic, 2017). Acute stress symptoms may be more prevalent following collective traumas such as natural disasters (Liu et al., 2010) when compared to individual traumas (Kassam-Adams, 2006).

Assessment of acute stress symptoms

The assessment of acute stress following exposure to a traumatic event in children and adolescents has been conducted in various ways. Many studies have used measures

designed to capture PTSD to identify youth who present with symptoms of acute stress in the one month post-trauma (Hamrin et al., 2004; Le Brocque et al., 2010). Previous studies of PTSD in youth have suggested that the use of questionnaires may have led to more children being classified as experiencing symptoms akin to PTSD than using clinical interview (Shalev, Freedman, Peri, Brandes, & Sahar, 1997). However, recent evidence suggests that there is no difference in prevalence of PTSD when measured using either questionnaire or interview (Hiller et al., 2016). The heterogeneity in assessment method is largely attributable to a lack of reliable, validated tools by which to capture ASD in youth until recently, e.g. measures which capture the DSM-IV ASD symptom algorithm (CASQ, Kassam-Adams & Winston, 2004; ASC-Kids, Kassam-Adams, 2006). In addition, 'gold standard' measures of assessment for ASD are relatively new and untested (Kassam-Adams et al., 2013). The authors of this study reported the stark contrast in prevalence of ASD dependent upon whether assessed by interview (25.5%) or questionnaire (6.5%), which was attributed to the greater coverage of dissociative symptoms for a DSM-IV ASD diagnosis via clinical interview.

Purpose of the Current Review

With a renewed focus on ASD following the publication of DSM-5, a reliable estimate of its prevalence would better inform the allocation of support and resources in the one month following trauma. In studies of acute stress symptoms in children and adolescents, prevalence rates have been reported to range from 1% (Kassam-Adams, 2006) to over 50% (Liu et al., 2010). Studies that have combined data from several sites have found prevalence rates ranging from 9% to 13.6% using criteria for either DSM-IV or DSM-5 ASD (Dalgleish et al., 2008; Kassam-Adams et al., 2012; McKinnon et al., 2016). However, diagnoses of ASD in these studies were derived through different methods of assessment which may have impacted upon the prevalence rate obtained. Further, the majority of youth included in these studies were exposed to road traffic collisions, which

limits how these findings can be generalized to youth who experience other types of trauma. Past studies of ASD in children and adolescents have commented upon the low participation rate of those eligible to take part (Meiser-Stedman, Smith, Glucksman, Yule, & Dalgleish, 2007) which may impact upon the real-world application of findings. Participation rate, from those children and adolescents eligible to take part, will be meta-analysed in this study to identify a baseline for the rate of participation. This meta-analytic review will focus upon reaching a reliable estimate of prevalence of ASD in children and adolescents following exposure to a traumatic event, whilst exploring whether prevalence is moderated by method of assessment, demographic and trauma variables.

Method

Prior to commencing the review, the existing literature was searched to determine whether the questions posed here have already been explored. Failing to find a review of the prevalence of ASD in children and adolescents, the Prospective Register of Systematic Reviews (PROSPERO) was searched to determine whether a similar review was being planned or currently taking place. Upon determining that no such review was in development, the protocol for this review was pre-registered on PROSPERO (CRD42017083980).

Eligibility Criteria

Inclusion criteria for studies to be selected were that the assessment of ASD was undertaken within one month following the traumatic event and adhered to criteria as classified in DSM-IV or DSM-5; the mean age of participants was below the age of 18; ASD was assessed via a self-report questionnaire or diagnostic clinical interview; and data was available to derive the prevalence of ASD. Studies included would likely be prospective longitudinal and cross-sectional designs. Data from the preliminary stages of randomized trials were also included where a reliable measure of ASD had been taken prior to intervention taking place. Exclusion criteria applied to studies included those that

administered interventions immediately post-trauma; those which did not report sample characteristics such as age or duration since the traumatic event; those which did not measure ASD as defined by DSM criteria; and those which recruited only participants with ASD and thus prevalence could not be estimated. Additionally, studies that reported duplicate data, solely reviewed past research, were purely qualitative, reported lifetime prevalence of ASD, or were single case studies were also excluded. Studies published in a language other than English were not included in the analysis but were recorded in accordance with guidance from the Centre for Reviews and Dissemination Guidelines (CRD; 2008). Studies which used only a parent report of ASD were also excluded. Previous research has demonstrated that parent report is an unreliable measure of the child's experience of symptoms, resulting in symptoms being under reported in the acute stage post-trauma (Meiser-Stedman et al., 2007) and the months that follow (Dyb, Holen, Braenne, Indredavik, & Aarseth, 2003; Meiser-Stedman et al., 2007).

Information Sources and Search Terms

Relevant studies were identified through following a systematic search of leading psychological and medical literature databases, including EMBASE, MEDLINE (PubMed), PsycINFO, PsycARTICLES and PILOTS (Published International Literature on Traumatic Stress). Further, reference sections of full texts, prior to the final number of studies being decided, were screened for relevant papers. Databases were searched for studies published between 1994 (when ASD was first defined by the DSM) and 1st January 2018. Where full texts of studies could not be accessed, efforts were made to contact the authors directly, which resulted in some full texts being retrieved. Dissertations identified through searches were retrieved via electronic depositories. The following search terms were used to identify relevant studies: (Acute Stress Disorder OR Acute Stress Symptoms OR Acute Stress Reaction OR Acute Stress Response) AND (Child* OR Adolescen* OR

Juvenil* OR Teen* OR Youth OR Young Person OR Young People); where these were present in the title and/or abstract.

Study Selection and Data Collection

All abstracts of papers from initial searches were screened by the first author. At the full-text stage of screening papers, the first reason encountered as to why a study did not meet inclusion criteria was recorded. A data extraction spreadsheet was developed which contained items of interest for inclusion in the meta-analysis. Data was collected for the following study variables: author, year of publication, country and World Bank classification of national income, design, setting, recruitment method, number of those eligible to take part, sample size, number of ASD cases and inclusion and exclusion criteria. For participants in each study, data was collected regarding ethnicity, age (mean, standard deviation and range), sex, trauma type (interpersonal, non-interpersonal, individual, collective), injury severity and hospital admission. Regarding how ASD was assessed in each study, extracted data pertained to the method of data collection (e.g. in person), timing of ASD assessment post-trauma, self-report measure (with clinical cut-off) or diagnostic interview used (with measure of reliability and validity), and the diagnostic criteria used. Where studies used both self-report questionnaires and structured diagnostic interviews to assess ASD, data was collected on both. However, in the meta-analysis the data from the interview was used as this is generally seen as the gold standard and has been done in previous research (Hiller et al., 2016).

Risk of Bias

To assess the risk of bias in the final included studies, a tool was developed based on those which have previously been used for prevalence studies (Hoy et al., 2012; Munn, Moola, Riitano, & Lisy, 2014). Questions concerned the participation rate and reasons for non-response, representativeness of the sample, recruitment, sample size and the way in which ASD was measured (Appendix A). The risk of bias tool included 10 questions, with

a possible score out of 20. Higher scores indicated lower risk of bias. Studies were given a rating of two for an item if it was well addressed, one if it was partially addressed, or zero if it was poorly addressed, not addressed, or not reported.

Data Synthesis

Data analysis was conducted using the OpenMeta[Analyst] software (Wallace et al., 2012) which utilises the Metafor package from the statistical programme 'R' (Viechtbauer, 2010). The prevalence of ASD from each study was computed, with these then pooled to produce a weighted estimate of prevalence of ASD. Heterogeneity was to be expected due to the clinical, methodological, and statistical variability of included studies. Examples of sources of heterogeneity include the characteristics of participants, the way in which ASD was assessed, the difference in reported prevalence of ASD and risk of bias between studies. Therefore, a random effects model was used in this study, providing broader and more conservative 95% confidence intervals around the estimate of prevalence than a fixed effects model (Der Simonian & Laird, 1986; Cuijpers, 2016). Heterogeneity was assessed via visual inspection of the forest plot, Cochran's *Q* test (Cochran, 1954) and the I^2 statistic (Higgins & Thompson, 2002). Whereas the *Q* can be used to identify the significance of heterogeneity, the I^2 statistic provides the level of heterogeneity as a percentage allowing for ease of interpretation (Higgins, Thompson, Deeks, & Altman, 2003). Estimates of prevalence of ASD were arcsine transformed to prevent the confidence intervals of studies with low prevalence falling below zero (Barendregt, Doi, Lee, Norman, & Vos, 2013).

Moderator analysis that were planned a priori included the method by which ASD was assessed, age, sex, ethnicity and trauma characteristics. Sensitivity analysis was conducted for the risk of bias score of each study as well as the representativeness of the sample. This was done using studies which had reported the total number of youth eligible for participation (not purely those contacted) in the study. Due to a lack of information

reported in studies, data regarding injury severity and hospital admission could not be meta-analysed. Therefore, the moderator analysis concerning trauma type was limited to interpersonal trauma and non-interpersonal trauma. We categorised interpersonal trauma studies as those in which participants had experienced assaults and attacks by others. Non-interpersonal trauma studies included exposure to events such as road traffic collisions, animal attacks and natural disasters. Categorising studies in this way was based upon the method of Alisic et al's. (2014) meta-analytic review of the prevalence of PTSD in youth, although we recorded studies with mixed samples as either interpersonal or non-interpersonal based upon the trauma type of the highest percentage of participants. Moderator analysis on country income, as defined by the World Bank classification (2014), was not achievable as all studies were from high or upper-middle income countries. Similarly, comparing studies of collective traumas such as natural disasters, to studies of individual traumas was not possible, due to only one final study relating to a collective trauma. Meta-regression was used to assess the differences between subgroups. Potential publication bias was assessed via visual inspection of funnel plots (Higgins & Green, 2011).

Results

Search Results

The process of study selection for inclusion in the meta-analysis can be seen in the PRISMA diagram (Figure 1). Following a systematic search, 2,393 results were obtained after duplicates had been removed. Of these, 205 full-text articles were assessed for eligibility for inclusion in the meta-analysis. This resulted in 17 studies that met inclusion criteria, totalling 2,918 participants, the details of which can be seen in Table 1.

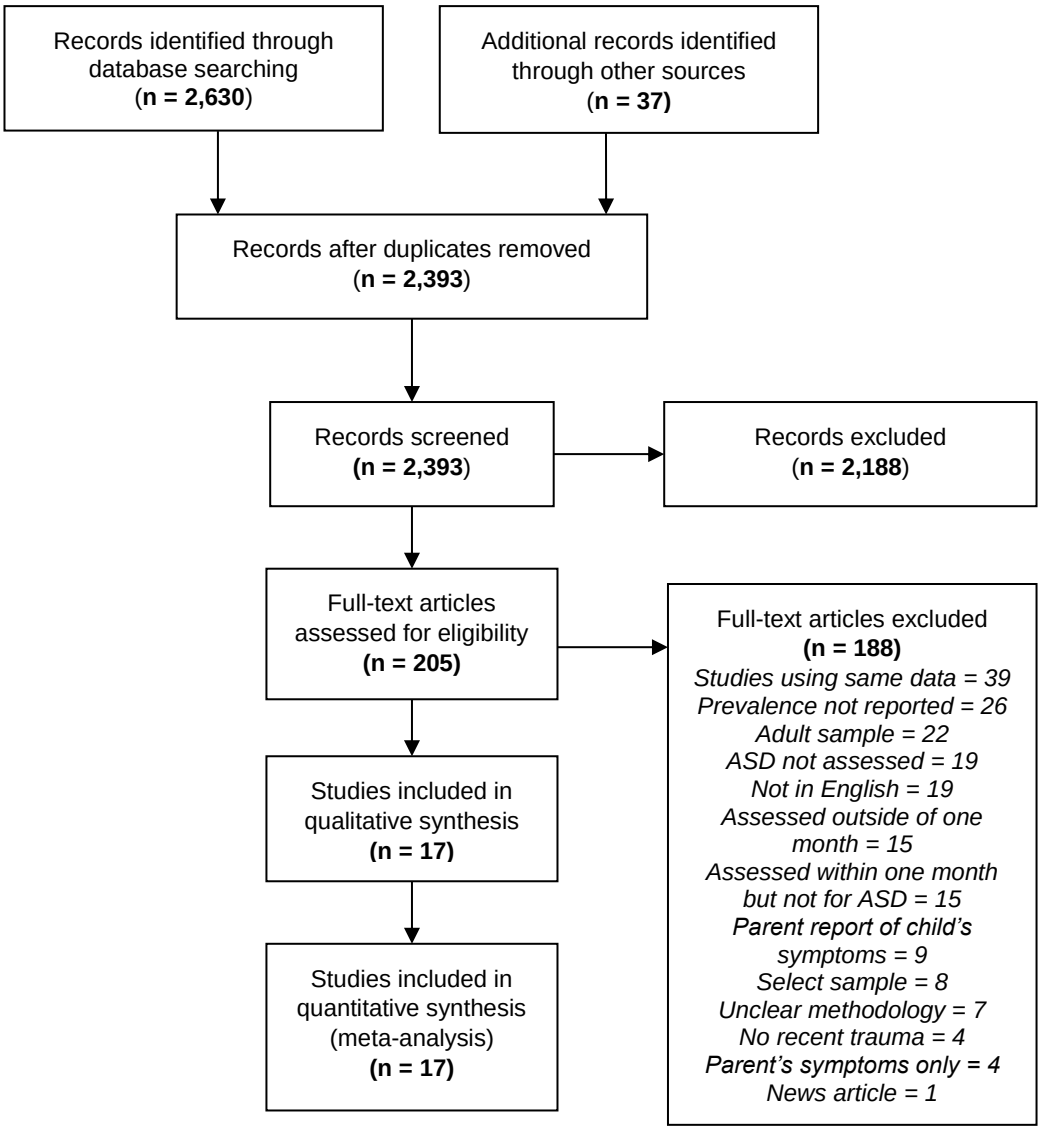

Figure 1. PRISMA Diagram demonstrating process of study selection

Table 1. Included studies, sample characteristics, methods of assessment, quality ratings and prevalence of ASD

Study	Country	Recruitment site	Age		Timing of ASD assessment	Measure of ASD	Method of assessment	Majority trauma type	Risk of bias score	Risk of bias category	Sample size	ASD prevalence	
			Range	*M (SD)*								*N*	%
Brown et al. (2016)	USA	Burn Centre & Emergency Department	7 - 18	13.5 (3.5)	*M* = 5.5 days	DICA-ASD	Interview, DSM-IV ASD algorithm	Non-interpersonal	12	Moderate	197	71	36.0
Bryant et al. (2004)	UK	Emergency Department	5 - 16	12.3 (2.9)	2 weeks	IESR-8 plus questions for DSM-IV ASD	Questionnaire, DSM-IV ASD algorithm	Non-interpersonal	9	Moderate	86	10	11.6
Ellis, Nixon, & Williamson (2009)	Australia	Emergency Department & Inpatient Ward	7 - 17	12.0 (2.8)	*M* = 20.4 days	ASC-Kids	Questionnaire, DSM-IV ASD algorithm	Non-interpersonal	16	Low	97	5	5.2
Fein, Kassam-Adams, Vu, & Datner (2001)	USA	Emergency Department	8 - 24	14.4 (3.4)	Within 24 hours of admission	ISRC	Subthreshold Questionnaire, DSM-IV ASD	Interpersonal	17	Low	81	24	29.6
Haag, Zehnder & Landolt (2015)	Switzerland	Emergency Department	7 - 16	11.6 (2.7)	10 days	IBS-A-KJ (German CAPS-CA)	Interview, DSM-IV ASD algorithm	Non-interpersonal	17	Low	101	3	3.0

Study	Country	Recruitment site	Age		Timing of ASD assessment	Measure of ASD	Method of assessment	Majority trauma type	Risk of bias score	Risk of bias category	Sample size	ASD prevalence	
			Range	*M (SD)*								*N*	%
Hamrin (1998)	USA	Emergency Department	11 - 15	13.9	24 hours post-admission	DSM-IV Clinical interview	Interview, DSM-IV ASD algorithm	Interpersonal	13	Moderate	16	9	56.2
Kassam-Adams & Winston (2004)	USA	Emergency Department	8 - 17	11.3 (2.5)	2 days – 1 month	CASQ	Questionnaire, DSM-IV ASD algorithm	Non-interpersonal	17	Low	243	19	7.8
Kassam-Adams (2006)	USA	Emergency Department & Intensive Care Unit	8 - 17	11.8	2 days – 1 month	ASC-Kids	Questionnaire, DSM-IV ASD algorithm	Non-interpersonal	8	High	176	2	1.1
Kassam-Adams et al. (2013)	USA	Health & Community Social Services	8 - 17	13 (2.6)	2 days – 1 month	DICA-ASD	Interview, DSM-IV ASD algorithm	Non-interpersonal	10	Moderate	479	122	25.5
Li, Zhang, Wang, & Lui (2010)	China	Emergency Department	5 - 17	9.4 (2.8)	1 week	CASQ	Questionnaire, DSM-IV ASD algorithm	Non-interpersonal	12	Moderate	358	38	10.6
Meiser-Stedman et al. (2007)	UK	Emergency Department	10 - 16	13.8 (1.9)	2 – 4 weeks	ADIS-C plus dissociation items	Interview, DSM-IV ASD algorithm	Interpersonal	15	Low	93	18	19.4

Study	Country	Recruitment site	Age		Timing of ASD assessment	Measure of ASD	Method of assessment	Majority trauma type	Risk of bias score	Risk of bias category	Sample size	ASD prevalence	
			Range	*M (SD)*								*N*	%
Meiser-Stedman, Smith, Glucksman, Yule, & Dalgleish (2008)	UK	Emergency Department	7 - 10		2 - 4 weeks	CAPS-CA plus dissociation items	Interview, DSM-IV ASD algorithm	Non-interpersonal	15	Low	48	11	22.9
Meiser-Stedman et al. (2017)	UK	Emergency Department	8 - 17	14.1 (2.9)	*M* = 22.0 days	CPTSDI plus dissociation items	Interview, DSM-5 ASD criteria	Non-interpersonal	14	Moderate	226	32	14.2
Pailler, Kassam-Adams, Datner, & Fein (2007)	USA	Emergency Department	12 - 17	14.3	Within 72 hours	IRSC	Subthreshold Questionnaire, DSM-IV ASD	Interpersonal	11	Moderate	394	46	11.7
Salmon et al. (2007)	Australia	Emergency Department	7 - 13	9.9 (2.6)	*M* = 25.6 days	CASQ	Questionnaire, DSM-IV ASD algorithm	Non-interpersonal	12	Moderate	76	6	7.9
Salmond et al. (2011)	UK	Emergency Department	8 - 17	13.5 (2.5)	2 – 4 weeks	ADIS-C plus dissociation items	Interview, DSM-IV ASD algorithm	Interpersonal	15	Low	50	19	38.0
Zhou, Zhang, Wei, Liu, & Hannak, (2016)	China	Middle School	9 - 15	13.2 (1.6)	2 weeks	ASDS	Subthreshold Questionnaire, DSM-IV ASD	Non-interpersonal	8	High	197	56	28.4

Note. ADIS-C = Anxiety Disorders Interview Schedule for Children; ASC-Kids = Acute Stress Checklist for Children; CAPS-CA = Clinician-Administered Posttraumatic Stress Disorder (PTSD) Scale for Children and Adolescents; CASQ = Child Acute Stress Questionnaire; IESR-8 = Impact of Event Scale-Revised – 8 items; IBS-A-KJ = Interview zur Erfassung der Akuten Belastungsstörungen bei Kindern und Jugendlichen; ISRC = Immediate Stress Reaction Questionnaire; ASDS = Acute Stress Disorder Scale; CPTSDI = Children's Posttraumatic Stress Disorder (PTSD) Inventory; DICA-ASD = Diagnostic Interview for Children and Adolescents for Acute Stress Disorder

Risk of Bias Assessment

Figure 2 displays the proportion of studies that were rated as low, moderate or high risk of bias for each of the 10 criteria, whilst Table 1 provides the overall risk of bias score for each individual study. Scores between 15-20 indicate a low risk of bias, 9-14 a moderate risk of bias, and less than 8 a high risk of bias. Details of the risk of bias assessment for each study can be seen in Appendix B. When independently assessed by another researcher, inter-rater reliability for a subsample of four of the included studies was good (Cohen's Kappa (*k*) = 0.76).

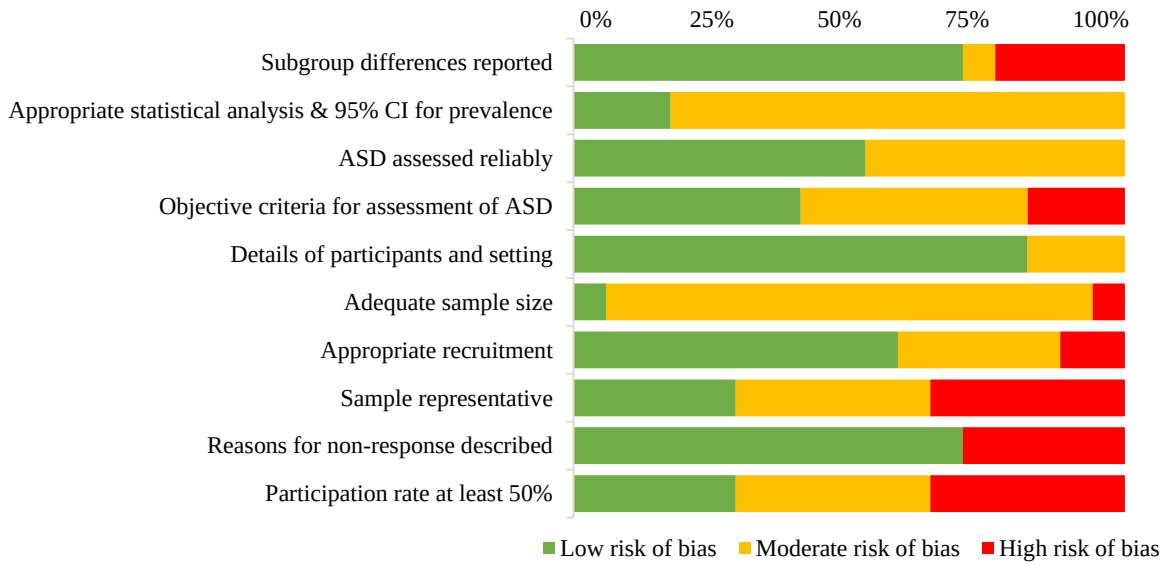

Figure 2. The proportion of studies that were rated as low, moderate or high risk of bias for each risk of bias question assessed.

Prevalence of ASD

With all 17 studies included, the pooled prevalence of ASD was 16.4% (95% CI 11.2 - 22.4%) with considerable heterogeneity found between studies ($Q(16) = 261.123$, $p < .001$, $I^2 = 93.9\%$) (Figure 3). The method by which ASD was assessed had a significant impact upon the estimated prevalence obtained. Eight studies assessed ASD using a clinical interview, adhering to DSM-IV or DSM-5 criteria. The estimated prevalence of

ASD from these studies was 23.7% (95% CI 15.1 – 33.6%), with considerable heterogeneity present ($Q(7) = 86.593$, $p < .001$, $I^2 = 91.9\%$). Six studies assessed ASD using a questionnaire which adhered to the diagnostic algorithm for DSM-IV ASD. The estimated prevalence from these studies was 6.8% (95% CI 3.5 – 11.0%), with high levels of heterogeneity ($Q(5) = 27.212$, $p <.001$, $I^2 = 81.6\%$). The remaining three studies assessed ASD using a questionnaire that did not conform to the diagnostic criteria. Participants were reported to have significant symptoms of acute stress if they had at least one symptom from each of the four DSM-IV ASD clusters (Fein et al., 2001; Pailler et al., 2007), or if they had a total score of 9 for dissociation items and 28 for the other three clusters combined (Zhou et al., 2016). The estimated prevalence of ASD from these three studies was 22.3% (95% CI 10.4 – 37.2%), with considerable heterogeneity present ($Q(2) = 30.879$, $p < .001$, $I^2 = 93.5\%$). Meta-regression analyses confirmed that a statistically significant difference existed between the estimated prevalence when assessed via an ASD specific questionnaire compared to clinical interview ($B = -0.242$ (95% CI -0.386 - -0.098, $p = .001$) (Figure 4).

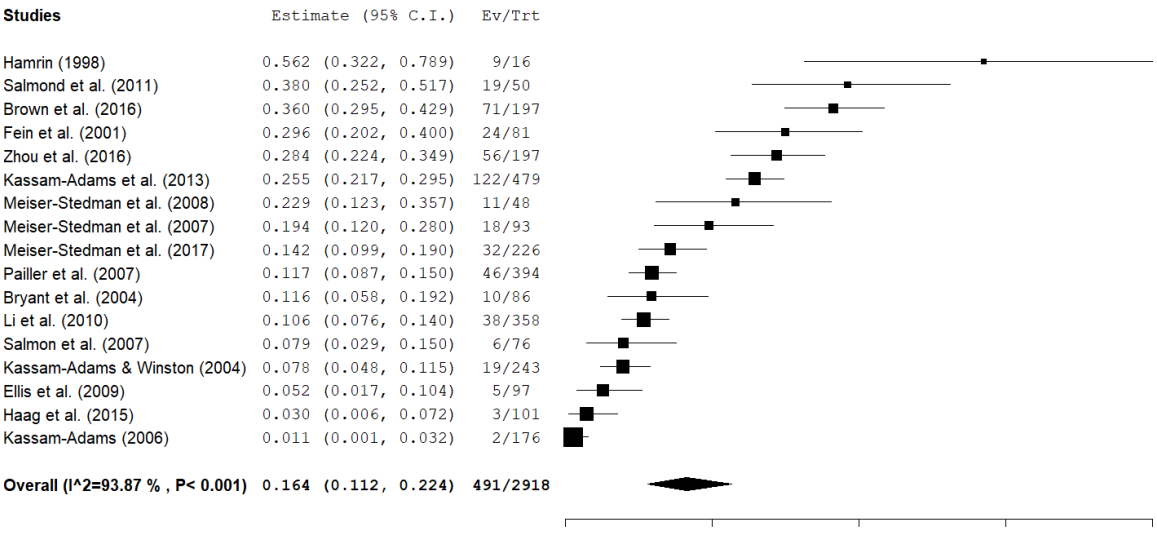

Figure 3. Pooled prevalence of ASD from 17 studies

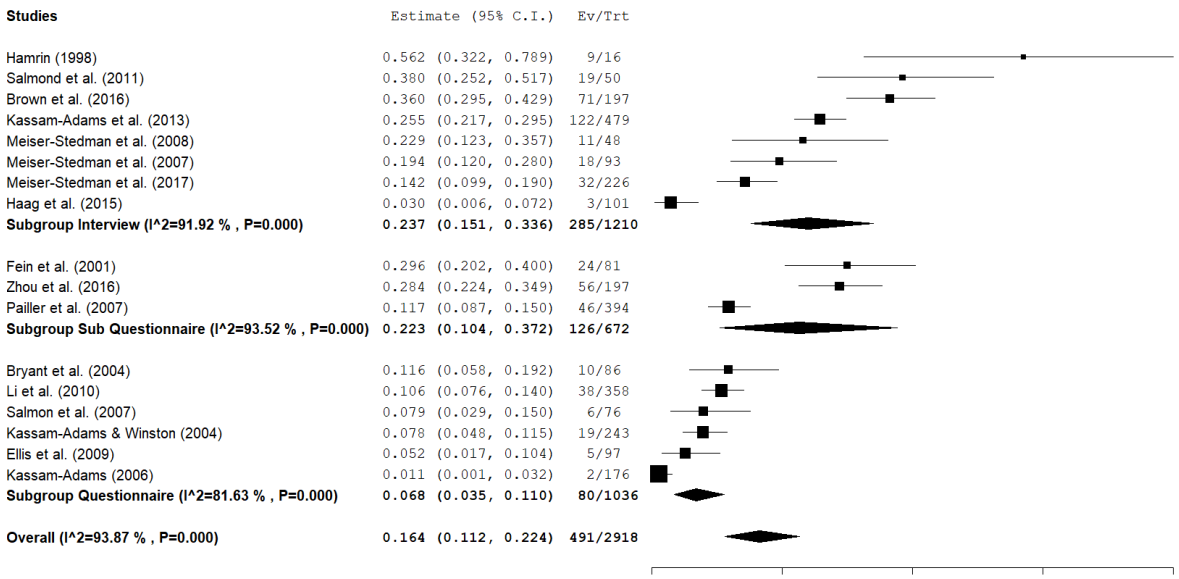

Figure 4. Pooled prevalence of ASD by method of assessment (interview, questionnaire, subthreshold questionnaire)

Sensitivity Analysis

Due to high heterogeneity between studies, sensitivity analysis was conducted by removing each study in turn to identify any significant impact upon the overall prevalence of ASD reported. This resulted in prevalence estimates ranging from 15.1% (95% CI 10.1 – 21.0%) to 17.8% (95% CI 12.7 – 23.6%) indicating that no one study greatly impacted upon the estimate of pooled prevalence obtained. This was also conducted for the eight studies that used clinical interview, resulting in prevalence estimates ranging from 21.1% (95% CI 12.8 – 30.8) to 27.4% (95% CI 19.9 – 35.6). Further sensitivity analysis was conducted through using meta-regression for the continuous measure of risk of bias. This proved to be insignificant ($B = 0.00$, $p = 0.975$) when considering all 17 studies, demonstrating that risk of bias had little impact upon prevalence estimates. When the two studies that were deemed to have a high risk of bias (Kassam-Adams, 2006; Zhou et al., 2016) were excluded from analysis, the estimated prevalence of ASD was not dissimilar (17.1%, CI 12 – 23), with heterogeneity unaffected ($Q(14) = 178.862$, $p < .001$, $I^2 =$ 92.2%). Therefore, these two studies were included in further analysis.

Moderator Analysis

Subgroup and moderator analysis were conducted using all 17 studies. Subgroup analysis for the method by which ASD was assessed is reported above. The mean age of participants in studies was found to be significant (B = 0.071 (95% CI 0.023 – 0.119), p = .004), i.e. studies with older participants reported higher prevalence of ASD. For studies in which the majority of participants had been exposed to interpersonal trauma (five studies), prevalence of ASD was higher (27.7%, 95% CI 15.5 – 42.0%) than in those where the majority had been exposed to non-interpersonal trauma (12 studies) (12.8%, 95% CI 7.2 – 19.7%). This finding was confirmed via meta-regression (B = 0.187 (95% CI 0.018 – 0.357), p = 0.031) and can be seen in Figure 5. No significant association was found between prevalence of ASD and sample characteristics regarding sex or ethnicity using meta-regression (p = 0.658 and p = 0.256, respectively).

To examine whether the association between older age and increased prevalence was a product of trauma type, a further meta-regression of age was conducted omitting the interpersonal trauma studies. Data on average age was available for 11 of the 12 non-interpersonal trauma studies, with the significant association of older age and increased prevalence of ASD still observed (B = 0.062 (95% CI 0.004 – 0.119), p = 0.035). However, the studies reporting the lowest mean age of participants were those which had used an ASD specific questionnaire to assess ASD, which as already demonstrated, led to significantly lower prevalence rates being reported.

Participation Rate

Eleven studies which reported the number of youth who were eligible to take part in the study were meta-analysed, producing a pooled estimate for participation rate of 50.9% (95% CI 40.3 – 61.4%). There was not a significant interaction between prevalence of ASD and participation rate using meta-regression, p = 0.116.

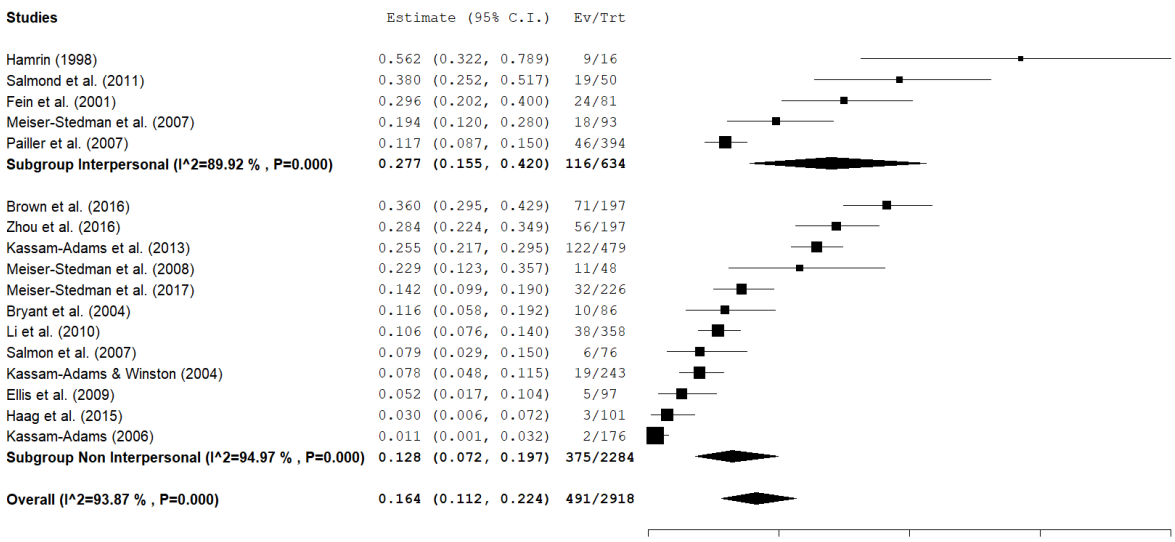

Figure 5. Pooled prevalence of ASD for interpersonal and non-interpersonal trauma studies

Publication Bias

Publication bias was assessed via visual inspection of a funnel plot (Appendix C). Observed asymmetry may be attributable to heterogeneity, in the way that ASD was assessed and the trauma event to which participants in different studies were exposed, rather than publication bias (Cuijpers, 2016). The funnel plot could be interpreted as indicating that smaller studies reporting low prevalence of ASD are less likely to be published. However, smaller studies may focus on specific groups of individuals. The study by Hamrin (1998) included in this review recruited youth who had experienced extreme violence as they had all been victims of gunshots. This can lead to the funnel plot displaying a small sample bias, rather than a publication bias (Cuijpers, 2016).

Discussion

The literature surrounding children and adolescents' symptoms of acute stress following exposure to a traumatic event has reported a range of prevalence rates. Created initially as a way of identifying individuals who may be at risk of developing later PTSD, ASD is increasingly viewed as being most helpful when identifying those who may benefit from more immediate support in the acute stage post-trauma. This meta-analysis sought to reach a reliable estimate of the prevalence of ASD in youth in the one month following

exposure to a traumatic event, with consideration of moderators such as method of assessment, demographic and trauma variables. Conducting a meta-analysis allowed us to pool 17 studies, totalling 2,918 participants, which provided an estimated prevalence of 16.4%. However, when focussed on the eight studies that assessed ASD using clinical interview, prevalence increased to 23.7%. Both estimates are higher than previous reports of prevalence of ASD from large samples of trauma exposed youth (Dalgleish et al., 2008; Kassam-Adams et al., 2012; McKinnon et al., 2016).

Impact of Moderators on Prevalence of ASD

Method of Assessment

The significant difference between prevalence of ASD obtained through using clinical interview when compared to an ASD specific questionnaire was striking. Similar to the findings from previous research (Kasam-Adams et al., 2013), prevalence rates of ASD in this meta-analysis were 23.7% when youth were administered a clinical interview, but only 6.8% when an ASD specific questionnaire was used. One of the ASD specific questionnaire studies (Bryant et al., 2004) used an adapted post-traumatic stress measure to include symptoms of ASD and therefore satisfy the diagnostic algorithm required for DSM-IV. Three of these studies (Kassam-Adams & Winston, 2004; Salmon, Sinclair, & Bryant, 2007; Li et al., 2010) used the CASQ, whereas the remaining two (Kassam-Adams, 2006; Ellis, Nixon, & Williamson, 2009) used the ASC-Kids. The low prevalence of ASD obtained through using these ASD specific questionnaires has implications for the way in which youth are assessed in the acute aftermath of a traumatic event. There will be instances where administering a questionnaire is preferable to an interview in order to make more efficient use of available resources. However, the findings here suggest that many children and adolescents who might meet diagnostic criteria through a clinical interview may not be identified using a questionnaire oriented to DSM-IV ASD criteria. This has been attributed to the lack of coverage of dissociative symptoms on questionnaire

measures of DSM-IV ASD when compared to interview, resulting in many youth not meeting diagnostic criteria (Kassam-Adams et al., 2013). Questionnaires for use with the updated DSM-5 criteria will no longer include the cluster-based algorithm, although will require the presence of at least nine of fourteen symptoms. Only one study in this meta-analysis utilised DSM-5 criteria (Meiser-Stedman et al., 2017), which prevented subgroup analysis of the two diagnostic classifications. Clinical interviews may allow for more time for acute symptoms to be explored with the young person when compared to a brief questionnaire measure, which may result in the identification of symptoms that might have otherwise been missed. With more time to assess for symptoms, interviewers may feel that they can tailor questions to meet the needs of the individual and perhaps obtain a more accurate representation of symptoms and functioning.

Interpersonal Trauma

Studies in which youth were exposed to interpersonal trauma reported higher prevalence of ASD than those in which participants had experienced a non-interpersonal trauma; a finding which corresponds with what has been described in PTSD research in youth (Alisic et al., 2014). It has been suggested that experiencing an interpersonal trauma results in maladaptive coping strategies and self-blame (Tolin & Foa, 2006), which may explain increased symptoms of acute stress when compared to non-interpersonal traumas (Gunaratnam & Alisic, 2017). The scope of the current review does not lend itself to adding further explanation to the current hypotheses surrounding interpersonal trauma and increased prevalence of ASD. However, it does provide evidence that an association exists and therefore future research should focus on delineating this relationship further, as well as underscoring the clinical importance of screening youth exposed to such trauma.

Demographic Characteristics

Where age has been found to increase the likelihood of ASD, this has often been in younger children (Saxe et al., 2005; Le Brocque et al., 2010). Contrary to the literature,

studies with older participants showed increased prevalence of ASD. This result was still present when the interpersonal trauma studies were removed to account for the higher prevalence of ASD in those studies. However, upon further inspection, the studies reporting the lowest mean age of participants were those which had used an ASD specific questionnaire to assess ASD. Therefore, the finding that older samples reported increased prevalence could be attributed to the method by which ASD was assessed in these studies and thus unrelated to the age of the sample. This review failed to identify a significant association between prevalence of ASD and ethnicity at the sample level, which appears consistent with previous research (Winston et al., 2002; Kassam-Adams & Winston, 2004; Ostrowski et al., 2011). Whereas several studies have reported girls to be at higher risk of developing ASD than boys, no association was detected between prevalence of ASD and gender when using the proportion of females across studies as the independent variable. Recent meta-analytic studies in youth have reported conflicting findings regarding female gender alone and risk of developing PTSD, with it being suggested that gender may interact with other trauma variables and coping styles to produce significant results (Trickey et al., 2012; Alisic et al., 2014).

Participation rate was meta-analysed for eleven of the included studies where data existed on the number of participants who took part from the number of youth eligible. The result of 50.9% suggests that although higher than some previous reports (Meiser-Stedman et al., 2007), conclusions drawn from the research are based upon half of youth who are identified as being eligible. Moreover, such a figure suggests a general willingness of recently trauma-exposed youth to participate in traumatic stress research.

Limitations

This is the first meta-analytic review focussed on prevalence of ASD in children and adolescents. However, this review does have several limitations. First, heterogeneity across studies was high, with sensitivity analysis failing to significantly decrease this. High

heterogeneity is likely attributable to the range of ways in which ASD was measured, varying prevalence rates, diverse trauma types and the variability in the length of time between the traumatic event and the assessment of ASD across studies. Second, moderator analyses planned a priori, including income of country and whether the trauma was collective or individual, could not be conducted due to a lack of identified studies. There is still much we do not know about ASD in developing countries, perhaps attributable to the difficulties in allocating resources to investigate this in the acute post-trauma period. Furthermore, efforts should be made to conduct and report assessments of ASD in youth following collective traumas of both an interpersonal and non-interpersonal nature. The findings from this review cannot be generalized to such populations as only one study was found that met inclusion criteria. Third, although a strength of this study is in demonstrating the difference in prevalence of ASD when measured via interview compared to questionnaire, heterogeneity may have been lower if all studies had utilised a gold standard interview. The moderator analysis conducted in this review would have lacked power had the additional ASD and subthreshold ASD questionnaire studies not been included. ASD is a relatively new diagnosis and therefore the number of studies that met inclusion criteria for this review are relatively low when compared to more established diagnoses such as PTSD. The risk of bias tool assigned equal weighting to each item, whilst it might be that some are more pertinent than others with regard to the quality of each study included in analysis. The findings presented in this article should be interpreted in the context of a small number of studies being used for moderator analysis.

Clinical Implications and Future Research

Findings from this meta-analysis suggest that studies in which children and adolescents were assessed via interview reported higher prevalence than in those which utilised a questionnaire, possibly due to the increased number of ways available to enquire about symptoms via interview (Kassam-Adams et al., 2013). Despite the de-emphasis of

dissociative symptoms, the updated DSM-5 ASD criteria may result in individuals being missed due to the sheer number of symptoms required to meet diagnosis. Recent research has suggested that a reduced symptom count of four or more symptoms may aid in identifying youth with severe acute stress reactions post-trauma (Kassam-Adams et al., 2012; Meiser-Stedman et al., 2017). Taken together, these findings should be considered when developing DSM-5 ASD specific questionnaires for use with children and adolescents. When the option of a clinical interview is not available, questionnaires may better fulfil their function of identifying youth with significant acute distress by using a subthreshold symptom count. Although likely dependant on the aims of the research, future studies assessing symptoms of acute stress should seek to use measures which correspond to the DSM-5 criteria. This would allow for improved and more reliable conclusions to be made from comparisons of studies in trauma exposed youth. Future research should aim to measure and report variables such as trauma severity, which may have contributed towards the high levels of heterogeneity found in this study. A consistent and agreed upon measure of trauma severity may help to delineate a relationship between this variable and prevalence of ASD across studies.

Conclusion

A significant strength of this review is the reported prevalence of ASD when measured via clinical interview compared to a specific ASD questionnaire. Prevalence of ASD in children and adolescents in the one month following exposure to a traumatic event was estimated to be 16.4%. When studies were limited to those which used a clinical interview to assess ASD, prevalence increased to 23.7%. Given the much lower prevalence obtained through using questionnaires adopting the DSM-IV cluster-based algorithm, the prevalence rate of 23.7% may be more reliable. Findings from the current review suggest that questionnaires which utilise the DSM-IV cluster-based algorithm for ASD may be too strict when intended to identify those youth with severe acute symptoms post-trauma. This

article provides a baseline of ASD prevalence in anticipation of future studies which will likely use the DSM-5 criteria. Future research should continue to examine the performance of ASD questionnaires when compared to clinical interview in identifying youth with significant symptoms of acute stress.

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Appendix A. Risk of Bias Tool

1	Was the participation rate of eligible persons at least 50%?	
More than 50% of those eligible took part in the study		2
Less than 50% of those eligible took part in the study		1
Number of eligible potential participants not reported		0
2	Were reasons for non-response described?	
Authors described reasons for non-response and numbers i.e. number of those that did not wish to take part broken down by reason		2
Authors described reasons for non-response but give no indication of numbers for each reason		1
Authors did not report reasons for non-response		0
3	Was the sample representative - were there differences between participants and those who did not take part in the study?	
No significant differences in demographics and/or trauma variables for those who did not participate compared to participants		2
Reported significant differences in demographics and/or trauma variables for those who did not participate		1
Authors did not report differences between those that did and did not participate		0
4	Were study participants recruited in an appropriate way?	
Consecutive or random sample of potential participants approached to take part in the study in person		2
Consecutive or random sample of potential participants were approached to take part in the study via letter or phone call		1
Authors do not report how participants were recruited		0
5	Was the sample size adequate?	
Sample size adequate to detect prevalence of ASD with consideration of previous studies and/or sample size calculation		2
Sample size adequate to detect prevalence of ASD without mention of previous studies or sample size calculation		1
No evidence of sample size justification or calculation and small sample size		0

6	Were the participants and the setting described in detail?	
Detailed information reported on characteristics and demographics of participants and trauma variables (e.g. age, gender, ethnicity, trauma type, injury severity, days in hospital if applicable), with information about the setting reported		2
Adequate information reported on some characteristics and demographics of participants and/or trauma variables, with some information about the setting		1
Demographic characteristics, trauma variables and setting not reported in any detail		0
7	Were objective, standard criteria used for the assessment of Acute Stress Disorder?	
Diagnostic interview shown to demonstrate good levels of validity and reliability in assessment of ASD in children and adolescents adhering to DSM-IV or DSM-5 criteria for ASD i.e. cluster-based algorithm for DSM-4; measured between 48 hours and 4 weeks post-trauma		2
Self-report questionnaire shown to demonstrate good levels of validity and reliability in assessment of ASD in children and adolescents adhering to DSM-IV or DSM-5 criteria for ASD i.e. cluster-based algorithm for DSM-4; or interview adhering to DSM criteria		1
Observer-rated questionnaire/interview, self-report questionnaire without utilising DSM criteria (e.g. not conforming to cluster-based algorithm for DSM-IV ASD), self-report questionnaire for PTSD, generic clinical interview		0
8	Was Acute Stress Disorder assessed reliably?	
Assessment carried out by Clinical Psychologist/Psychiatrist/appropriately trained professional in person, at the most convenient location (e.g. at home if participant discharged from hospital), with efforts made to see the child/adolescent alone		2
Assessment carried out by Clinical Psychologist/Psychiatrist/appropriately trained professional over the phone. Or, carried out in person but doesn't give detail about who conducted this.		1
Assessment of ASD indirect e.g. through proxy such as parent or healthcare professional. Lack of information about where assessment took place and who facilitated this		0
9	Was there appropriate statistical analysis?	
Statistical methods used for analysis were appropriate, with confidence intervals at 95% reported for prevalence estimate		2
Statistical methods used for analysis were appropriate, but confidence intervals for prevalence not reported		1
Statistical methods used for analysis were inappropriate or lack of information on statistical methods utilised when data reported		0

10	Are all important confounding factors/subgroups/differences identified and accounted for?

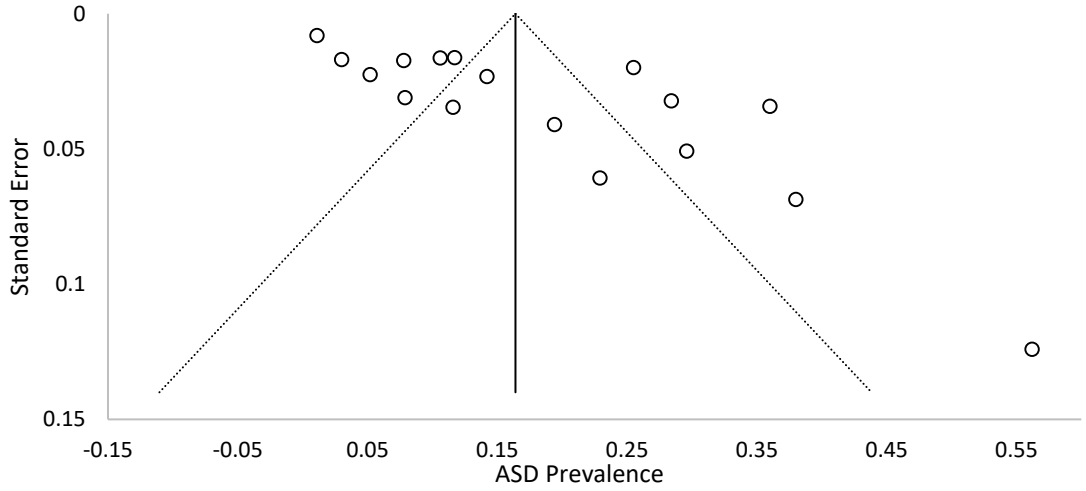
The authors report overall prevalence of ASD as well as performing statistical analysis to identify particular subgroups within the sample e.g. compare prevalence of ASD in males to females; correlation or regression between moderator variables and ASD rate/severity	2
The authors report overall prevalence of ASD whilst commenting on observed differences between subgroups	1
The authors report overall prevalence of ASD but do not comment on subgroups or confounding variables	0

Appendix B. Risk of Bias Ratings by Study

Study	Risk of bias criteria										Score /20
	1	2	3	4	5	6	7	8	9	10	
Brown et al., (2016)											12
Bryant et al., (2004)											9
Ellis et al., (2009)											16
Fein et al., (2001)											17
Haag et al., (2015)											17
Hamrin, (1998)											13
Kassam-Adams & Winston, (2004)											17
Kassam-Adams, (2006)											8
Kassam-Adams et al., (2013)											10
Li et al., (2010)											12
Meiser-Stedman et al., (2007)											15
Meiser-Stedman et al., (2008)											15
Meiser-Stedman et al., (2017)											14
Pailler et al., (2007)											11
Salmon et al., (2007)											12
Salmond et al., (2011)											15
Zhou et al., (2016)											8

Note. Each study was rated green (criterion well addressed = 2), amber (criterion partially addressed = 1) or red (criterion poorly addressed, not addressed or not reported = 0).

Appendix C. Funnel Plot to Assess Publication Bias



Bridging Chapter

A significant proportion of children and adolescents reach diagnostic criteria for Acute Stress Disorder (ASD) in the one month following exposure to a traumatic event, as evidenced in the previous article. The prevalence rate of 23.7% when assessed via clinical interview is higher than previous estimates in the literature which have combined the findings from interview and questionnaire measures. Studies that have pooled a smaller number of samples have reported prevalence rates of 9% and 10.5% using DSM-IV (Dalgleish et al., 2008; Kassam-Adams et al., 2012) and 13.6% using DSM-5 criteria (McKinnon et al., 2016).

We found prevalence of ASD assessed via clinical interview to be 23.7% in children and adolescents. A meta-analytic review of the rate of Post-Traumatic Stress Disorder (PTSD) in youth estimated prevalence to be 15.9% when assessed via interview (Alisic et al., 2014). These findings taken together support the degree of spontaneous recovery observed in symptoms of acute stress post-trauma in youth (Le Brocque et al., 2010; Hiller et al., 2016). Prevalence of PTSD in children and adolescents has been evidenced to reduce by approximately 50% between the first one to six months post-trauma (Hiller et al., 2016). However, when focussed on symptom levels rather than diagnostic classification, a natural decline was observed in the first three months but rarely beyond this point. It could be concluded that screening for PTSD in youth may be unjustified before three months have passed since the traumatic event, as many will experience a natural decline in symptoms up to this point. However, this would disadvantage youth who experience severe symptoms in the acute stage (Hiller et al., 2016) as well as those in which such symptoms persist.

Although less reliance is placed upon ASD as a predictor of PTSD, recent studies suggest that DSM-5 ASD is a better predictor of PTSD than the previous DSM-IV version (Bryant et al., 2015; Meiser-Stedman et al., 2017). Longitudinal studies of traumatic stress

have identified four trajectory groups (Ginzburg et al., 2003; Bonanno & Mancini, 2012) in which an individual can be categorized. An individual would be categorized as belonging to the *resilient* group if both ASD and PTSD were absent; *recovered* if they had ASD but not PTSD; *delayed onset* if they had PTSD but not prior ASD and *persistent* if they had both ASD and PTSD. Severe symptoms in the acute stage have been found to persist in youth who have less social support, increased anxiety (La Greca, Silverman, Lai & Jaccard, 2010) and who have experienced prior trauma (Copeland et al., 2007). Focussing on diagnostic classifications, individuals with ASD have been more likely to develop PTSD through holding maladaptive cognitions and coping strategies (Meiser-Stedman, Dalgleish, Glucksman, Yule & Smith, 2009), presenting with an increased number of symptoms regarding negative alterations in cognition and mood (Meiser-Stedman et al., 2017), experiencing symptoms of peri-traumatic dissociation, being female and having lower socioeconomic status (Brown et al., 2016).

Of the 23.7% of youth reaching diagnosis of ASD in the previous article, the literature suggests that many will experience a natural decline in their symptoms over the first few months. However, there will be a portion of these whose symptoms remain chronic and could thus be categorized as the *persistent* group. Of children and adolescents diagnosed with ASD at the acute stage, between 29% to 48% have been shown to experience persistent symptoms and continue to a diagnosis of PTSD (Brown et al., 2016; Meiser-Stedman et al., 2017), with similar results obtained (24% to 31%) when using questionnaire cut-offs (Le Brocque, Hendrikz, & Kenardy, 2010; De Young et al., 2012). Although conducted with small samples of youth, the findings from these studies suggest that a significant proportion with a diagnosis of ASD will go on to develop PTSD. Obtaining a greater understanding of the factors which differentiate youth whose symptoms persist, from those whose symptoms naturally recover, has been suggested as a future direction for research (Hiller et al., 2016). This would not only serve to improve the

identification of youth who might go on to develop PTSD from ASD, but also help families and clinicians think about factors which may prevent the natural recovery seen in many other children and adolescents (Meiser-Stedman et al., 2017).

The Transition to Posttraumatic Stress Disorder from Acute Stress Disorder: Exploring the Predictive Utility of Initial Symptom Profile in Children and Adolescents

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(Author Guidelines: Appendix G)

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Abstract

A significant minority of children and adolescents experience symptoms of acute stress following exposure to a traumatic event, some of whom will meet criteria for Acute Stress Disorder (ASD) within the first month post-trauma. Despite a period of natural recovery in the months that follow, previous research has identified that for a minority of youth who meet criteria for ASD, symptoms will remain persistent thus meeting criteria for Post-Traumatic Stress Disorder (PTSD). This study aimed to identify whether the initial symptom profile of children and adolescents who met criteria for ASD and later PTSD (the *persistent* group) could be differentiated from those who had the acute diagnosis but did not develop PTSD (the *recovered* group). Data from an International archive of studies that have investigated acute and post-traumatic stress symptoms in youth was accessed in order to answer this question. When comparing individual symptoms of ASD, only the symptom of sleep disturbances was found to be significantly associated with youth whose symptoms remain persistent after correcting for multiple comparisons. However, when using a subthreshold ASD diagnosis, two further symptoms (difficulties with concentration and distress at internal or external reminders) were also found to be significantly associated with transition to PTSD. These findings are discussed with reference to the current literature on child and adolescent traumatic stress. The results of this study highlight the need for sleeping problems post-trauma, and the role that they play in recovery, to be explored in future research with children and adolescents.

Keywords: Child; Adolescent; Trauma; Stress; Acute; Posttraumatic

Introduction

Impact of Traumatic Events on Children and Adolescents

With rising numbers of people exposed to traumatic events (Forneris et al., 2013), children and adolescents are at a high risk of exposure (Hanson et al., 2008) with more than two thirds exposed to one or more traumatic events by the age of 16 (Copeland, Keeler, Angold, & Costello, 2007). Whilst many will naturally recover from acute post-traumatic stress symptoms (Le Brocque, Hendrikz, & Kenardy, 2010), a substantial minority will go on to develop Post-Traumatic Stress Disorder (PTSD; Alisic et al., 2014). Left untreated, difficulties such as depression, hospital admissions, and substance misuse can occur into adulthood (Green et al., 2010; Kessler, Sonnega, Bromet, Hughes, & Nelson, 2010; Scott, McLaughlin, Smith, & Ellis, 2012); demonstrating both an individual and economic cost of distress following trauma (National Institute for Health and Care Excellence [NICE], 2005).

Acute Stress Disorder and Posttraumatic Stress Disorder

Acute Stress Disorder (ASD) was introduced in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV; American Psychiatric Association, 1994) to identify those people experiencing severe traumatic stress responses occurring in the first month post-trauma and who may subsequently develop PTSD (Harvey & Bryant, 2002). In DSM-IV, ASD comprised symptoms of dissociation, re-experiencing, avoidance and arousal which formed a cluster-based algorithm for determining the presence of the condition. Following the release of the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5; American Psychiatric Association, 2013), the criteria for ASD no longer consists of the cluster-based algorithm and instead requires the presence of at least nine from fourteen symptoms. There has also been a shift away from the purpose of ASD being to identify those who might go on to develop PTSD (Kassam-Adams et al., 2012; Bryant, 2017), to instead function primarily as a tool for recognising clinically

significant symptoms in the acute phase that warrant treatment. The DSM-5 diagnosis for PTSD retains symptom clusters, with the greatest change being the previous DSM-IV cluster of *Avoidance and Numbing* now split in two; *Avoidance* and *Negative Alterations in Cognition and Mood* (NACM). Additional symptoms have been added to the latter which were not specified in DSM-IV. Recent findings suggest that past and present DSM criteria perform similarly well in identifying prevalence of both ASD and PTSD (Meiser-Stedman et al., 2017).

Alternative Algorithms for ASD

It has been suggested that the updated DSM-5 criteria for ASD may not be the optimal method of measuring ASD in youth (McKinnon et al., 2016). Before its publication, Kassam-Adams et al. (2012) examined the performance of the DSM-5 ASD criteria when identifying youth presenting with symptoms of acute traumatic stress. Seventy-five percent of children who reported impairment in the one month post-trauma did not receive a diagnosis of ASD and thus were potentially unable to access appropriate services. The authors concluded that a reduced symptom threshold of four or more symptoms would better achieve the objective of the acute diagnosis in identifying distressed youth with impairment in functioning through a trade-off between specificity and sensitivity.

ASD as a Predictor of PTSD

Previous studies suggest that ASD is not a helpful indicator for predicting the likelihood of PTSD (Kassam-Adams & Winston, 2004; Meiser-Stedman, Yule, Smith, Glucksman, & Dalgleish, 2005; Meiser-Stedman et al., 2017). Relying on DSM-IV and subthreshold ASD diagnosis to predict youth who would go on to develop PTSD resulted in almost two thirds being missed in one study (Kassam-Adams & Winston, 2004), whereas in another only half of PTSD cases would have likely met criteria for ASD (Meiser-Stedman et al., 2005).

Meiser-Stedman et al. (2017) examined the use of alternative diagnostic algorithms in predicting PTSD, including *two-week PTSD* as proposed by Brewin, Andrews and Rose (2003), and subthreshold DSM-5 ASD (four or more acute symptoms) as suggested by (Kassam-Adams et al., 2012). Requiring four or more symptoms instead of the nine or more stipulated by DSM-5 led to improvements in sensitivity (80% of PTSD cases met criteria for acute diagnosis) but with a lower Positive Predictive Value (PPV). *Two-week PTSD* had similar predictive properties to ASD, but with a smaller PPV and improved sensitivity (75% of PTSD cases met criteria for acute diagnosis).

Regarding the power of clusters of acute stress symptoms to predict later PTSD, the emphasis placed on the dissociative symptom cluster for DSM-IV ASD has not been supported in children and adolescents (Meiser-Stedman et al., 2007; Brown et al., 2016). A significant limitation in many studies examining predictors of PTSD in youth is the sparsity of cases that experience both ASD at the acute stage and PTSD at the later time point, with recent studies reporting that a small number of participants would sit within this group (e.g. 11%, Brown et al., 2016; 8%, De Young, Kenardy, Cobham, & Kimble, 2012).

Research Recommendations

Previous research suggests that early psychological interventions following trauma can be ineffective and at worst harmful (Wessely & Deahl, 2003). To prevent potentially harmful interventions being offered to children and adolescents immediately following the experience of a traumatic event, recommendations suggest that children should be screened to identify those most at risk for developing chronic symptoms of post-traumatic stress and interventions should be offered accordingly (Kramer & Landolt, 2011). However, at present there is not a clear understanding of which components of an ASD presentation may help to identify those cases which may become chronic i.e. develop PTSD.

Despite the relatively poor ability of ASD to predict PTSD in children and adolescents, more research into this area could help shape the way in which clinical interventions are

offered to young people following trauma (Meiser-Stedman et al., 2017). The widespread natural recovery observed in the first months following exposure to a traumatic event (Le Brocque et al., 2010; Alisic et al., 2014) is an important feature of child and adolescent responses to trauma and requires further exploration to identify factors that may influence this (Hiller et al., 2016).

The newly introduced symptom cluster of NACM to the DSM-5 criteria for PTSD comprises of symptoms including distorted blame, negative expectations of self or the world, and negative emotional state. Through assessing for these symptoms during the acute one-month period post-trauma, Meiser-Stedman et al. (2017) found that, when compared to other clusters (e.g. arousal, re-experiencing), scores were significantly higher two weeks post-trauma in the *persistent* group (those that developed PTSD following ASD) than in the *recovered* group (those that did not develop PTSD following ASD). This suggests that symptoms concerning negative alterations in cognition and mood at the acute stage could be used to identify individuals who may be more likely to develop PTSD from ASD. However, only 14 participants were in the *persistent* group and so these results should be interpreted in the context of a small sample.

Current Study

This study will use data collated from previous studies and stored within the PTSD after Acute Child Trauma (PACT) data archive. The PACT archive contains anonymised data from prospective studies of children and adolescents exposed to an acute, potentially traumatic event (Kassam Adams et al., 2012). Data from 19 studies are stored within the PACT archive, including those from the United States, United Kingdom, Australia and Switzerland. The PACT data archive is led by the Children's Hospital of Philadelphia (CHOP).

Research Questions

At the time of writing, there are no studies of which the author is aware that examine the predictive power of ASD symptom clusters/groupings, individual symptoms, and total symptom count in cases that reach diagnostic criteria for ASD, when considering the development of later PTSD in youth. In the present study, ASD cases that later develop PTSD (*persistent*) will be compared to ASD cases that do not develop PTSD (*recover*) in their initial symptom profiles. Using existing data from the PACT Data Archive will allow for a larger sample size and more statistical power for analysis, resulting in more generalizable findings through using data sourced from different countries. Questions to be explored in this study are:

1. Can ASD cases who go on to develop PTSD be distinguished from ASD cases who do not develop PTSD based on their initial symptom presentation? In particular, it is hypothesised that cases with the *negative mood* symptom of DSM-5 ASD will be less likely to have recovered at follow up and therefore more likely to have PTSD.
2. Does using different algorithms of ASD diagnoses (DSM-IV, DSM-5, subthreshold DSM-5) impact upon the results obtained when addressing our first research question?

Method

Participants

For the primary analysis in this study, children and adolescents between the ages of 6-17 years were selected who met the criteria for either DSM-IV or DSM-5 ASD where the presence or absence of DSM-IV PTSD could also be derived. Of 763 cases where data existed to derive the presence/absence of DSM-IV or DSM-5 ASD as well as PTSD at a later time point, 109 children and adolescents between the ages of 8-17 years met criteria for either DSM-IV or DSM-5 ASD. Furthermore, 338 of these participants met criteria for subthreshold DSM-5 ASD. The demographic characteristics, trauma type, injury details

and country/region of these can be seen in Table 2. This data came from nine studies within the PACT Data Archive. In each study, all participants were recruited following exposure to a single traumatic event. All children and adolescents included in this sample were directly exposed to a traumatic event as defined by DSM ASD and PTSD diagnoses. Measures of ASD were completed one day to one-month post-trauma (*M* = 13.54 days, *SD* = 6.69). PTSD was later assessed via either questionnaire or interview between three to twelve months post-trauma (*M* = 186.3 days (approx. 6.2 months), *SD* = 47.3 days (approx. 1.6 months)).

Table 2. Demographic characteristics, trauma type, injury details and country/region of participants

	M (SD) / N (%)			
Characteristic	DSM-IV or DSM-5 ASD		Subthreshold DSM-5 ASD	
Age	11.6	(2.8)	11.8	(2.7)
Sex (male)	55	(50.6)	221	(65.4)
Ethnic minority	52	(46.9)	174	(51.5)
Trauma type				
Road traffic accident	61	(55.9)	162	(47.9)
Interpersonal violence	14	(12.8)	37	(10.9)
Sporting accident	13	(11.9)	76	(22.6)
Traumatic fall	9	(8.4)	28	(8.3)
Acute medical event	5	(4.6)	18	(5.3)
Burn	2	(1.8)	5	(1.5)
Other	5	(4.6)	12	(3.5)
Child Injured - Yes	81	(74.3)	273	(80.8)
Fracture - Yes	43	(39.4)	145	(42.9)
Hospital admission - Yes	52	(47.7)	162	(47.9)
ICU admission – Yes	10	(9.2)	38	(11.2)
Country/Region				
USA	60	(55.0)	225	(66.6)
UK	30	(27.5)	59	(17.5)
Australia	15	(13.8)	40	(11.8)
Switzerland	4	(3.7)	14	(4.1)

Measures

Acute Stress Disorder

Acute stress symptoms were assessed using a range of different questionnaires and interviews in the original studies. Participant responses were reviewed by an expert group who assessed whether each symptom of acute stress was present or absent. Full details of this process can be found in Kassam-Adams et al. (2012). For the purposes of deriving DSM-5 ASD in this study, DSM-IV ASD symptoms were transposed to DSM-5 ASD symptoms through discussions between the authors (Appendix D). This resulted in the 17 possible DSM-IV ASD symptoms being reduced to 14 possible DSM-5 symptoms, allowing for a reliable measure of DSM-5 ASD (nine or more symptoms) to be generated. DSM-IV ASD was generated using the original DSM-IV symptoms and the cluster-based algorithm of at least three from five dissociation symptoms, one from four re-experiencing symptoms, one from two avoidance symptoms, and one from six arousal symptoms. Subthreshold DSM-5 ASD (four or more symptoms) was derived based on previous research that the full criteria may be too restrictive and omit children and adolescents with clinically significant traumatic stress (Kassam-Adams et al., 2012; Meiser-Stedman et al., 2017). Cases were excluded from analysis if the DSM-IV ASD algorithm could not be completed (e.g. missing data for three or more dissociation symptoms), or data were missing for six or more DSM-5 symptoms (unable to reach diagnostic threshold of nine symptoms). ASD diagnoses did not include impairment due to this data being unavailable for a large proportion of the cases.

Post-Traumatic Stress Disorder

Of the 109 ASD cases, 74 (67.89%) were assessed for PTSD using a structured diagnostic interview. Forty-six (42.2%) of these were assessed via the Clinician-Administered PTSD Scale for Children & Adolescents (CAPS-CA; Nader et al., 1996), 24 (22%) via the Anxiety Disorders Interview Schedule for Children (ADIS-C; Silverman &

Nelles, 1988), and 4 (3.7%) via the German version of the CAPS-CA (IBS-P-KJ; Steil & Füchsel, 2006). The remaining 35 (32.11%) were assessed via questionnaire. Of the cases that met criteria for subthreshold DSM-5 ASD, 177 (52.37%) were assessed for PTSD using a structured diagnostic interview; 119 (35.2%) via the CAPS-CA, 44 (13.00%) via the ADIS-C, and 14 (4.10%) via the IBS-P-KJ. The remaining 161 (47.63%) were assessed via questionnaire. Where some studies used both a self-report questionnaire as well as a diagnostic interview for assessing PTSD, the result of the interview was prioritised. The presence or absence of PTSD as measured by interview was derived using the DSM-IV diagnostic algorithm (at least one from five re-experiencing symptoms, three from seven avoidance symptoms, and two from five arousal symptoms). Due to the addition of several new symptoms to the DSM-5 PTSD criteria, this could not be derived from the data available within the PACT Data Archive as this was collected prior to the release of the updated PTSD criteria.

The questionnaire measures used to assess PTSD were the Child PTSD Symptom Scale (CPSS; Foa, Johnson, Feeny & Treadwell, 2001) and the Child and Adolescent Trauma Survey (CATS; March, Amaya-Jackson, Terry, & Costanzo, 1997). The CPSS has been shown to have excellent internal reliability in a sample of trauma exposed children and adolescents (Chronbach's alpha = 0.90; Nixon et al., 2013). A cut-off of 16 was used to indicate the presence of PTSD, as this has demonstrated better levels of sensitivity and specificity (Nixon et al., 2013) when compared to the original cut-off of 11 proposed by Foa et al. (2001). The CATS has been shown to demonstrate excellent internal (March et al., 1997) and test-retest reliability (March, Amaya-Jackson, Murray, & Schulte, 1998). A cut-off of 15 was used for deriving PTSD from the CATS total score (Suliman, Kaminer, Seedat, & Stein, 2005). PTSD diagnosis did not include impairment due to this data being unavailable for a large proportion of the cases.

Ethical Considerations

The Institutional Review Board (IRB) of the Archive's home institution determined that the PACT Data Archive is exempt from IRB review (per 45 CFR 46.101(b) #4) due to the anonymization of the data. The PACT Steering Committee approved this study to investigate the research questions stated earlier (Appendix E). Each dataset involved its own local Research Ethics Committee or IRB approval.

Data Analysis

Due to the level of skew and kurtosis in the continuous data for symptom groupings and total symptom count, nonparametric Mann-Whitney *U* tests were carried out to identify differences between the persistent and recovered groups. Effect sizes for Mann-Whitney *U* tests were generated from the *z*-score divided by the square root of the sample size (Rosenthal, 1991), denoted by Pearson's *r* correlation co-efficient. Effect size for Pearson's *r* can be categorized as small (0.1), medium (0.3) and large (0.5). A series of chi-squared tests were undertaken to identify any individual acute stress symptoms which were significantly associated with the development of later PTSD. Effect sizes for chi-square tests are reported in the form of odds ratios and Cramer's *V*. Following this, significant variables were entered into a logistic regression model. For chi-square expected values less than five, Fisher's exact test was used; whilst Bonferroni corrected alpha values were used for multiple comparisons (Field, 2013) and are reported within the results. Exact significance values (as opposed to asymptotic) were used and all tests of significance were two-sided. A confidence level of 95% was set a priori. Analyses were completed using SPSS (version 23) and Excel (Microsoft, 2016).

Results

Of the 109 ASD cases at one month, 67 (61.5%) did not have PTSD at the later time point (the *recovered* group) whereas 42 (38.5%) went on to have PTSD (the *persistent* group).

Symptom Groups and Total Symptom Counts

Cases that met criteria for either DSM-IV or DSM-5 ASD that were in either the *persistent* or *recovered* group were compared on DSM-5 ASD symptom groupings (re-experiencing, dissociation, avoidance, arousal) and symptom counts (both DSM-IV and DSM-5 totals). Number of symptoms in the negative mood grouping for DSM-5 was omitted from this analysis as this only contains one possible symptom. Using a Bonferroni adjusted alpha level of .0083 for multiple comparisons, only the total number of arousal symptoms were found to be significant (Table 3). Those with PTSD had significantly more arousal symptoms at the acute stage (*Mdn* = 4) when compared to those without PTSD (*Mdn* = 3) demonstrating a small to medium effect size, $U = 1831.00$, $z = 2.715$, $p = .007$, $r = 0.26$. Total number of DSM-5 ASD symptoms was significant prior to Bonferroni correction. Those with PTSD had more ASD symptoms at the acute stage ($M = 10.476$) than those without PTSD ($M = 9.492$), despite having the same median number of symptoms (*Mdn* = 10), demonstrating a small effect size, $U = 1761.00$, $z = 2.258$, $p = .024$, $r = 0.216$.

Table 3. Means and standard deviations for DSM-IV or DSM-5 ASD cases by trajectory

Symptom Grouping	Recovered (n = 67)	Persistent (n = 42)	Total sample (n = 109)
Re-experiencing (0-4)	2.57 (0.99)	2.95 (0.86)	2.72 (0.95)
Dissociative (0-2)	1.54 (0.61)	1.46 (0.64)	1.50 (0.62)
Avoidance (0-2)	1.72 (0.49)	1.78 (0.47)	1.74 (0.48)
Arousal (0-5)	3.24 (1.30)	3.90 (1.37)*	3.47 (1.35)
Total DSM-5 symptoms (9-14)	9.49 (1.73)	10.51 (1.86)	9.87 (1.83)
Total DSM-IV symptoms (6-17)	10.60 (2.05)	11.67 (2.51)	11.01 (2.83)

Note. * $p < .0083$ (Bonferroni corrected alpha level).

Individual Acute Stress symptoms

Chi-squared analysis for each of the 14 DSM-5 ASD symptoms used a Bonferroni corrected alpha value of .0035 (Table 4). The symptoms of distress at reminders and

altered sense of reality are not reported in the table as they each had a zero in one cell of the chi-square (symptom absent/PTSD). There was a significant association between the sleep disturbances symptom being present and later PTSD χ^2 (1) = 11.097, p = .001. The odds of being in the *persistent* group were 6.024 (CI 1.924 - 18.865) times higher if a participant reported sleep disturbances in the acute stage than if they did not, demonstrating a medium effect size (V = 0.319). This same result was also found when analysing the 94 DSM-5 ASD cases. When analysing DSM-IV ASD cases against the 17 individual DSM-IV symptoms, no symptoms were identified as being significant after Bonferroni correction was applied.

Table 4. Chi-squares and odds ratios of DSM-5 ASD symptoms predictive utility for later PTSD diagnosis from DSM-IV or DSM-5 cases

	Symptom Absent		Symptom Present				
Symptom	No PTSD	PTSD	No PTSD	PTSD	*OR*	(95% CI)	χ^2
Intrusive memories/thoughts	14	3	53	39	3.43	(0.92, 12.78)	3.71
Bad dreams	41	19	26	23	1.91	(0.87, 4.17)	2.66
Flashbacks	35	21	32	21	1.09	(0.51, 2.37)	0.05
Negative emotion	38	24	29	17	0.93	(0.42, 2.04)	0.03
Dissociative amnesia	24	18	43	24	0.74	(0.34, 1.64)	0.54
Avoid internal reminders	4	4	63	38	0.60	(0.14, 2.55)	0.48
Avoid external reminders	13	3	52	37	3.08	(0.82, 11.59)	2.99
Sleeping difficulties	26	4	41	38	6.02	(1.92, 18.87)*	11.09*
Irritable behaviour	22	10	45	32	1.56	(0.65, 3.75)	1.01
Hypervigilant	13	7	42	30	1.33	(0.47, 3.72)	0.29
Concentration problems	22	8	45	34	2.08	(0.83, 5.23)	2.46
Exaggerated startle	22	13	44	29	1.12	(0.49, 2.56)	0.07

Note. * $p < .0035$ (Bonferroni corrected alpha level).

Subthreshold DSM-5 ASD

Using the same sample of 763 cases as used above, the subthreshold DSM-5 ASD (four or more symptoms) criteria was applied. This resulted in 338 cases, 250 of which recovered whereas 88 were persistent (i.e. had later PTSD). The 88 cases identified here constituted 80.7% of all cases with PTSD in the selected dataset of 763 cases. The increased sample size from using these diagnostic criteria resulted in no low expected frequencies and only one cell with an actual frequency of zero when using chi-square tests. Utilising the same analysis plan described above, the number of intrusion symptoms, number of arousal symptoms, and total count of DSM-5 ASD symptoms were all found to be significant after adjustment for multiple comparisons (Table 5). Those with PTSD had significantly more re-experiencing symptoms at the acute stage (M = 2.35) when compared to those without PTSD (M = 1.72), despite having the same median count (Mdn = 2), demonstrating a small effect size, U = 14243.00, z = 4.24, p < .001, r = 0.23. Those with PTSD also had significantly more arousal symptoms at the acute stage (Mdn = 3) when compared to those without PTSD (Mdn = 2) demonstrating a small to medium effect size, U = 15080.50, z = 5.279, p < .001, r = 0.287. Those with PTSD had significantly more ASD symptoms in total at the acute stage (Mdn = 7.5) than those without PTSD (Mdn = 6) demonstrating a small to medium effect size, U = 14766, z = 4.829, p < .000, r = 0.262.

Table 5. Means and standard deviations for subthreshold DSM-5 ASD cases by trajectory

	Recovered		Persistent		Total sample	
Symptom Grouping	(n = 250)		(n = 88)		(n = 338)	
Re-experiencing (0-4)	1.71	(1.14)	2.36	(1.12)*	1.88	(1.16)
Dissociative (0-2)	1.08	(0.74)	1.13	(0.78)	1.08	(0.74)
Avoidance (0-2)	1.38	(0.68)	1.30	(0.78)	1.35	(0.72)
Arousal (0-5)	2.01	(1.40)	3.01	(1.43)*	2.30	(1.47)
Total DSM-5 symptoms (4-14)	6.46	(2.34)	8.08	(2.81)*	6.88	(2.54)

Note. * p < .01 (Bonferroni corrected alpha level).

There was a significant association between the following acute symptoms and later PTSD for subthreshold DSM-5 ASD cases (Bonferroni corrected alpha level of 0.0035): being distressed by cues or reminders of the trauma (χ^2 (1) = 20.813, p < .001, OR = 10.238 (CI 3.105 – 33.760), V = 0.273); concentration difficulties following the trauma (χ^2 (1) = 19.146, p < .001, OR = 2.993 (CI 1.813 – 4.939), V = 0.238); and difficulties with sleep (χ^2 (1) = 18.123, p < .001, OR = 3.080 (CI 1.812 – 5.238), V = 0.232).

Logistic Regression Modelling

Following the identification of several possible predictor variables (i.e. cluster symptom counts or individual symptoms) for PTSD in the analysis above, these were then entered into a hierarchical logistic regression. Variables were entered into the hierarchical regression model via forced entry based upon their level of significance from earlier analysis.

To reach the final model for positive DSM-IV or DSM-5 ASD cases that go on to develop PTSD, the individual symptom of sleeping difficulties was entered into the model first (χ^2 (1) = 12.357, Wald χ^2 = 9.508, p < .000), followed by the total number of arousal symptoms (χ^2 (1) = 0.880, Wald χ^2 = 0.866, p = .348), total number of all symptoms (χ^2 (1) = 1.930, Wald χ^2 = 1.877, p = .165), total number of re-experiencing symptoms (χ^2 (1) = 0.572, Wald χ^2 = 0.570, p = .449), and the individual symptom of intrusions (χ^2 (1) = 1.132, Wald χ^2 = 1.067, p = .287). The most parsimonious final model included only the significant individual symptom of sleep difficulties, χ^2 (1) = 12.357, Wald χ^2 = 9.508, p < .000, Cox and Snell R^2 = .10, Nagelkerke R^2 = .15. Results of this model can be seen in Table 6.

Table 6. Coefficients of the model predicting PTSD from DSM-IV/DSM-5 ASD [95% BCa bootstrap confidence intervals based on 1000 samples]

		95% CI for Odds Ratio		
Included	*b*	Lower	Odds ratio	Upper
Constant	-1.87 [-3.26, -1.20]			
Sleep difficulties present	1.80 [0.62, 21.18]	1.92	6.02	18.86

Due to the promising results using the subthreshold DSM-5 ASD criteria, a second hierarchical logistic regression was considered for these data using the same predictor variables. To reach the final model for positive subthreshold DSM-5 ASD cases that go on to develop PTSD, the individual symptom of sleeping difficulties was entered into the model first (χ^2 (1) = 19.372, Wald χ^2 = 17.531, p < .000), followed by the distress at reminders symptom (χ^2 (1) = 25.679, Wald χ^2 = 14.603, p < .000), concentration difficulties symptom (χ^2 (1) = 6.422, Wald χ^2 = 6.358, p = 0.12), the total number of arousal symptoms (χ^2 (1) = 1.191, Wald χ^2 = 1.187, p = .275), total number of re-experiencing symptoms (χ^2 (1) = 1.598, Wald χ^2 = 1.589, p = .206), and the total number of all symptoms (χ^2 (1) = 1.329, Wald χ^2 = 1.319, p = .249). The most parsimonious final model included symptoms of sleeping difficulties (χ^2 (1) = 19.372, Wald χ^2 = 17.531, p < .000), distress at reminders (χ^2 (1) = 25.679, Wald χ^2 = 14.603, p < .000), and concentration difficulties (χ^2 (1) = 6.422, Wald χ^2 = 6.358, p = .011). With these three variables included, the final model was significant, χ^2 (3) = 51.474, p < .001, Cox and Snell R^2 = .168, Nagelkerke R^2 = .245. Further results of this model can be seen in Table 7.

Table 7. Coefficients of the model predicting PTSD from subthreshold DSM-5 ASD [95% BCa bootstrap confidence intervals based on 1000 samples]

		95% CI for Odds Ratio		
Included	*b*	Lower	Odds ratio	Upper
Constant	-3.99			
	[-5.55, -3.18]			
Sleep difficulties present	1.10	1.60	2.99	5.60
	[0.48, 1.90]			
Distress at reminders	2.24	2.80	9.40	31.56
	[1.08, 20.52]			
Concentration difficulties	0.77	1.19	2.15	3.91
	[0.11, 1.40]			

Discussion

Focussing on youth who met criteria for acute stress diagnoses, this study examined the utility of acute symptoms within the first one month post-trauma in predicting later PTSD in children and adolescents. Logistic regression for both DSM-IV/DSM-5 ASD and subthreshold DSM-5 ASD showed the most parsimonious model to include only individual symptoms. This suggests that single symptoms perform better when predicting the development of later PTSD, in youth who show high levels of acute stress, than the number of symptoms in a specific group (arousal) and overall symptom count.

Acute Symptom of Negative Mood

The hypothesis that ASD cases who experienced the symptom of *negative mood* would be less likely to have recovered and more likely to have PTSD was not supported. This hypothesis was developed following a recent study which demonstrated that the number of symptoms in the DSM-5 PTSD cluster of NACM (measured at the acute stage) was higher in those that went on to have PTSD than in those who did not (Meiser-Stedman et al., 2017). By having a larger sample size and information on the presence and absence of specific individual symptoms at the acute stage, it was hoped that the present study could identify a similar result utilising just the one symptom of *negative mood* which has

been added to the DSM-5 ASD diagnosis, instead of the PTSD NACM symptom cluster used by Meiser-Stedman et al. (2017).

Symptoms of ASD Associated with PTSD

When focussing on cases at the acute stage that met diagnosis for either DSM-IV or DSM-5 ASD (excluding impairment), the only individual symptom to differ significantly between the *recovered* and *persistent* PTSD group was that of difficulties with sleep. The final logistic regression model included only this one symptom, with the number of arousal symptoms and total count of acute symptoms proving insignificant when added. This was a surprising finding, as sleeping problems have rarely been explored when determining the predictors of acute and post-traumatic stress reactions in children and adolescents (e.g. Trickey, Siddaway, Meiser-Stedman, Serpell, & Field, 2012). In adults, sleep disturbances in individuals with PTSD have been found to make symptoms more severe (Cox & Olatunji, 2016). It has been suggested that if left untreated in adults, difficulties with sleep could lead to the maintenance and exacerbation of PTSD through the resulting increase in post-trauma emotional distress (Gerhart, Hall, Russ, Canetti, & Hobfoll, 2014). The finding in this study that disturbance in sleep was the only symptom that clearly differed between those that developed PTSD and those that did not has been found in the adult literature. In survivors of road traffic accidents, sleep disturbances were predictive of PTSD up to six months (Harvey & Bryant, 1998) and one year (Koren, Arnon, Lavie, & Klein, 2002) post-trauma. In youth, disturbances in sleep have been found to impact upon later symptoms of post-traumatic stress (Brown, Mellman, Alfano, & Weems, 2011), with suggestions that difficulties with sleep could directly impact upon fatigue and irritability, thereby interfering with processes that contribute towards recovery from post-traumatic stress. Although this study did not concern the acute stage post-trauma, it demonstrated that sleeping difficulties may continue to impact upon the emotional wellbeing of youth two years post-trauma.

Research in adults suggests that sleep plays a central role in organizing traumatic and distressing memories (Nishida, Pearsall, Buckner, & Walker, 2009). More specifically, studies have found that in individuals who are deprived of REM sleep, there is poorer consolidation of memories (Diekelmann & Born, 2010; Menz et al., 2013). Children and adolescents with and without ASD following exposure to a traumatic event have been found to rate their trauma memories as being more sensory and fragmented in nature when compared to other types of memories, with the level of disorganisation in trauma narratives predicting the severity of acute stress symptoms independent of other trauma-related and demographic factors (Salmond et al., 2011). The presence of intrusive memories that are more fragmented and sensory in nature is common in the acute phase post-trauma. The present findings may therefore be explained by the consolidation and integration of highly emotional trauma memories in children and adolescents who met diagnostic criteria for ASD being disrupted through poor sleep. This could explain the increased likelihood of symptoms of post-traumatic stress enduring (PTSD). Recent research has found that symptoms of post-traumatic stress reduce between one and three months post-trauma, as youth report their memories becoming less fragmented and sensory in nature (McKinnon, Brewer, Meiser-Stedman, & Nixon, 2017). The decline of acute stress symptoms observed in youth during the initial months following trauma, without intervention, have been explored in recent years (Le Brocque, Hendrikz, & Kenardy, 2010; La Greca et al., 2013; Alisic et al., 2014; Hiller et al., 2016). The results of this study could indicate that through consolidating trauma memories, sleep plays an important role in the natural recovery seen in children and adolescents following exposure to a traumatic event.

In secondary analysis, the symptoms of problems with concentration and distress at internal and external reminders of the trauma were associated with the development of PTSD from a reduced count version of DSM-5 ASD. Studies in adults have found that PTSD is associated with reductions in working memory and attention (Vasterling, Brailey,

Constans, & Sutker, 1998; Elzinga & Bremner, 2002). It is possible that difficulties with concentration could be a result of poor sleep (Spoormaker & Montgomery, 2008). However, there was no interaction between these two symptoms when tested using logistic regression in the present study. The symptom of distress at reminders was highly prevalent in the DSM-IV/DSM-5 ASD cases, therefore, the value of its association with development of PTSD only became clear when utilising the subthreshold DSM-5 ASD criteria. When seen through the lens of a cognitive model of PTSD as applied to youth (e.g. Ehlers & Clark, 2000; Meiser-stedman, 2002), this symptom may relate to a child's interpretation of acute stress symptoms. If they interpreted the presence of symptoms to mean that they were "going mad" or losing control, then it would be an understandable reaction to feel upset and distressed through their experience. The meaning that one attributes to symptoms of post-traumatic stress is a central component of the cognitive model of PTSD in both youth and adults (Ehlers & Clark, 2000). Further, children and adolescents may then make efforts to manage this distress through adopting maladaptive cognitive and meta-cognitive strategies, which would further serve to maintain symptoms of post-traumatic stress (Meiser-Stedman, 2002). Although this cannot be reliably concluded in the present study, when using subthreshold DSM-5 ASD diagnosis, this symptom was more predictive of later PTSD than the total number of symptoms reported by children and adolescents in the acute stage. Whilst results should be interpreted tentatively, this may suggest that normalizing the nature of acute stress symptoms may serve to decrease a child's acute distress, which may decrease the chance of developing PTSD.

Limitations

This study has a number of limitations which should be acknowledged in interpreting the results. Firstly, the diagnostic criteria for all forms of ASD as well as PTSD did not include impairment in this study due to the unavailability of this data. It is likely that if impairment was included, the sample size would have been smaller although

findings may have been more applicable to previous research which has utilised stricter diagnostic criteria. Second, the assessment of ASD and PTSD in the original studies that make up the PACT Data Archive utilised different methods of assessment, which resulted in dichotomized variables for presence and absence of both the acute symptoms and later PTSD diagnosis. The different methods of assessment may have been a contributing factor to the poor sensitivity of all acute diagnoses in this study. Third, symptoms of both ASD and PTSD were assessed using measures designed for DSM-IV criteria. The majority of symptoms in DSM-5 ASD are the same as those in DSM-IV, or combinations of symptoms from the previous criteria. However, the DSM-5 ASD symptom of *negative mood* was not present in the DSM-IV diagnosis, and so in this study it was created from the DSM-IV symptom of *numb/detachment from others*. Although a limitation, this has been done in other studies that have attempted to look at the comparative performance of symptoms from both versions of the DSM (Kassam-Adams et al., 2012). A further limitation of this study is the reliance on DSM-IV PTSD and not the updated version, due to data not existing on the new symptoms which form DSM-5 PTSD. However, much of the current literature at this time uses the DSM-IV classification and recent studies have demonstrated that the prevalence of PTSD when assessed according to either DSM-IV or DSM-5 is comparable (Meiser-Stedman et al., 2017). The majority of children and adolescents in this sample experienced a road traffic accident, and so the findings of this study may not be generalizable to youth who have experienced traumatic events such as terrorist attacks or natural disasters. Although difficulties with sleep in the weeks following trauma was found to be predictive of PTSD from ASD, there was an absence of information relating to participants sleep quality prior to the trauma taking place.

The relationship found between sleep difficulties in those with ASD and the development of later PTSD may be indirect and better explained by other factors not measured in this study. Research has suggested that youth with injuries following trauma

are more likely to experience persistent symptoms (Le Brocque et al., 2010) and it could be that the severity of the trauma leads to the persistence of acute symptoms. Further, youth who have less social support are more likely to have persistent post-trauma symptoms (La Greca, Silverman, Lai, & Jaccard, 2010). La Greca et al. (2010) also found that children who experienced loss or disruption following trauma experienced more persistent symptoms. Significant loss or disruption would likely impact upon the child's immediate environment and family functioning. It is likely that the relationship between early acute symptoms and the development of later PTSD is complex, consisting of many inter and intra-personal factors.

Future Research

Whilst previous research has demonstrated evidence of the role of sleep disturbance in the development of PTSD following exposure to a traumatic event in adults, there has not been many studies investigating this in youth populations. Often studies investigating ASD and PTSD in youth do not focus on sleep, and do not use validated sleep questionnaires. In light of the findings in the present study, future longitudinal studies of post-traumatic stress symptoms in children and adolescents should consider the use of validated questionnaires relating to sleep (insomnia, nightmares, sleep quality) so that the role of sleep in the development of PTSD in youth can be further explored. Further, measures of general anxiety and parental mental health would allow for mediation analysis and perhaps a better understanding of the key factors involved in the development of persistent post-trauma symptoms. Whilst this study may help us to further understand factors that lead to children and young people developing PTSD after ASD in the acute phase post-trauma, an area for future research would be to focus on those who do not present with significant symptoms in the acute stage but go on to develop PTSD. This could lead to the identification of early risk markers for the development of PTSD in the

absence of severe acute symptoms, helping to inform service response in the weeks following a traumatic experienced by a child or young person.

Conclusion

This study is the first to show an association between sleep disturbance in youth who are highly symptomatic at the acute stage post-trauma and later development of PTSD. When considering the adult literature, it could be suggested that sleep difficulties are not only a symptom of trauma exposure but may also play a central role in the transition to later PTSD. Future studies should focus on elucidating this relationship in children and adolescents utilising the DSM-5 criteria for ASD and PTSD.

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Appendix D. Transposing DSM-IV to DSM-5 ASD Symptoms

DSM-IV ASD Symptom Cluster	DSM-5 ASD Symptom Group
Dissociative symptoms **Criterion B – at least three of:**	**Negative mood symptom**
Subjective sense of numbing, detachment, or absence of emotional responsiveness	Persistent inability to experience positive emotions
	Dissociative symptoms
Reduction in awareness of surroundings/being in a daze Derealization Depersonalization Dissociative amnesia	Altered sense of reality of self/surroundings As above As above Inability to remember important aspect of trauma
Re-experiencing symptoms **Criterion C – at least one of:**	**Re-experiencing symptoms**
Intrusive thoughts/images Bad dreams Flashbacks Distress on exposure to reminders	Intrusive memories Bad dreams Flashbacks Distress due to internal/external cues resembling aspect of the trauma
Avoidance symptoms **Criterion D – at least one of:**	**Avoidance symptoms**
Efforts to avoid internal reminders Efforts to avoid external reminders	Efforts to avoid internal reminders Efforts to avoid external reminders
Arousal symptoms **Criterion E – at least one of:**	**Arousal symptoms**
Sleep disturbances Irritability Poor concentration Hypervigilance Exaggerated startle response Agitation/motor restlessness	Sleep disturbances Irritable behaviour Concentration problems Hypervigilance Exaggerated startle response N/A

Appendix E. Authorisation for Access to PACT Data Archive

Request for data from the PTSD after Acute Child Trauma (PACT) Data Archive

The PACT Data Archive Steering Committee will review all requests for access to data from the Archive.

NOTE: The PACT Data Archive includes only de-identified datasets, but investigators are nonetheless expected to take appropriate precautions to prevent inadvertent identification of individuals whose data is included in the Archive.

****

Please complete the following information:

1. Specific data elements requested:

Age
Gender
Study Country
Trauma type data (i.e Primary Trauma Type)
Was child treated in ED / A&E because of this event? (Just to classify sample)
Loss of consciousness
ASD symptoms (i.e. acute phase) – [Would the "processed" data from Kassam-Adams et al. 2012 be available, i.e. B1, B2 etc etc?]
Data useful for deriving PTSD diagnosis (e.g. structured interview outcomes *or* symptom cut-offs on questionnaire measures) at 2-12 months post-trauma.

2. Inclusion / exclusion criteria for datasets or cases:

We would aim to use all datasets that include i) acute stress symptom data and ii) PTSD diagnosis data (i.e. either interview) follow up data
No exclusion criteria.

3. Research question(s) to be addressed:

Can ASD cases who go on to develop PTSD be distinguished from ASD who do <u>not</u> develop PTSD on the basis of their initial symptom presentation?

4. Investigator's relevant training and experience:

If a trainee, describe supervision arrangement and supervisor's relevant training and experience.

The main analyses and report writing will be undertaken by Jack Walker, a trainee clinical psychologist at the University of East Anglia (UEA). He will be supervised by Dr Richard Meiser-Stedman.

5. Describe measures for data security.

Data will be stored on secure UEA data servers.

… and sign the following statement:

I agree to utilize data received from the PACT Data Archive only to address the research questions identified in this application, and to communicate with the Archive Steering committee about any substantive changes / modifications to these planned analyses.

I agree to acknowledge the PACT Data Archive in presentations and publications that result from analyses of these data.

I commit to maintain data security, and to take appropriate precautions to prevent inadvertent identification of individuals whose data is included in the Archive.

I understand that I may not re-release data obtained from the Archive to others.

SIGNATURE: 

NAME: Richard Meiser-Stedman
TITLE: Reader in Clinical Psychology
INSTITUTION: University of East Anglia
DATE: 14th September 2017
(NOTE: SUPERVISOR MUST CO-SIGN WITH TRAINEE)

From: Kassam-adams, Nancy <ADAMSN@email.chop.edu>
Sent: 20 September 2017 16:31
To: Richard Meiser-Stedman (MED); Jack Walker (MED)
Subject: RE: PACT - ASD, persistent vs recovery cases?

The committee has approved this. So now we can then work on pulling the data that you need. Will try to do that soon, but not sure on time line – do you have a deadline?

Nancy

Additional Methods Chapter for Empirical Study

Measures of Acute Stress Symptoms

As referred to in the methods section of the empirical paper, original studies that contributed data to the PACT Data Archive utilised several ways to assess acute symptoms. The range of measures can be seen in Table 8. Responses from each participant were reviewed by an expert group who assessed whether each symptom of acute stress, used to derive a diagnosis of DSM-IV ASD, was either present or absent. This resulted in 109 cases who met criteria for either DSM-IV or DSM-5 ASD. The PACT Project Group first identified questions from each measure that related to each symptom of DSM-IV ASD. Where items were deemed congruent, the presence or absence of each symptom was recorded as a dichotomous variable. An item was recorded as present based upon each measure's standard scoring rules. For example, when deriving responses from a Likert scale on a questionnaire measure, 0-1 would indicate absence of the symptom, whereas 2-3 would indicate that the symptom was present. Where standard scoring rules for the presence of symptoms did not exist on a measure, the expert group reached consensus on an appropriate system based upon those in existence for interpreting other measures. More information on this process can be found in Kassam-Adams et al. (2012).

Subthreshold DSM-5 ASD

In addition to the primary analysis focussed on DSM-IV or DSM-5 ASD cases, secondary analysis was conducted for those cases which met Subthreshold criteria of four or more acute symptoms from DSM-5 ASD, which identified 338 cases. The rationale for the use of this diagnostic criteria was that previous studies have identified that the updated DSM criteria may overlook as many of 75% of children and adolescents with significant distress in the acute phase (Kassam-Adams et al., 2012). Further, this reduced threshold version of ASD has been found to identify significantly more youth who go on to develop later PTSD than the full criteria of the presence of nine or more symptoms (Meiser-

Stedman et al., 2017). The studies in which subthreshold ASD cases were found can be seen in Table 9.

Data Analysis

As stated in the methods section of the empirical paper, due to the level of skew and kurtosis in the continuous data for symptom groupings and total symptom count, nonparametric Mann-Whitney *U* tests were carried out to identify differences between the persistent and recovery groups. Histograms and P-P plots were visually inspected to identify skew and kurtosis. Skew and kurtosis values were converted to *z* scores by subtracting the mean of the distribution from the score for each respectively, and then dividing the standard error of the distribution. Using this equation, absolute values greater than 1.96 are significant (Field, 2013), which resulted in several significant results. This was confirmed via significant results on the Shapiro-Wilk test. These were not conducted for every symptom grouping as it became apparent that non-parametric tests would be the preferred method of analysis after log transformation did little to negate the violation of these assumptions.

Table 8. Characteristics of studies included in analysis for DSM-IV and DSM-5 ASD cases from PACT dataset

Study	Age range	Country/ Region	Acute symptoms assessed	Measure of acute stress symptoms	PTSD assessed	Measure of PTSD	N (%)
Kassam-Adams & Winston (2004)	8-17	USA	2 – 4 weeks	CASQ	6 – 12 months	CAPS-CA	25 (22.9)
Kassam-Adams (2006)	8-17	USA	24 hours – 2 weeks	ASC-KIDS, CATS	3 – 6 months	CATS	24 (22.0)
Kassam-Adams et al. (2013)	8-17	USA	24 hours – 2 weeks	ASC-KIDS	3 – 6 months	CPSS	6 (5.5)
Kassam-Adams et al. (2011)	8-17	USA	24 hours – 2 weeks	CPSS	6 – 12 months	CPSS	2 (1.8)
Kassam-Adams & Winston (2006, unpublished)	8-17	USA	2 – 4 weeks	ASC-KIDS	3 – 6 months	CPSS	3 (2.8)
Meiser-Stedman et al. (2005)	10-16	UK	2 – 4 weeks	ADIS-C, CRIES	6 – 12 months	ADIS-C	24 (22.0)
Meiser-Stedman et al. (2008)	5-10	UK	2 – 4 weeks	CAPS-CA, CRIES	6 – 12 months	CAPS-CA	6 (5.5)
Nixon et al. (2010)	7-17	Australia	2 – 4 weeks	ASC-Kids, CPSS	6 – 12 months	CAPS-CA	15 (13.8)
Zehnder et al. (2010)	7-14	Switzerland	24 hours – 2 weeks	IBS-A-KJ DSM-IV ASD Interview	6 – 12 months	IBS-P-KJ (CAPS-CA) German Translation	4 (3.7)

Note. ADIS-C = Anxiety Disorders Interview Schedule for Children; ASC-Kids = Acute Stress Checklist for Children; CAPS-CA = Clinician-Administered Posttraumatic Stress Disorder (PTSD) Scale for Children and Adolescents; CASQ = Child Acute Stress Questionnaire; CRIES = Children's Impact of Event Scale; CPSS = Child PTSD Symptom Scale; CATS = Child & Adolescent Trauma Survey; IBS-A-KJ = Interview zur Erfassung der Akuten Belastungsstörungen bei Kindern und Jugendlichen; IBS-P-KJ = Interview zur Erfassung der Posttraumatischen Belastungsstörungen bei Kindern und Jugendlichen.

Table 9. Characteristics of studies included in analysis for subthreshold DSM-5 ASD cases from PACT dataset

Study	Age range	Country/ Region	Acute symptoms assessed	Measure of acute stress symptoms	PTSD assessed	Measure of PTSD	*N* (%)
Kassam-Adams & Winston, (2004)	8-17	USA	2 – 4 weeks	CASQ	6 – 12 months	CAPS-CA	68 (20.1)
Kassam-Adams (2006)	8-17	USA	24 hours – 2 weeks	ASC-KIDS, CATS	3 – 6 months	CATS	78 (23.1)
Fein et al. (2001)	8-17	USA	24 hours – 2 weeks	ISRC	6 – 12 months	CATS	3 (0.9)
Kassam-Adams et al. (2013)	8-17	USA	24 hours – 2 weeks	ASC-KIDS	3 – 6 months	CPSS	43 (12.7)
Kassam-Adams et al. (2011)	8-17	USA	24 hours – 2 weeks	CPSS	6 – 12 months	CPSS	16 (4.7)
Kassam-Adams & Winston (2006, unpublished)	8-17	USA	2 – 4 weeks	ASC-KIDS	3 – 6 months	CPSS	17 (5.0)
Cox & Kenardy (2010)	7 - 16	Australia	24 hours – 2 weeks	TSCC, CTSQ	6 – 12 months	TSCC	4 (1.2)
Meiser-Stedman et al. (2005)	10-16	UK	2 – 4 weeks	ADIS-C, CRIES	6 – 12 months	ADIS-C	44 (13.0)
Meiser-Stedman et al. (2008)	5-10	UK	2 – 4 weeks	CAPS-CA, CRIES	6 – 12 months	CAPS-CA	15 (4.4)
Nixon et al. (2010)	7-17	Australia	2 – 4 weeks	ASC-Kids, CPSS	6 – 12 months	CAPS-CA	36 (10.7)
Zehnder et al. (2010)	7-14	Switzerland	24 hours – 2 weeks	IBS-A-KJ DSM-IV ASD Interview	6 – 12 months	IBS-P-KJ (CAPS-CA) Interview	14 (4.1)

Note. ADIS-C = Anxiety Disorders Interview Schedule for Children; ASC-Kids = Acute Stress Checklist for Children; CAPS-CA = Clinician-Administered Posttraumatic Stress Disorder (PTSD) Scale for Children and Adolescents; CASQ = Child Acute Stress Questionnaire; CRIES = Children's Impact of Event Scale; CPSS = Child PTSD Symptom Scale; CATS = Child & Adolescent Trauma Survey; IBS-A-KJ = Interview zur Erfassung der Akuten Belastungsstörungen bei Kindern und Jugendlichen; IBS-P-KJ = Interview zur Erfassung der Posttraumatischen Belastungsstörungen bei Kindern und Jugendlichen; ISRC = Immediate Stress Reaction Questionnaire; TSCC = Trauma Symptom Checklist for Children.

Additional Results Chapter for Empirical Study

Analysis of DSM-IV ASD Cases

There were a total of 64 DSM-IV ASD cases in the sample, 24 of which went on to have PTSD (the persistent group) and 40 did not (the recovered group). As can be seen from Table 10, DSM-IV symptom clusters were used for this analysis. When conducting Mann-Whitney *U* analysis using a Bonferroni corrected alpha level of .01, the number of arousal symptoms and total number of symptoms were significantly different between the two groups. This demonstrated a similar pattern of results to those obtained for DSM-IV/DSM-5 ASD cases as reported in the main paper; the analysis of which utilised DSM-5 ASD individual symptoms, symptom groupings, and total count. Focussing on the DSM-IV cases shown in Table 1, those with PTSD had more arousal symptoms at the acute stage (*Mdn* = 4) when compared to those without PTSD (*Mdn* = 3) demonstrating a medium effect size, $U = 675.50$, $z = 2.772$, $p = .006$, $r = 0.346$. Those with PTSD had more DSM-IV ASD symptoms at the acute stage (*Mdn* = 13) than those without PTSD (*Mdn* = 11) demonstrating a medium effect size, $U = 674.50$, $z = 2.715$, $p = .007$, $r = 0.339$.

Table 10. Means and standard deviations for DSM-IV cases by trajectory

Symptom Cluster	Recovered (*n* = 40)	Persistent (*n* = 24)	Total sample (*n* = 64)
Dissociation (0-5)	3.50 (0.68)	3.71 (0.81)	3.58 (0.73)
Re-experiencing (0-4)	2.70 (1.20)	3.42 (1.06)	2.97 (1.19)
Avoidance (0-2)	1.73 (0.45)	1.83 (0.38)	1.76 (0.43)
Arousal (0-6)	2.85 (1.33)	3.83 (1.43)*	3.22 (1.44)
Total DSM-IV symptoms (6-17)	10.78 (2.48)	12.79 (2.73)*	11.53 (2.74)

Note. * $p < .01$ (Bonferroni corrected alpha level).

Analysis of DSM-5 ASD Cases

There were a total of 94 DSM-5 ASD cases in the sample, 39 of which went on to have PTSD (the persistent group) and 55 did not (the recovered group). When conducting Mann-Whitney *U* analysis using a Bonferroni corrected alpha level of .01, no significant

results were found (Table 11). However, prior to Bonferroni correction the number of arousal symptoms were significant, which demonstrates a similar trend to the significant results obtained for DSM-IV ASD cases alone and for DSM-IV or DSM-5 cases as reported in the main paper. The symptom concerning negative mood was omitted from this analysis as this single symptom does not constitute a group.

Table 11. Means and standard deviations for DSM-5 cases by trajectory

Symptom Grouping	Recovered (n = 55)	Persistent (n = 39)	Total sample (n = 94)
Re-experiencing (0-4)	2.82 (0.86)	3.00 (0.86)	2.89 (0.86)
Dissociative (0-2)	1.51 (0.63)	1.44 (0.64)	1.48 (0.63)
Avoidance (0-2)	1.76 (0.47)	1.79 (0.47)	1.78 (0.47)
Arousal (0-5)	3.60 (1.12)	4.13 (1.03)	3.82 (1.11)
Total DSM-5 symptoms (9-14)	10.09 (1.16)	10.72 (1.69)	10.35 (1.43)

Note. No significant findings using Bonferroni corrected alpha level of $p < .01$.

When assessing the predictive utility of individual DSM-5 symptoms using DSM-5 ASD cases alone (Table 12), one symptom proved to be significant from chi-square analysis using a Bonferroni corrected alpha level of .0035. The symptoms of distress at reminders and altered sense of reality are not reported in the table as they each had a zero in one cell of the chi-square (symptom absent/PTSD). As in the analysis reported in the main paper, there was a significant association between the sleep disturbances symptom being present and later PTSD χ^2 (1) = 10.377, p = .002. The odds of developing later PTSD were 9.00 (CI 1.948 - 41.577) times higher if a participant reported sleep disturbances in the acute stage than if they did not, demonstrating a medium effect size (V = 0.332).

Table 12. Chi-squares and odds ratios of DSM-5 symptoms predictive utility for PTSD from DSM-5 ASD cases

	Symptom Absent		Symptom Present				
Symptom	No PTSD	PTSD	No PTSD	PTSD	*OR*	(95% CI)	χ^2
Intrusive memories	6	3	49	36	1.47	(0.34, 6.27)	0.27
Bad dreams	29	17	26	22	1.44	(0.63, 3.29)	0.76
Flashbacks	25	18	30	21	0.97	(0.43, 2.22)	0.00
Negative emotion	33	24	22	14	0.88	(0.37, 2.05)	0.09
Dissociative amnesia	20	17	35	22	0.74	(0.32, 1.71)	0.49
Avoid internal reminders	2	3	53	36	0.45	(0.07, 2.85)	0.75
Avoid external reminders	10	3	44	34	2.58	(0.66, 10.09)	1.94
Sleeping difficulties	18	2	37	37	9.00	(1.95, 41.58)*	10.38*
Irritable behaviour	14	7	41	32	1.56	(0.56, 4.32)	0.74
Hypervigilant	8	6	39	29	0.99	(0.31, 3.17)	0.00
Concentration problems	15	5	40	34	2.55	(0.84, 7.74)	2.85
Exaggerated startle	13	10	41	29	0.92	(0.36, 2.38)	0.03

Note. * $p < .00035$ (Bonferroni corrected alpha level).

Analysis of Subthreshold DSM-5 ASD Cases

The analysis relating to the DSM-5 individual symptoms, symptom groupings, and total count of symptoms are reported in the results section of the empirical paper. The results of chi-square analysis of individual symptoms, along with the odds ratio of youth with that symptom developing later PTSD (being in the *persistent* group), can be seen in Table 13. The symptom of altered sense of reality is not reported in the table as this had a zero in one cell of the chi-square (symptom absent/PTSD).

Logistic Regression models

For both final logistic regression models, the standardized residuals, deviance, and DF Beta were inspected, and all fell within normal limits. The final models were not tested for linearity or multicollinearity as they did not include any continuous variables. The models were run a second time using bias corrected and accelerated (BCa) bootstrapping methods which provided confidence intervals for the beta value based on 1000 samples. Bootstrapping in this way is suggested to be more accurate than the 95% confidence interval method (Efron & Tibshirani, 1993; Field, 2013).

The most parsimonious final model for predictive factors of later PTSD from DSM-IV or DSM-5 ASD cases is reported in the results section of the empirical paper, along with the χ^2, Wald χ^2 and p-value. Table 14 provides the *b* coefficients of each step of the model, along with the odds ratio and 95% confidence intervals.

The most parsimonious final model for predictive factors of later PTSD from subthreshold DSM-5 ASD cases is reported in the results section of the empirical paper, along with the χ^2, Wald χ^2 and p-value. Table 15 provides the *b* coefficients of each step of the model, along with the odds ratio and 95% confidence intervals.

Table 13. Chi-squares and odds ratio of DSM-5 symptoms predictive utility for PTSD from subthreshold DSM-5 ASD cases

	Symptom Absent		Symptom Present				
Symptom	No PTSD	PTSD	No PTSD	PTSD	*OR*	(95% CI)	χ^2
Intrusive memories	88	20	159	68	1.88	(1.07, 3.30)	4.94
Bad dreams	189	54	61	34	1.95	(1.13, 3.27)	6.53
Flashbacks	180	55	67	33	1.61	(0.96, 2.69)	3.34
Distressed by cues/reminders of the trauma	61	3	143	72	10.24	(3.11, 33.76)*	20.81*
Negative emotion	176	63	67	24	1.00	(0.58, 1.73)	0.00
Dissociative amnesia	145	50	105	37	1.02	(0.62, 1.67)	0.01
Avoid internal reminders	55	22	195	66	0.85	(0.48, 1.49)	0.33
Avoid external reminders	94	32	145	49	0.99	(0.59, 1.66)	0.00
Sleeping difficulties	134	24	116	64	3.08	(1.81, 5.24)*	18.12*
Irritable behaviour	152	42	97	46	1.72	(1.05, 2.80)	4.72
Hypervigilant	96	29	112	52	1.54	(0.91, 2.61)	2.55
Concentration problems	166	35	84	53	2.99	(1.81, 4.94)*	19.15*
Exaggerated startle	145	37	103	51	1.94	(1.19, 3.18)	7.06

Note. * $p < .00035$ (Bonferroni corrected alpha level).

Table 14. Steps of logistic regression to reach final model for DSM-IV or DSM-5 ASD to PTSD

		95% CI for Odds Ratio		
Included	*b*	Lower	Odds Ratio	Upper
Constant	-3.87			
Sleep difficulties present	1.60	1.38	4.95	17.75
Number of arousal symptoms	-0.01	0.59	0.99	1.65
Total symptom count	0.12	0.74	1.13	1.73
Number of re-experiencing symptoms	0.09	0.58	1.09	2.05
Intrusive symptom present	0.84	0.47	2.32	11.45

Table 15. Steps to reach final model for subthreshold DSM-5 ASD to PTSD

		95% CI for Odds Ratio		
Included	*b*	Lower	Odds Ratio	Upper
Constant	-4.03			
Sleep difficulties present	0.87	1.13	2.37	4.98
Distress at reminders present	1.99	1.99	7.31	26.83
Concentration difficulties present	0.57	0.81	1.77	3.90
Number of arousal symptoms	0.29	0.90	1.34	1.97
Number of intrusion symptoms	0.35	0.95	1.42	2.13
Total symptom count	-0.14	0.69	0.87	1.10

Discussion Chapter

The two articles presented speak to the assessment of acute stress symptoms and their predictive utility when considering recovery trajectories in children and adolescents following exposure to a traumatic event. More specifically, these papers focus on the assessment of youth who will initially present with severe symptoms, the symptom profiles of which may assist in identifying which children and adolescents are more likely to experience persistent symptoms which lead to enduring distress and symptomatology.

Overview

Meta-Analysis

Conducting a meta-analysis of prevalence rates of Acute Stress Disorder (ASD) in youth following exposure to a traumatic event allowed us to establish a pooled prevalence of 16.4%. This demonstrates that a significant minority of youth experience clinically significant acute reactions post-trauma. An estimated prevalence of 23.7% was obtained across studies which assessed ASD via clinical interview, whereas a much lower rate of 6.8% was found across studies that utilised an ASD-specific questionnaire adhering to the DSM-IV cluster-based algorithm. This finding should be interpreted in the context of high levels of heterogeneity across all studies, and within subgroups of studies, included in the meta-analysis. However, the significant difference observed in prevalence of ASD dependent upon method of assessment may be attributable to the limitations in assessing for acute symptoms (i.e. dissociation) in youth via questionnaire when compared to a more expansive interview (Kassam-Adams et al., 2013). This contrasts to measures commonly used in place of clinical interviews when assessing Post-Traumatic Stress Disorder (PTSD) in youth, which have often found an increase in clinical cases when using questionnaire measures (Nixon et al., 2013). This is possibly explained by the ASD algorithm component of the questionnaires used in studies included in this meta-analysis, whereas symptoms of post-traumatic stress in many studies utilise a cut-off for a continuous score (Perrin,

Meiser-Stedman & Smith, 2005). However, no difference was found in the number of cases that met a 'diagnosis' via a continuous cut-off score when compared to a cluster-based algorithm for DSM-IV PTSD in the study by Nixon et al. (2013). This perhaps suggests that the relatively poor coverage of the dissociation symptoms on questionnaire measures of ASD lead to a decrease in the number of youth identified. Nixon et al. (2013) concluded that the use of the Child PTSD Symptom Scale (CPSS) was justified in absence of a DSM-IV PTSD interview using a cut-off of 16 due to its inclination to over-diagnose.

Unlike those for PTSD, current ASD-specific questionnaires may lead to underreporting. One exception to this is a study which used the ASC-Kids questionnaire and reported high prevalence of ASD in a sample of sexually assaulted young women (Nilsson et al., 2015). However, this study was not included in the meta-analysis as participants only completed the ASC-Kids if they wished to attend a specialist crisis group intervention for victims of sexual assault. This suggests that the sample was selective and not representative of all women who attended the emergency clinic following assault. Despite the high prevalence obtained in Nilsson et al. (2015), it appears that the majority of studies which use ASD specific questionnaires may underreport youth with the acute disorder. These measures should perhaps therefore be approached with caution in the absence of clinical interview, used as a continuous measure, or used to identify subthreshold diagnoses. This may prove to be redundant following the release of the DSM-5 and the introduction of a symptom count instead of the cluster-based algorithm. However, self-report questionnaires designed to assess DSM-5 ASD should ensure a suitable coverage of symptoms to allow for the reasonably high threshold of nine from fourteen symptoms to be met.

Studies included in the meta-analysis in which youth were exposed to an interpersonal trauma reported higher prevalence than those of non-interpersonal trauma. The findings of youth with PTSD reflect this finding (Alisic et al., 2014). From these

findings, it could be hypothesised that symptoms are more likely to remain persistent in youth subjected to interpersonal trauma.

Empirical Study

The main findings from the empirical study were that youth who met criteria for DSM-IV or DSM-5 ASD could be differentiated between those whose symptoms remained persistent and those who recovered on their initial symptom profile. Specifically, those with an increased number of arousal symptoms in the acute stage, and those with problems with sleep, were more likely to experience persistent symptoms and later reach diagnostic criteria for PTSD. Following hierarchical logistic regression, only the individual symptom of difficulties with sleep was found to be significant. Of the 109 DSM-IV or DSM-5 ASD cases identified, 38.5% (42) later reached diagnostic criteria for PTSD. The percentage of ASD cases here that can be categorized as belonging to the *persistent* group is broadly consistent with the figures of 29% (Brown et al., 2016) and 48% (Meiser-Stedman et al., 2017) found in previous research utilising clinical interview to diagnose ASD and PTSD.

The secondary analysis using the subthreshold DSM-5 ASD of four or more symptoms was based upon findings that using the full criteria could overlook up to 75% of youth with significant distress (Kassam-Adams et al., 2012; Meiser-Stedman et al., 2017). Irrespective of the development of later PTSD, the current DSM-5 criteria may not adequately meet its remit of identifying children and adolescents with severe symptoms in the acute stage post-trauma who require immediate intervention or support (McKinnon et al., 2016). Utilising the subthreshold criteria therefore seemed appropriate given recent findings. Further, when considering development of later PTSD, subthreshold DSM-5 ASD has been found to be more sensitive to a later diagnosis than full DSM-5 criteria (Meiser-Stedman et al., 2017). It was therefore felt justified to conduct analysis concerning the predictive utility of symptom groupings and individual symptoms for cases which met this diagnostic category as well.

Through conducting this analysis, we found that the *persistent* group had more arousal symptoms, more re-experiencing symptoms, and more symptoms overall than the *recovered* group when using the subthreshold DSM-5 ASD diagnosis. Individual symptoms that differentiated these two groups were problems with sleep, difficulties concentration, and being upset by cues or reminders of the traumatic event. Following hierarchical logistic regression, only the three individual symptoms were found to be significant. These findings speak to the screening of youth at risk of developing persistent symptoms of post-traumatic stress. Whilst subthreshold DSM-5 ASD shows good sensitivity in relation to later PTSD and identified 80.8% of later PTSD cases in our sample, it has also been shown to have poor specificity leading to the identification of many false positives (Meiser-Stedman et al., 2017). When assessing symptoms of acute stress in youth, the number of false positives may not be of huge concern as studies often wish to instead minimize the number of false negatives due to the greater harm which comes from failing to identify youth who may go on to experience difficulties (Perrin et al., 2005; Kassam-Adams et al., 2012).

Several proposals have been suggested to limit the impact of the high number of false positives that may be identified through using subthreshold ASD and PTSD criteria. The problem of a high number of false positives could be remedied through a second screen some weeks later to identify those whose symptoms have not naturally declined as seen in so many youth post-trauma (Brown et al., 2015; Hiller et al., 2016) or those in which symptoms have increased. The findings from the empirical paper presented here suggest that those who meet criteria for subthreshold DSM-5 ASD in the acute phase, and present with symptoms of poor sleep, distress at reminders and concentration difficulties, may be at risk of developing ongoing post-traumatic stress symptoms.

Strengths of Research

Meta-Analysis

The first paper presented here was a meta-analysis of ASD prevalence in children and adolescents. To the authors knowledge, this is the first meta-analytic review focussed on this disorder in youth. Many studies in youth exist pertaining to symptoms of post-traumatic stress in the acute phase. However, these often utilise measures which are not consistent with a diagnosis of ASD. Therefore, a significant strength of this study is that the majority of studies included measured ASD adhering to DSM criteria. Although including other studies that did not specifically address ASD would have increased the number of studies dramatically, it would likely have also increased heterogeneity even further resulting in findings being less reliable due to the range of different measures of acute stress included. There were three studies included which did not adhere strictly to DSM-IV criteria but did follow subthreshold ASD criteria. Although not strictly comparable to the other interview and questionnaire measures, this provided an insight into the prevalence obtained on subthreshold ASD measures when compared to the ASD-specific questionnaires. As stated in the original paper, a significant strength of this meta-analysis was the results obtained regarding the significant difference in prevalence of ASD when assessed via interview or questionnaire.

Empirical Study

The empirical study was conducted using a pre-existing dataset. This large sample enabled many youth meeting criteria for ASD and PTSD to be derived, thus providing a large number of youth in the *persistent* group which were the focus for analysis. Further, the use of subthreshold DSM-5 ASD in this study allowed for acute symptoms associated with this diagnosis to be included in analysis when identifying their predictive utility. Many studies in the literature report on subthreshold ASD due to the noted difficulties with both the DSM-IV and DSM-5 diagnoses in identifying acutely distressed youth (Kassam-

Adams et al., 2012; McKinnon et al., 2016; Meiser-Stedman et al., 2017) and therefore results from this secondary analysis may provide directions for future research.

Limitations of Research

Meta-Analysis

As ASD is a relatively young diagnosis, the number of studies utilising gold standard assessments of ASD are few. Therefore, the number of studies involved in the meta-analysis is rather small which limits the conclusions that can be drawn from moderator analysis. Further, when visually inspecting the funnel plot, there appears to be a small sample bias; smaller studies reported higher prevalence through potentially focussing on specific groups of injured youths. Despite these limitations, the meta-analysis provides a baseline of ASD prevalence and some interesting avenues to be explored regarding apparent moderators.

Empirical Study

Whereas the use of pre-existing data was a significant strength of this study, it was also restrictive in the sense that there were limitations on the analysis that could be conducted due to prior research agreements. The focus of research questions were on those youth who had ASD at one month; more specifically the *persistent* group, and thus analysis was conducted solely with this group in mind. Prior research agreements meant that the *delayed onset* group could not be explored following the identification of sleep difficulties being predictive of later PTSD in the *persistent* group. It could be that there are early symptoms, such as sleep difficulties, that those without ASD experience and that these symptoms have a role in the development of later PTSD despite the absence of severe symptoms in the acute phase post-trauma. The measures which were used to assemble ASD diagnoses can be seen in the Additional Methods Chapter. It is noted that some of the questionnaires used in the original PACT data archive to assess acute stress symptoms were those that were found in the meta-analysis to possibly have poorer

coverage of dissociation symptoms and thus result in lower prevalence rates (e.g. CASQ, ASC-Kids). However, as many of the positive ASD cases used in the empirical study were those that met DSM-5 criteria, this may have been less problematic, due to the abolition of the cluster-based algorithm and resulting de-emphasis on symptoms of dissociation. In addition, a substantial minority of later PTSD cases relied upon questionnaire cut-offs to derive the presence or absence of PTSD. To negate the likelihood of over-diagnosing youth with PTSD on continuous measures (Perrin et al., 2005), stricter cut-offs were used for these measures where empirically supported in the literature (e.g. Nixon et al., 2013). The prevalence of ASD was not reported for this sample due to the way in which cases were selected from the PACT archive. Missing data was handled in such a way to maximise the number of positive ASD cases for analysis.

Clinical Implications: Early Interventions

Universal Interventions

With an estimated prevalence of ASD when assessed via interview of 23.7% obtained in the meta-analysis, it appears that offering universal early interventions to all youth who have experienced a traumatic event may be unwarranted. This could potentially limit the intensity and quality of resources allocated to those who may present with significant acute distress and therefore more in need of immediate support.

Despite the expected prevalence of youth with symptoms of acute stress, previous studies have sought to assess the efficacy of universal preventative interventions for all youth exposed to a traumatic event. Zehnder, Meuli and Landolt (2010) conducted single-session debriefing 10 days post-trauma which focussed on reconstructing the accidents, psycho-education and identifying maladaptive cognitive appraisals relating to the trauma. Although younger children presented with fewer symptoms of depression and behavioural problems, no difference was found between the control and treatment group regarding symptoms of post-traumatic stress. The literature has found little evidence for the efficacy

of single-session psychological debriefing (Pfefferbaum, Nitiemna, Tucker, & Newman, 2017).

One study reported on all children subjected to an earthquake enrolled in a school-based intervention post-trauma. Findings suggest that those without acute symptoms developed new symptoms following the intervention whereas children with more severe acute symptoms improved (Laor, 2002). This led to recommendations that youth with severe acute symptoms should be seen separately to those without, to limit this 'contamination' effect (Berkowitz, 2003). For those who do not experience significant symptoms of acute stress, encouraging them to review and re-expose themselves to the trauma has been suggested to interfere with the natural recovery process (Mayou, Ehlers & Hobbs, 2000) and is therefore unjustified in youth without acute symptoms (Berkowitz, 2003).

Cox, Kenardy and Hendrikz (2010) provided information to parents of children who had experienced a traumatic event in order to determine whether this impacted upon recovery trajectory. Although this information was available from two weeks, there was no record of at what time point it was accessed by parents and youth. Reductions were found in anxiety, although no differences in symptoms of post-traumatic stress were observed in the group that received psycho-education.

Selective Interventions

As most children recover without professional assistance, it has been suggested that post-trauma interventions should follow a stepped care model wherein youth who present with risk factors for long-term psychological difficulties should receive progressively intensive treatment (Kramer & Landolt, 2011). The proposed model would include the distribution of written information (psycho-education) for children and parents who are at low risk of developing severe symptoms, further assessment of those who present with high risk, and structured early intervention for those who continue to present in this way

(Kramer & Landolt, 2011). The principles of stepped care have been used in services following natural disasters, whereby youth reporting severe symptoms of acute stress on a self-report measure were then administered a clinical interview, along with their parents, to determine whether they met criteria for a post-traumatic mental health condition (McDermott & Cobham, 2014).

ASD: Symptom Predictors of PTSD

The findings of both articles presented here speak to the use of targeted interventions. The renewed purpose of DSM-5 ASD to identify those youth who present with severe acute symptoms, thus benefitting from early intervention (Bryant, 2017), suggests that youth with ASD would be the focus of early support and resources. The estimated prevalence from the meta-analysis suggests that around a quarter of youth exposed to trauma would benefit from early interventions. The empirical project identified the single acute symptom of sleep difficulties, as well as the total number of arousal symptoms, to be predictive of PTSD. However, problems with sleep were found to be most strongly associated. This has implications for the way in which youth are screened at the acute stage for the likelihood of persistent symptoms. Results from the present study suggest that of those that reach criteria for ASD at the acute stage, difficulties with sleep are more predictive of later PTSD than any other individual symptom, symptom grouping (e.g. dissociation symptoms), or even the total count of acute symptoms.

Sleep Difficulties and Arousal

The relationship between sleep quality and consolidation of trauma memories is explored in the discussion of the empirical paper. Wittman, Zehnder, Jenni and Landolt (2012) found that youth with full or subthreshold PTSD required at least three times longer to fall asleep at night, and got less sleep, when compared to youth without the diagnosis. Predictors of problems with sleep onset included being female, the child's level of post-traumatic stress symptoms, and their mother's level of post-traumatic stress. Whilst they

did not find nightmares to be significantly related to sleep onset and maintenance problems, the acute symptom of nightmares were not found to be predictive of PTSD status in our empirical study. In explaining their result, Wittman et al. (2012) hypothesise that if a child perceives their mother to be stressed, this might reinforce their worries and fear experienced post-trauma. If a mother were experiencing post-traumatic stress symptoms herself, she may be unable to provide the child the context for talking about the trauma memories or be unable to effectively assist the child with self-soothing at bedtime.

If nightmares are not impacting upon a child's ability to get to sleep following trauma, what is? Problems associated with high levels of arousal can impact upon sleep, with both worry and rumination before bedtime associated with insomnia following trauma (Bader & Schafer, 2007). Attempts to reappraise trauma-related intrusions in the acute phase have been found to increase post-traumatic stress symptoms at follow up (Meiser-Stedman et al., 2014). Considering that reappraisal of the trauma memory was predicted to be a positive cognitive strategy, this was a somewhat unexpected finding. The authors suggest that increased levels of rumination at follow up was associated with use of reappraisal in the acute phase, which if ruminative in nature, may have led to increased stress levels through a preoccupation with the meaning and cause of the traumatic event.

Selective Interventions for Acute Sleep and Arousal Symptoms

The findings from the empirical study suggest that early interventions offered to those who fulfil criteria for ASD would be most helpful when incorporating skills or techniques based upon sleep hygiene. This would fulfil the aim of early interventions in targeting factors likely to increase development of more severe, long term difficulties (De Young & Kenardy, 2017). It is unclear as to the extent that early interventions, either universal or selective, focus upon the importance of sleep post-trauma. Marsac, Donlon and Berkowitz (2014) recommended that selective interventions for youth deemed to be at

risk of developing post-traumatic stress symptoms should involve the importance of the family system, child-caregiver communication and psycho-education.

The most effective selective intervention shown to date is the Child and Family Traumatic Stress Intervention (CFTSI), a four-session preventative early intervention for the trauma-exposed child and their caregiver. Delivered within 30 days of the traumatic event, this has shown to result in fewer children and adolescents receiving a later PTSD diagnosis (Berkowitz, Stover, & Marans, 2011). More specifically, youth demonstrated significant reductions in their symptoms of avoidance and reexperiencing, but not hyperarousal. It was suggested that due to most participants living in highly stressed urban neighbourhoods, and being of low socioeconomic status, hyperarousal symptoms may be necessary in their daily lives and a pre-trauma adaptation to such an environment. The average number of prior traumatic events that a child had experienced was high, raising the possibility that CFTSI was treating PTSD from prior trauma instead of preventing the likelihood of future PTSD from severe acute stress (Berkowitz et al., 2011). Regarding sleep, it may be that through CFTSI encouraging communication and attunement, parents were better able to assist their children to soothe and initiate sleep (Wittman, Zehnder, Jenni, & Landolt, 2012).

Despite promising results from CFTSI, the elements which served as therapeutic mechanisms have not been assessed. However, involving parents in early interventions for youth presenting with acute stress symptoms post-trauma has been found to increase success (Newman et al., 2014). Another early intervention that includes parents is Teaching Recovery Techniques (TRT). TRT is a manualized group intervention designed to be delivered in a range of settings following wars and natural disasters (Yule, Dyregrov, Raundalen, & Smith, 2013). The emphasis of this intervention is to equip children, and parents in a separate group, with skills and techniques to manage acute symptoms in order to prevent them becoming persistent. The intervention can be started within the first month

although often is dependent upon the context of the trauma. Unlike other early interventions, TRT describes a clear process for implementation and the elements involved, consisting of five two-hour sessions. The third session is aimed at arousal symptoms including sleep, relaxation, and concentration (Yule et al., 2013). Based on results from the current empirical study, such an intervention may prove beneficial for those youth who reach diagnosis for ASD in preventing symptoms persisting. TRT has shown good outcomes with youth in a range of settings, however, the active therapeutic mechanisms of the intervention are yet to be identified. Delivered as a group intervention for youth who have often experienced a shared collective trauma, it is suggested that TRT encourages mutual self help and support (Yule et al., 2013). Group interventions promote a sense of shared experience which can be de-stigmatizing through normalising symptoms (Deblinger, Pollio & Dorsey, 2016).

Trauma-Focussed Cognitive Behavioural Therapy (TF-CBT) for children and parents (Cohen & Mannarino, 2008) is a lengthy intervention generally delivered well after the acute stage. However, the initial sessions focus on stress management techniques including psycho-education, relaxation, and cognitive skills. Although intended as an adjunct for the emotionally intensive processing of the trauma which follows, findings from the present empirical study suggest that such techniques may be beneficial in decreasing increased symptoms of arousal in the acute stage post-trauma. With increased arousal symptoms being found to impact upon sleep quality (Bader & Schafer, 2007), clinical interventions that address post-trauma sleeping difficulties may serve to improve coping, enhance mood, and reduce symptoms of trauma-related distress (Gerhart et al., 2014).

Subthreshold DSM-5 ASD: Predictors of PTSD

Results of the empirical study indicated that predictors of PTSD from subthreshold DSM-5 ASD were the individual symptoms of sleeping problems, concentration

difficulties, and becoming distressed by reminders or cues of the traumatic event. The previous section on intervention focuses on providing selective interventions to those youth who reach diagnostic criteria for ASD in the acute phase post-trauma. However, the prevalence of 23.7% obtained in the first paper, from studies using clinical interview to assess ASD, is likely to underestimate those who would benefit from support. All but one of the studies contributing to this estimate utilised the DSM-IV diagnosis of ASD which has received criticism for its undue emphasis on the number of dissociation symptoms required to reach diagnosis (Kassam-Adams et al., 2004; Meiser-Stedman et al., 2007; Dalgleish et al., 2008). This criticism has applied to the diagnostic criteria in general, regardless of whether symptoms in the acute phase were assessed via questionnaire or interview. Therefore, allocating resources for selective interventions for those who may reach subthreshold ASD diagnoses, as described earlier in this chapter, may be more appropriate. However, this would likely result in the addition of many children and adolescents who will not go on to experience problematic symptoms or impairment due to the natural recovery observed in many youth-post-trauma (La Greca et al., 2010; Le Brocque et al., 2010; De Young et al., 2012; Brown et al., 2016; Hiller et al., 2016; Zhou et al., 2016). Designing services in such a way that selective interventions were offered to all children and adolescents that met subthreshold ASD could result in similar problems to that encountered when applying universal interventions post-trauma.

Watchful Waiting and Screening for Persistent Symptoms

Whilst it might not be either practicable or suitable to offer selective early interventions to all children and adolescents that meet criteria for subthreshold ASD, the use of this diagnostic category may assist in identifying youth who would benefit from a period of ‘watchful waiting’ (NICE, 2005). It has been suggested that this time period should include repeated screening or assessment in order to identify those youth whose symptoms are not declining naturally as would be expected in the majority (Price, Kassam-

Adams, Alderfer, Christofferson, & Kazak, 2016). Kenardy, Cox and Brown (2015) found that a preventative early intervention was most effective when targeted at youth with more severe acute stress symptoms than when provided to all children and adolescents, which was found to save time and resources. Although high levels of acute traumatic stress were used by Kenardy and colleagues (2015) to identify 'at risk' participants, the authors suggested that there may be more optimal risk factors. We would propose that the individual symptoms identified in this empirical study (sleep problems, concentration difficulties, distress at reminders) could serve to assist in this screening process. March et al. (2015) employed a re-screening process at 4-6 weeks post-trauma, after initial assessment of acute symptoms in the first month. Those who had been deemed at risk of developing further symptoms from the first screen were re-screened and took part in a clinical interview. This assisted in identifying youth whose symptoms had further decreased and thus did not need intervention at the later time point, resulting in resources being directed towards youth with the greatest need. Our empirical study found that in addition to the individual symptoms identified through logistic regression, increased arousal, re-experiencing, and overall symptoms were predictive of later PTSD from subthreshold DSM-5 ASD. It is suggested that these findings could be incorporated into a brief screen to be used whilst children and adolescents are in the 'watchful waiting' period, in the hope of more accurately identifying youth who are more likely to develop PTSD and thus allowing for resources to be allocated accordingly for early intervention.

Although the benefit of providing interventions within three months of trauma exposure has been questioned due to the observed natural recovery in youth (Hiller et al., 2016), a recent review of selective interventions with those 'at risk' demonstrated that the interventions included were superior to natural recovery in those exposed to natural and man-made disasters (Pfefferbaum et al., 2017). In a recent meta-analysis of early interventions in trauma exposed youth, those delivered within the first four months yielded

the largest effect sizes (Newman et al., 2014). This provides evidence for the relevance and need of early interventions in youth at risk of developing ongoing post-traumatic stress symptoms.

Contribution to the Evidence Base

The pooled estimate from the meta-analysis provides a baseline for prevalence of ASD in children and adolescents. In addition, subgroup analyses provide insights into the different prevalence obtained for ASD when assessed via interview or questionnaire, which has implications for the future development of measures used to assess acute symptoms.

Findings from the empirical study suggest that when focussed on ASD diagnosis, the symptom of difficulties with sleep holds predictive utility in delineating which children and adolescents with ASD will go on to experience persistent symptoms, as measured by the presence of PTSD in this study. When expanded to youth who meet subthreshold DSM-5 ASD diagnosis, the individual symptoms of sleeping difficulties, problems with concentration and distress at reminders of the trauma were found to be most predictive of a *persistent* trajectory. The predictive utility of these symptoms adds to our developing knowledge of other factors which have been found to identify those youth who follow what would be categorized as a *persistent* trajectory. A profile of youth who may be more likely to experience persistent symptoms is starting to take shape. Youth with injuries (Le Brocque et al., 2010; Brown et al., 2016), burns (De Young et al., 2012), female gender (Brown et al., 2016), less social support, increased anxiety (La Greca et al., 2010), low socioeconomic status (Brown et al, 2016), increased heart rate post-trauma (Olsson, Kenardy, De Young, & Spence, 2008), increased exposure to disaster (Zhou et al., 2016) and those who have experienced prior trauma (Copeland et al., 2007) are more likely to have persistent symptoms. Additional factors include those who hold maladaptive cognitions and coping strategies (Meiser-Stedman, Dalgleish, Glucksman, Yule, & Smith,

2009) and have more symptoms of negative alterations in cognition and mood as measured via DSM-5 PTSD in the acute phase post-trauma (Meiser-Stedman et al., 2017).

Future Research

The findings of the empirical study highlight areas for future research in youth with ASD or acute distress who then go on to experience PTSD or persistent symptoms. The transition from ASD to PTSD is complex and identifying reliable predictors is likely to reflect this. However, we are now building a profile of factors that appear to be involved in identifying the substantial minority of approximately 10% of all youth exposed to traumatic events who follow this trajectory. The empirical study focussed on identification of symptoms at the acute stage that were predictive of PTSD. However, it is likely that a combination of symptoms, biological variables, pre-trauma characteristics, cognitions, coping skills, injury, and parent behaviour impact upon whether youth spontaneously recover from acute symptoms or not. These factors should continue to be investigated to best identify youth who may sit within the *persistent* group. Following from the results of this study, the role of sleep in the acute phase post-trauma should be further explored in youth. To investigate this, studies of trauma-exposed children and adolescents should include questionnaires dedicated to enquiring about sleep, which will allow for subjective measures to be obtained from child report. Additionally, objective measures of sleep could be sought in a smaller sample of children and adolescents where possible.

Measures of both acute and post-traumatic stress symptoms vary in the literature, which led to a smaller number of studies being included in the meta-analysis. It seems likely that studies will continue to adopt measures which meet the aims of their research. Although not measuring symptoms of ASD per se, questionnaires with a continuous cut-off score administered within one month and again at follow up allow for a direct comparison between time points and increased methods of statistical analysis. By using dichotomous ratings of presence or absence of symptoms and diagnoses, we were unable to

analyse the linear relationship between ASD and PTSD symptoms. It seems likely that future studies will continue to use these measures dependent upon their objective. However, with the arrival of DSM-5 ASD, which adopts a total symptom count instead of a cluster-based algorithm, questionnaires might be more easily compared using a cut-off score. Many studies of youth within the acute phase after collective trauma, including terror attacks and natural disasters, often use questionnaire measures of post-traumatic stress symptoms within one month. This is largely attributable to the time and resources available in situations where pre-existing services are not set-up. As a result, the findings presented in both the meta-analysis and empirical study may not be generalized to youth who have experienced these types of trauma and therefore future research should aim to identify the trajectory of youth who present with severe symptoms in the account phase following these traumatic events.

Conclusion

The meta-analysis conducted in the first paper provides a pooled estimate of ASD from studies which largely utilised DSM-IV criteria. As discussed, the significant impact of moderators, including the method of assessment and type of trauma, provide directions for future practice and research in the assessment of trauma-exposed youth and those who may require early intervention. Findings from the empirical study suggest symptom profiles of youth who may benefit from a watchful 'waiting approach' or be prioritised for early intervention. An association was found between sleeping difficulties in the one month post-trauma and the development of future PTSD in youth who meet criteria for ASD. The focus on those meeting criteria for ASD highlights youth with the most severe post-trauma reactions and provides insight into the symptoms which may increase likelihood of persisting distress. However, given the common use of reduced criteria in the literature, subthreshold DSM-5 ASD was also explored. Those who met subthreshold DSM-5 ASD and whose symptoms remain persistent were more likely to have difficulties

with sleeping problems, concentration, and becoming distressed at reminders of the trauma when compared to those youth who recover from acute symptoms. Taken together, these two articles further our understanding of the prevalence of ASD in youth post-trauma as well as those acute symptoms which predict the likelihood of symptoms persisting in the months that follow.

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Appendix F. Author Guidelines for Clinical Psychology Review

Article structure

Manuscripts should be prepared according to the guidelines set forth in the Publication Manual of the American Psychological Association (6th ed., 2009). Of note, section headings should not be numbered.

Manuscripts should ordinarily not exceed 50 pages, *including* references and tabular material. Exceptions may be made with prior approval of the Editor in Chief. Manuscript length can often be managed through the judicious use of appendices. In general the References section should be limited to citations actually discussed in the text. References to articles solely included in meta-analyses should be included in an appendix, which will appear in the on line version of the paper but not in the print copy. Similarly, extensive Tables describing study characteristics, containing material published elsewhere, or presenting formulas and other technical material should also be included in an appendix. Authors can direct readers to the appendices in appropriate places in the text.

It is authors' responsibility to ensure their reviews are comprehensive and as up to date as possible (at least through the prior calendar year) so the data are still current at the time of publication. Authors are referred to the PRISMA Guidelines (http://www.prisma-statement.org/statement.htm) for guidance in conducting reviews and preparing manuscripts. Adherence to the Guidelines is not required, but is recommended to enhance quality of submissions and impact of published papers on the field.

Appendices

If there is more than one appendix, they should be identified as A, B, etc. Formulae and equations in appendices should be given separate numbering: Eq. (A.1), Eq. (A.2), etc.; in a subsequent appendix, Eq. (B.1) and so on. Similarly for tables and figures: Table A.1; Fig. A.1, etc.

Essential title page information

Title. Concise and informative. Titles are often used in information-retrieval systems. Avoid abbreviations and formulae where possible. **Note: The title page should be the first page of the manuscript document indicating the author's names and affiliations and the corresponding author's complete contact information.**

Author names and affiliations. Where the family name may be ambiguous (e.g., a double name), please indicate this clearly. Present the authors' affiliation addresses (where the actual work was done) below the names. Indicate all affiliations with a lower-case superscript letter immediately after the author's name and in front of the appropriate address. Provide the full postal address of each affiliation, including the country name, and, if available, the e-mail address of each author within the cover letter.

Corresponding author. Clearly indicate who is willing to handle correspondence at all stages of refereeing and publication, also post-publication. **Ensure that telephone and fax numbers (with country and area code) are provided in addition to the e-mail address and the complete postal address.**

Present/permanent address. If an author has moved since the work described in the article was done, or was visiting at the time, a "Present address"' (or "Permanent address") may be indicated as a footnote to that author's name. The address at which the author actually did the work must be retained as the main, affiliation address. Superscript Arabic numerals are used for such footnotes.

Abstract

A concise and factual abstract is required (not exceeding 200 words). This should be typed on a separate page following the title page. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separate from the article, so it must be able to stand alone. References should therefore be avoided, but if essential, they must be cited in full, without reference to the reference list.

Graphical abstract

Although a graphical abstract is optional, its use is encouraged as it draws more attention to the online article. The graphical abstract should summarize the contents of the article in a concise, pictorial form designed to capture the attention of a wide readership. Graphical abstracts should be submitted as a separate file in the online submission system. Image size: Please provide an image with a minimum of 531 × 1328 pixels (h × w) or proportionally more. The image should be readable at a size of 5 × 13 cm using a regular screen resolution of 96 dpi. Preferred file types: TIFF, EPS, PDF or MS Office files. You can view Example Graphical Abstracts on our information site.
Authors can make use of Elsevier's Illustration Services to ensure the best presentation of their images and in accordance with all technical requirements.

Highlights

Highlights are mandatory for this journal. They consist of a short collection of bullet points that convey the core findings of the article and should be submitted in a separate editable file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point). You can view example Highlights on our information site.

Keywords

Immediately after the abstract, provide a maximum of 6 keywords, using American spelling and avoiding general and plural terms and multiple concepts (avoid, for example, 'and', 'of'). Be sparing with abbreviations: only abbreviations firmly established in the field may be eligible. These keywords will be used for indexing purposes.

Abbreviations

Define abbreviations that are not standard in this field in a footnote to be placed on the first page of the article. Such abbreviations that are unavoidable in the abstract must be defined at their first mention there, as well as in the footnote. Ensure consistency of abbreviations throughout the article.

Acknowledgements

Collate acknowledgements in a separate section at the end of the article before the references and do not, therefore, include them on the title page, as a footnote to the title or otherwise. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

Formatting of funding sources

List funding sources in this standard way to facilitate compliance to funder's requirements:

Funding: This work was supported by the National Institutes of Health [grant numbers xxxx, yyyy]; the Bill & Melinda Gates Foundation, Seattle, WA [grant number zzzz]; and the United States Institutes of Peace [grant number aaaa].

It is not necessary to include detailed descriptions on the program or type of grants and awards. When funding is from a block grant or other resources available to a university,

college, or other research institution, submit the name of the institute or organization that provided the funding.

If no funding has been provided for the research, please include the following sentence:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Footnotes

Footnotes should be used sparingly. Number them consecutively throughout the article. Many word processors can build footnotes into the text, and this feature may be used. Otherwise, please indicate the position of footnotes in the text and list the footnotes themselves separately at the end of the article. Do not include footnotes in the Reference list.

Electronic artwork

General points

• Make sure you use uniform lettering and sizing of your original artwork.
• Embed the used fonts if the application provides that option.
• Aim to use the following fonts in your illustrations: Arial, Courier, Times New Roman, Symbol, or use fonts that look similar.
• Number the illustrations according to their sequence in the text.
• Use a logical naming convention for your artwork files.
• Provide captions to illustrations separately.
• Size the illustrations close to the desired dimensions of the published version.
• Submit each illustration as a separate file.

A detailed guide on electronic artwork is available.

You are urged to visit this site; some excerpts from the detailed information are given here.

Formats

If your electronic artwork is created in a Microsoft Office application (Word, PowerPoint, Excel) then please supply 'as is' in the native document format.
Regardless of the application used other than Microsoft Office, when your electronic artwork is finalized, please 'Save as' or convert the images to one of the following formats (note the resolution requirements for line drawings, halftones, and line/halftone combinations given below):
EPS (or PDF): Vector drawings, embed all used fonts.
TIFF (or JPEG): Color or grayscale photographs (halftones), keep to a minimum of 300 dpi.
TIFF (or JPEG): Bitmapped (pure black & white pixels) line drawings, keep to a minimum of 1000 dpi.
TIFF (or JPEG): Combinations bitmapped line/half-tone (color or grayscale), keep to a minimum of 500 dpi.

Please do not:

• Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); these typically have a low number of pixels and limited set of colors;
• Supply files that are too low in resolution;
• Submit graphics that are disproportionately large for the content.

Color artwork

Please make sure that artwork files are in an acceptable format (TIFF (or JPEG), EPS (or PDF), or MS Office files) and with the correct resolution. If, together with your accepted article, you submit usable color figures then Elsevier will ensure, at no additional charge, that these figures will appear in color online (e.g., ScienceDirect and other sites) regardless of whether or not these illustrations are reproduced in color in the printed version. **For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article**. Please

indicate your preference for color: in print or online only. Further information on the preparation of electronic artwork.

Figure captions

Ensure that each illustration has a caption. Supply captions separately, not attached to the figure. A caption should comprise a brief title (**not** on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

Tables

Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. Number tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Be sparing in the use of tables and ensure that the data presented in them do not duplicate results described elsewhere in the article. Please avoid using vertical rules and shading in table cells.

References

Citations in the text should follow the referencing style used by the American Psychological Association. You are referred to the Publication Manual of the American Psychological Association, Sixth Edition, ISBN 1-4338-0559-6, copies of which may be ordered from http://books.apa.org/books.cfm?id=4200067 or APA Order Dept., P.O.B. 2710, Hyattsville, MD 20784, USA or APA, 3 Henrietta Street, London, WC3E 8LU, UK. Details concerning this referencing style can also be found at http://humanities.byu.edu/linguistics/Henrichsen/APA/APA01.html

Citation in text

Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full. Unpublished results and personal communications are not recommended in the reference list, but may be mentioned in the text. If these references are included in the reference list they should follow the standard reference style of the journal and should include a substitution of the publication date with either 'Unpublished results' or 'Personal communication'. Citation of a reference as 'in press' implies that the item has been accepted for publication.

Web references

As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

Data references

This journal encourages you to cite underlying or relevant datasets in your manuscript by citing them in your text and including a data reference in your Reference List. Data references should include the following elements: author name(s), dataset title, data repository, version (where available), year, and global persistent identifier. Add [dataset] immediately before the reference so we can properly identify it as a data reference. The [dataset] identifier will not appear in your published article.

References in a special issue

Please ensure that the words 'this issue' are added to any references in the list (and any citations in the text) to other articles in the same Special Issue.

Reference management software

Most Elsevier journals have their reference template available in many of the most popular reference management software products. These include all products that support Citation Style Language styles, such as Mendeley and Zotero, as well as EndNote. Using the word processor plug-ins from these products, authors only need to select the appropriate journal template when preparing their article, after which citations and bibliographies will be automatically formatted in the journal's style. If no template is yet available for this journal, please follow the format of the sample references and citations as shown in this Guide.

Users of Mendeley Desktop can easily install the reference style for this journal by clicking the following link:
http://open.mendeley.com/use-citation-style/clinical-psychology-review
When preparing your manuscript, you will then be able to select this style using the Mendeley plug-ins for Microsoft Word or LibreOffice.

Reference style

References should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same author(s) in the same year must be identified by the letters "a", "b", "c", etc., placed after the year of publication. **References should be formatted with a hanging indent (i.e., the first line of each reference is flush left while the subsequent lines are indented).**

Examples: Reference to a journal publication: Van der Geer, J., Hanraads, J. A. J., & Lupton R. A. (2000). The art of writing a scientific article. *Journal of Scientific Communications,* 163, 51-59.

Reference to a book: Strunk, W., Jr., &White, E. B. (1979). *The elements of style.* (3rd ed.). New York: Macmillan, (Chapter 4).

Reference to a chapter in an edited book: Mettam, G. R., & Adams, L. B. (1994). How to prepare an electronic version of your article. In B.S. Jones, & R. Z. Smith (Eds.), *Introduction to the electronic age* (pp. 281-304). New York: E-Publishing Inc.

[dataset] Oguro, M., Imahiro, S., Saito, S., Nakashizuka, T. (2015). *Mortality data for Japanese oak wilt disease and surrounding forest compositions*. Mendeley Data, v1. http://dx.doi.org/10.17632/xwj98nb39r.1

Appendix G. Author Guidelines for the Journal of Abnormal Child Psychology

TITLE PAGE
Title Page
The title page should include:

- The name(s) of the author(s)
- A concise and informative title
- The affiliation(s) and address(es) of the author(s)
- The e-mail address, and telephone number(s) of the corresponding author
- If available, the 16-digit ORCID of the author(s)

Abstract

Please provide an abstract of 150 to 250 words. The abstract should not contain any undefined abbreviations or unspecified references.
Keywords
Please provide 4 to 6 keywords which can be used for indexing purposes.

TEXT

Text Formatting

Manuscripts should be submitted in Word.

- Use a normal, plain font (e.g., 10-point Times Roman) for text.
- Use italics for emphasis.
- Use the automatic page numbering function to number the pages.
- Do not use field functions.
- Use tab stops or other commands for indents, not the space bar.
- Use the table function, not spreadsheets, to make tables.
- Use the equation editor or MathType for equations.
- Save your file in docx format (Word 2007 or higher) or doc format (older Word versions).

Manuscripts with mathematical content can also be submitted in LaTeX.

- LaTeX macro package (pdf, 352 kB)

Headings

Please use no more than three levels of displayed headings.
Abbreviations

Abbreviations should be defined at first mention and used consistently thereafter.

Footnotes

Footnotes can be used to give additional information, which may include the citation of a reference included in the reference list. They should not consist solely of a reference citation, and they should never include the bibliographic details of a reference. They should also not contain any figures or tables.

Footnotes to the text are numbered consecutively; those to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data). Footnotes to the title or the authors of the article are not given reference symbols. Always use footnotes instead of endnotes.

Acknowledgments

Acknowledgments of people, grants, funds, etc. should be placed in a separate section on the title page. The names of funding organizations should be written in full.

MANUSCRIPT FORMAT

All JACP manuscripts should be submitted to Editorial Manager in 12-point Times New Roman with standard 1-inch borders around the margins.

APA STYLE

Page length: 35 pages; Text must be double-spaced; APA Publication Manual standards must be followed.

TERMINOLOGY

- Please use the standard mathematical notation for formulae, symbols etc.:

Italic for single letters that denote mathematical constants, variables, and unknown quantities

Roman/upright for numerals, operators, and punctuation, and commonly defined functions or abbreviations, e.g., cos, det, e or exp, lim, log, max, min, sin, tan, d (for derivative)

Bold for vectors, tensors, and matrices.

SCIENTIFIC STYLE

- Please always use internationally accepted signs and symbols for units (SI units).
- Generic names of drugs and pesticides are preferred; if trade names are used, the generic name should be given at first mention.

REFERENCES

Citation

Cite references in the text by name and year in parentheses. Some examples:

- Negotiation research spans many disciplines (Thompson 1990).
- This result was later contradicted by Becker and Seligman (1996).
- This effect has been widely studied (Abbott 1991; Barakat et al. 1995; Kelso and Smith 1998; Medvec et al. 1999).

Reference list

The list of references should only include works that are cited in the text and that have been published or accepted for publication. Personal communications and unpublished works should only be mentioned in the text. Do not use footnotes or endnotes as a substitute for a reference list.

Reference list entries should be alphabetized by the last names of the first author of each work.

- Journal article

Harris, M., Karper, E., Stacks, G., Hoffman, D., DeNiro, R., Cruz, P., et al. (2001). Writing labs and the Hollywood connection. Journal of Film Writing, 44(3), 213–245.

- Article by DOI

Slifka, M. K., & Whitton, J. L. (2000) Clinical implications of dysregulated cytokine production. Journal of Molecular Medicine, https://doi.org/10.1007/s001090000086

- Book

Calfee, R. C., & Valencia, R. R. (1991). APA guide to preparing manuscripts for journal publication. Washington, DC: American Psychological Association.

- Book chapter

O'Neil, J. M., & Egan, J. (1992). Men's and women's gender role journeys: Metaphor for healing, transition, and transformation. In B. R. Wainrib (Ed.), Gender issues across the life cycle (pp. 107–123). New York: Springer.

- Online document

Abou-Allaban, Y., Dell, M. L., Greenberg, W., Lomax, J., Peteet, J., Torres, M., & Cowell, V. (2006). Religious/spiritual commitments and psychiatric practice. Resource document. American Psychiatric Association. http://www.psych.org/edu/other_res/lib_archives/archives/200604.pdf. Accessed 25 June 2007.

Journal names and book titles should be italicized.

For authors using EndNote, Springer provides an output style that supports the formatting of in-text citations and reference list.

- EndNote style (zip, 3 kB)

TABLES

- All tables are to be numbered using Arabic numerals.
- Tables should always be cited in text in consecutive numerical order.
- For each table, please supply a table caption (title) explaining the components of the table.
- Identify any previously published material by giving the original source in the form of a reference at the end of the table caption.
- Footnotes to tables should be indicated by superscript lower-case letters (or asterisks for significance values and other statistical data) and included beneath the table body.

ARTWORK AND ILLUSTRATIONS GUIDELINES

Electronic Figure Submission

- Supply all figures electronically.
- Indicate what graphics program was used to create the artwork.
- For vector graphics, the preferred format is EPS; for halftones, please use TIFF format. MSOffice files are also acceptable.
- Vector graphics containing fonts must have the fonts embedded in the files.
- Name your figure files with "Fig" and the figure number, e.g., Fig1.eps.

Line Art

- Definition: Black and white graphic with no shading.
- Do not use faint lines and/or lettering and check that all lines and lettering within the figures are legible at final size.
- All lines should be at least 0.1 mm (0.3 pt) wide.
- Scanned line drawings and line drawings in bitmap format should have a minimum resolution of 1200 dpi.
- Vector graphics containing fonts must have the fonts embedded in the files.

Halftone Art

- Definition: Photographs, drawings, or paintings with fine shading, etc.
- If any magnification is used in the photographs, indicate this by using scale bars within the figures themselves.
- Halftones should have a minimum resolution of 300 dpi.

Combination Art

- Definition: a combination of halftone and line art, e.g., halftones containing line drawing, extensive lettering, color diagrams, etc.
- Combination artwork should have a minimum resolution of 600 dpi.

Color Art

- Color art is free of charge for online publication.
- If black and white will be shown in the print version, make sure that the main information will still be visible. Many colors are not distinguishable from one another when converted to black and white. A simple way to check this is to make a xerographic copy to see if the necessary distinctions between the different colors are still apparent.
- If the figures will be printed in black and white, do not refer to color in the captions.
- Color illustrations should be submitted as RGB (8 bits per channel).

Figure Lettering

- To add lettering, it is best to use Helvetica or Arial (sans serif fonts).
- Keep lettering consistently sized throughout your final-sized artwork, usually about 2–3 mm (8–12 pt).
- Variance of type size within an illustration should be minimal, e.g., do not use 8-pt type on an axis and 20-pt type for the axis label.
- Avoid effects such as shading, outline letters, etc.
- Do not include titles or captions within your illustrations.

Figure Numbering

- All figures are to be numbered using Arabic numerals.
- Figures should always be cited in text in consecutive numerical order.
- Figure parts should be denoted by lowercase letters (a, b, c, etc.).
- If an appendix appears in your article and it contains one or more figures, continue the consecutive numbering of the main text. Do not number the appendix figures,

"A1, A2, A3, etc." Figures in online appendices (Electronic Supplementary Material) should, however, be numbered separately.

Figure Captions

- Each figure should have a concise caption describing accurately what the figure depicts. Include the captions in the text file of the manuscript, not in the figure file.
- Figure captions begin with the term Fig. in bold type, followed by the figure number, also in bold type.
- No punctuation is to be included after the number, nor is any punctuation to be placed at the end of the caption.
- Identify all elements found in the figure in the figure caption; and use boxes, circles, etc., as coordinate points in graphs.
- Identify previously published material by giving the original source in the form of a reference citation at the end of the figure caption.

Figure Placement and Size

- Figures should be submitted separately from the text, if possible.
- When preparing your figures, size figures to fit in the column width.
- For most journals the figures should be 39 mm, 84 mm, 129 mm, or 174 mm wide and not higher than 234 mm.
- For books and book-sized journals, the figures should be 80 mm or 122 mm wide and not higher than 198 mm.