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Psychotic Like Experiences are Associated with Suicide Ideation and Behavior in 9 to 10 Year Old Children in the United States

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Abstract

Those experiencing psychotic like experiences (PLEs) are at higher risk for suicide ideation and behavior. However, it is unclear if PLEs are related to suicide ideation and behavior in children, and whether other factors such as impulsivity or emotion dysregulation might moderate the relationship. We hypothesize that PLEs are associated with suicide ideation and behavior, with impulsivity and emotion dysregulation moderating this relationship, in middle childhood. History of PLEs, suicide ideation and behavior, depression, emotion dysregulation, and impulsivity were assessed for 10,624 children aged 9 to 10.9 years (47.8% female, 34.4% minority race, 20.0% Hispanic) as part of the Adolescent Brain Cognitive DevelopmentSM study. Hypotheses about associations between variables were assessed using hierarchical linear modeling. PLEs were associated with suicide ideation and suicide behavior even when controlling for depression severity. Emotion dysregulation and impulsivity were also associated with suicide ideation and moderated the relationship between PLEs and suicide ideation. Variation in suicide ideation due to impulsivity and emotion dysregulation appears to be strongest when people are experiencing low levels to no PLEs. Only impulsivity and PLEs were associated with suicide behavior. Depression was associated with suicide ideation, but not suicide behavior. PLEs may be an important risk factor for suicide ideation and behavior in 9 to 10-year-old children, comparable to adult and adolescent populations. When considering prevention of suicidality, these data suggest that considering the relations between PLEs, impulsivity and emotion dysregulation may be important.

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Compliance with Ethical Standards

Conflicts of Interest

T. Niendam is a co-founder and shareholder in Safari Health, Inc. The other authors have no conflicts of interest to declare

Ethics Approval

Institutional review board approval was obtained for each Adolescent Brain Cognitive Development (ABCD) Study site. Secondary approval for this analysis was given by the University of California institutional review board (1462784-1).

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Keywords

Suicide behavior; Suicide ideation; Psychotic like experiences; Impulsivity; Emotion Dysregulation

1 Introduction

Death by suicide in children aged 10–14 nearly tripled between 2007–2017, making it the second leading cause of death in youth aged 10–24 (Curtin & Heron, 2019), yet the underlying causes of suicide for young people remain unclear. In comparison to adults (Ertl et al., 2019), risk factors such as family relationships, bullying, impulsivity and emotion dysregulation have more of an impact on suicide risk for young people (Carballo et al., 2019; Ertl et al., 2019; Heffer & Willoughby, 2018; Sheftall et al., 2016). A deeper understanding of factors associated with suicide risk in children is vital for the development of effective early intervention and prevention strategies for suicide in youth.

Psychotic like experiences (PLEs) are common in childhood (Laurens et al., 2007) and may also increase the risk of suicidal thoughts and behaviors (Bromet et al., 2017). PLEs are experiences similar to positive psychosis symptoms, such as hearing whispers that are not there, but occur across the continuum of healthy and clinical populations (Van Os, Linscott, Myin-Germeys, Delespaul, & Krabbendam, 2009). In individuals with threshold psychotic symptoms, the highest risk for suicide exists in the earliest stages of psychotic illness (Nordentoft, Madsen, & Fedyszyn, 2015). While children are more likely to experience PLEs than full threshold psychosis, PLEs are also associated with an elevated risk of suicide. PLEs are associated with increased suicidal thoughts and behaviors in both adults (DeVylder, Lukens, Link, & Lieberman, 2015; Honings, Drukker, Groen, & van Os, 2016), and adolescents (Honings et al., 2016; Nishida et al., 2014; Yates et al., 2019). Other studies in adolescents suggest there may be a particular relationship between PLEs and suicide behavior but not ideation (Kelleher et al., 2014). The relationship between PLEs and childhood suicide ideation and behavior, however, is not well understood. Retrospective reports from adults aged 18–100 indicate a link between historical PLEs and suicide behavior (plans and suicide attempts) occurring before age 12 (Bromet et al., 2017), but this could be affected by recall bias. PLEs also appear to be more strongly associated with suicide ideation and behavior (plans and suicide attempts) in younger populations, when compared to older populations (Bromet et al., 2017). Despite this, to our knowledge, the relationship between suicide ideation or suicide behavior and PLEs has not been examined during childhood, as reported by children under 11. Given the prevalence of the general childhood population experiencing PLEs is higher than older populations, ranging from 4.7% to 35.3%, (Kelleher et al., 2012), and the relationship between PLEs and suicide is strongest for younger populations, this is an important literature gap.

To effectively reduce suicide risk in middle childhood, it is important to understand what additional factors may moderate the relationship between PLEs and suicide ideation and behavior that are specific to children. Two factors that may moderate the relationship between psychosis and suicide risk are emotion dysregulation (Grattan, Tully, Lesh, Carter,

& Niendam, 2019) and impulsivity (Nanda et al., 2016). These factors may be particularly important to a pediatric population experiencing PLEs, given young people's tendency to experience impulsive suicide attempts (Beckman et al., 2019) as well as alterations in emotion regulation as they approach adolescence (Cracco, Goossens, & Braet, 2017), and the possibility that PLEs are related to emotional dysregulation (Osborne, Willroth, DeVlyder, Mittal, & Hilimire, 2017). These factors are also of particular interest given they could be directly targeted with psychological and pharmacological interventions.

Emotion regulation is the maintenance of increasing and decreasing emotions, and the evaluation and modification of one's own emotional state (Gross & Jazaieri, 2014). Emotion dysregulation occurs when this process has been impaired, and is present across the psychosis spectrum (Grattan & Linscott, 2019; Kimhy et al., 2016). Emotion dysregulation is consistently linked to suicide outcomes, particularly in youth and adolescent populations (Heffer & Willoughby, 2018). Research on the link between suicide and emotion dysregulation is lacking in childhood populations; however some evidence suggests maladaptive responses to negative emotions in children are linked to suicide outcomes (Tamás et al., 2007). The link between emotion dysregulation and suicide for those experiencing psychosis spectrum symptoms is even less clear. Preliminary evidence suggests that emotion dysregulation is associated with suicide behavior in young adults with first episode psychosis (FEP; Grattan et al., 2019). Further, adults with more PLEs experience increased difficulties with emotion dysregulation and more maladaptive emotion regulation strategies (Osborne et al., 2017). Blair, Nitzburg, DeRosse, and Karlsgodt (2018) found similar patterns of emotion dysregulation in typically developing youth aged 10–21 with PLEs. Considering emotion dysregulation is common across the psychosis spectrum, and is associated with suicide outcomes in FEP, emotion dysregulation may also moderate suicide risk in those with PLEs. This is especially important to clarify in children, given that emotion dysregulation may play an important role in suicidal behavior for younger populations (Rajappa, Gallagher, & Miranda, 2012).

Impulsivity is common in those with psychotic disorders (Ouzir, 2013) and is associated with increased risk for suicide for these groups (Nanda et al., 2016), though this relationship is not clear for children. Importantly, impulsivity seems to have a particular impact on suicide risk for young people (Carballo et al., 2019). Beckman et al. (2019) found that younger adults (< 25) were more likely to have impulsive suicide attempts than their older counterparts (25+). In addition, studies have shown that children with ADHD are at an increased risk of suicide (Sheftall et al., 2016), possibly due to impulsive behaviors. Increased impulsivity is thought to lead to a more rapid transition between suicide ideation and behavior (such as suicide attempts) in adolescents (O'Brien, Nicolopoulos, Almeida, Aguinaldo, & Rosen, 2019). In relation to PLEs, Blair et al. (2018) found that positive PLEs were associated with impulsivity whereas negative PLEs were not in a sample of 10–21 year olds. Thus, experiencing high impulsivity in conjunction with PLEs may further increase suicide ideation and behavior risk in young people. Given that impulsivity is associated with difficulties in emotion regulation in young people (Hatkevich, Penner, & Sharp, 2019), emotion dysregulation and impulsivity may be two factors that are important to consider in conjunction when considering how PLEs are related to suicide ideation and suicide behavior. In addition, psychosis and depression are highly co-morbid (Fusar-Poli, Nelson, Valmaggia,

Yung, & McGuire, 2014), and so depression was included as a co-variate in the present study. No studies to our knowledge have examined the impact of both impulsivity and emotion dysregulation on the relationship between PLEs and suicide variables in children, and whether these factors are impactful beyond the effects of depression.

The present study aims to examine whether PLEs are associated with a history of suicide ideation and behavior in children aged 9 to 10, as well as examining whether emotion dysregulation and impulsivity moderate this relationship, using data from the Adolescent Brain Cognitive Development (ABCD) study. We hypothesize that (1) rates of historical suicide ideation and behavior will be higher in children experiencing higher rates of PLEs, (2) this relationship will remain when controlling for depressive symptoms and, (3) the relationship between suicide ideation and behavior and PLEs will be moderated by emotion dysregulation and impulsivity such that those experiencing high emotion dysregulation or impulsivity and PLEs will be more likely to report suicide ideation and behavior, (4) these relationships will be significant with and without controlling for depression.

2 Method

2.1 Participants

A sample of 11,875 individuals was obtained from the ABCD study. This is a large-scale study tracking children aged 9 to 10 years who were recruited from 22 research sites across the United States. Participants were excluded from ABCD study participation for the following reasons: child not fluent in English, MRI contraindication (e.g., irremovable ferromagnetic implants or dental appliances, claustrophobia, pregnant), major neurological disorder, gestational age less than 28 weeks or birthweight less than 1,200 grams, history of traumatic brain injury, or had a current diagnosis of schizophrenia, autism spectrum disorder (moderate, severe), mental retardation/intellectual disability, or alcohol/substance use disorder (Karcher et al., 2018). Of the 11,875 participants, 3.6% ($n = 423$) were missing data on variables of interest (see Table S1). The final sample included was 11,452 individuals aged 9 to 10.9 years (47.9% female, 35.0% reporting a minority race, 20.2% Hispanic). Participants removed from the final sample did not differ from included participants on PLE total scores, PLE distress scores, suicide ideation score, suicide behavior score, emotion dysregulation scores, impulsivity scores, sex at birth, financial adversity, or race; but a greater percentage reported being Hispanic ($p < 0.001$) and were younger ($p = 0.007$).

Data were accessed from the National Institutes of Mental Health Data Archive in October 2019. Institutional review board approval was previously obtained for each site. Parents and children provided written informed consent or assent.

2.2 Measures

2.2.1 Psychotic like experiences—Participants completed the Prodromal Questionnaire–Brief Child Version (PQ-BC) as described in (Karcher et al., 2018). This is a 21 item self-report questionnaire modified for use in 9–10 year olds that asks about prodromal psychotic like experiences (e.g., hearing whispers, seeing shadows) with a visual

response scale included as a distress scale. Both distress and total scores were calculated. The total score is a sum of the number of items endorsed (possible scores range from 0 to 21), and the distress score is the total number of endorsed items weighted by distress with possible scores ranging from 0 to 126 (a score of zero indicates no PLEs, each PLE reported is given a 1 + the score on the distress scale from 0–5); total and distress score correlation: $r = 0.813$; total score internal reliability: $\alpha = 0.863$, distress score internal reliability: $\alpha = 0.865$).

2.2.2 Depression and Suicide Measures—Previously described in Barch et al. (2018), parent and youth versions of the Kiddie-Structured Assessment for Affective Disorders and Schizophrenia (K-SADS) for DSM-5 were used to measure experiences of depression, suicide ideation and suicide behavior. For all K-SADS modules, participants were first administered a screening interview, then the supplement was administered if the participant was positive on the screening items. For participants not positive on the screener, the supplement items were assumed to be 0. For the depression module, the screening items included depressed mood, irritability, and anhedonia. We examined depression using summations of any current child rated depression symptoms, with possible scores ranging from 0 to 17. Given the high co-morbidity between those at risk for psychosis and depression (Fusar-Poli et al., 2014), depression score was included as a co-variate to rule out the impact of current depression on reporting of historical suicide and PLE factors, and to understand whether the relationship between suicide and PLE factors could be accounted for by current depression. We examined history of suicide ideation and behavior using child responses to the KSADS suicide questions. Suicide ideation was coded as present or absent, and included any of the following: passive suicide ideation (wishing you were dead), active non-specific suicide ideation (thoughts of killing oneself), active suicide ideation with a method (thoughts of killing oneself using a specific method), active suicide ideation with intent (thoughts and intent to kill oneself using a specific method) or active suicide ideation with intent and a plan (thoughts and intent to kill oneself using a specific method and a plan of doing so). Suicide behavior was coded as present or absent, and included any of the following: preparation behavior, aborted attempt (started to make an attempt but stopped oneself), interrupted attempt (started to make an attempt but someone or something else stopped oneself), or actual attempt (completed an attempt with the intent to die).

Analyses focused on youth reports of depression, suicide ideation and suicide behavior given that parental reports, particularly in families experiencing conflict, can differ significantly from youth reports (Klaus, Mobilio, & King, 2009). The internal reliability of youth reported depression items ($\alpha = 0.832$) and suicide ideation items ($\alpha = 0.700$) in this sample were acceptable. The internal reliability of youth reported suicide behavior was poor ($\alpha = 0.477$) indicating reporting one type of suicide behaviour was not related to reporting another type of suicide behaviour.

2.2.3 Impulsivity—Impulsivity was measured using the child-rated UPPS-P (negative urgency, premeditation [lack of], perseverance [lack of], sensation seeking, positive urgency) for Children Short Form (UPPS-P-CSF; ABCD version; (Watts, Smith, Barch, & Sher, 2019). This study focused on negative urgency, or the tendency to act impulsively to reduce

feelings of negative affect (Anestis & Joiner, 2011), as this has been the most consistently linked to suicide outcomes (Millner et al., 2018). The internal reliability of the negative urgency scale in this sample was acceptable ($\alpha = 0.629$).

2.2.4 Emotion Dysregulation—Emotion dysregulation was estimated using the emotional self-regulation score from the parent report form of the Child Behavior Checklist (Achenbach & Edelbrock, 1983). As in previous literature, emotion dysregulation was coded as a yes/no dichotomous variable, with youth considered to be emotionally dysregulated if their sum score on the Attention, Aggression and Anxious/Depressed subscales was between 180–210 (Biederman et al., 2012). This is thought to be a measure of deficits in self-regulating the physiological arousal caused by strong emotions (Biederman et al., 2012). This score profile was selected because the symptoms are congruent with the concept of emotional self-regulation. This score has predictive validity when identifying severe forms of mood and behavioral dysregulation in children with ADHD (Biederman et al., 2009), and in predicting later substance use and suicide behavior (Holtmann et al., 2011). In the present sample the internal reliability of these three scores was acceptable ($\alpha = 0.766$).

2.3 Statistical Analysis

Demographics and suicide variables were compared across youth with and without reported PLEs, and those included and excluded from the sample, using chi-square, Kruskal-Wallis, and Mann-Whitney U tests in SPSS version 25. For demographic comparisons, minority race and ethnicity were considered separately, but for modeling race and ethnicity was coded as one variable with two groups - white, non-Hispanic and born in the United States, compared to all others. Financial adversity was coded as a sum of endorsement to seven parent rated financial adversity questions as described in supplementary materials.

Remaining analyses were completed in R Studio (RStudio, 2015) using binomial hierarchical linear modeling in the lme4 package. Multiple comparisons were corrected for using a Benjamini and Hochberg false discovery rate of 0.05. Given the ABCD study included siblings, to account for non-independence of observations due to familial relatedness, family members were treated as clustered observations, as were the 22 ABCD research sites. All analyses were initially conducted with family unit and research site modeled as random intercepts. Age, sex at birth, financial adversity, race/ethnicity, and depression were included as covariates. As the majority of those experiencing suicide behavior also have experienced ideation, analyses of suicide behavior also controlled for suicide ideation. Models adjusted for co-variates are included in the text, and unadjusted models (models without co-variates) are included in supplementary materials as these were a poorer representation of the observed data as indicated by AIC values (Table S2). Given the statistical rarity of the dependent variable, models were too complex to converge when containing two random effects, the random effect that accounted for the most variance and produced the best model was retained (family). If variables were not normally distributed, as identified by visual inspection of histograms, they were log transformed. This was completed for PLE total and distress scores.

Hierarchical linear modeling first analyzed the associations between PLEs (total and distress scores modeled separately) and lifetime suicide ideation or suicide behavior (coded as present or not present) when controlling for sex at birth, ethnicity/race, financial adversity and age (with and without current youth reported depression symptoms). Next, we analyzed whether emotion dysregulation and impulsivity moderated the relationship between PLEs and suicide ideation or behavior by adding emotion dysregulation and impulsivity as interaction terms with PLEs, with and without current depression. Results were consistent using lifetime depression. Results are expressed as unstandardized estimates (B statistics) with 95% bootstrapped confidence intervals (1000 iterations), and odds ratios. Unstandardized estimates are given rather than standardized in order to be able to interpret the magnitude of change in each factor. Also presented are Akaike's information criterion (AIC) which provides an index of relative fit for models of a given dependent variable with different sets of predictor variables; a reduction of $AIC > 2$ can be considered as indicating an improvement in a models goodness-of-fit (Claeskens, 2016). The form of the interactions was determined by a combination of examining coefficients and graphical illustrations of the data.

3 Results

Sample demographics are presented in Table 1 and show 61.3% of the final sample reported a history of at least one psychotic like experience ($n = 7015$). A greater percentage of this group reported being male ($p = 0.003$), a minority race ($p < 0.001$), Hispanic ($p < 0.001$), reported suicide ideation and behavior ($p < 0.001$), reported financial adversities ($p < 0.001$) and were younger ($p < 0.001$).

Total PLE score and PLE distress score were associated with suicidal ideation in both adjusted and unadjusted models, as shown in Table 2 and Table S2. Youth who endorsed a 10% increase in total PLE score were at 8.5 greater odds of endorsing a history of suicide ideation. In addition, a 10% increase in PLE distress scores indicated youth were at 6.2 greater odds of endorsing a history of suicide ideation. Similarly, total PLE score and PLE distress score were also associated with suicide behavior in both adjusted and unadjusted models. Youth who endorsed a 10% increase on the total PLE score were at 6.2 times greater odds of reporting a history of suicide behavior. Youth reporting a 10% increase in PLE distress score were at 5.2 greater odds of reporting a history of suicide behavior. Depression was also associated with suicide ideation and behavior, but addition of depression to the models did not change the pattern of significant results.

Adding impulsivity and emotion dysregulation as moderating factors to all of the models resulted in a better representation of the observed data, as indicated by AIC values. Impulsivity and emotion dysregulation were associated with suicide ideation when controlling for PLE total score in both adjusted and unadjusted models, as displayed in Table 3 and Table S2. Youth reporting a one unit increase in impulsivity score were at 1.25 greater odds of reporting a history of suicide ideation, and youth who were high in emotion dysregulation were at 2.92 greater odds of reporting a history of suicide ideation when considering PLE total scores. Only impulsivity interacted with PLE total score to associate with ideation, in both adjusted and unadjusted models, as displayed in Table 3 and Table S2.

While higher PLE total scores were associated with a higher likelihood of reporting a history of suicide ideation as expected, variation in suicide ideation due to impulsivity scores was higher for lower PLE total scores (shown in Figure 1). For a 10% increase in PLE total score, when impulsivity scores are 0, youth are at 9 times greater odds of reporting suicide ideation; however when impulsivity scores are 10, youth are 8 times greater odds of reporting suicide ideation.

For PLE distress scores, the pattern of significant main and interaction effects for both adjusted and unadjusted models was primarily the same as for PLE total scores (Table 3). However, emotion dysregulation additionally did interact with PLE distress score to predict suicide ideation history in both adjusted and unadjusted models. Those in the high emotion dysregulation group were more likely to report suicide ideation than those in the low dysregulation group, but only if they also reported low PLE scores. For those with higher PLE scores there was no difference in suicide ideation between groups. Regardless of emotion dysregulation, higher PLE scores were associated with a higher likelihood of reporting a history of suicide ideation. The moderation effects are shown in Figure 2. AIC values suggest little difference in goodness-of-fit for models predicting suicide ideation when comparing the PLE total versus distress scores. When controlling for emotion dysregulation and impulsivity all of the models, the association with depression remained for suicide ideation but not behavior.

With PLE total scores, impulsivity was associated with a higher likelihood of reporting a history of suicide behavior; emotion dysregulation was not associated with suicide behavior (Table 3). These effects were significant for both unadjusted models and adjusted models. Youth reporting a one unit increase in impulsivity score were at 1.40 greater odds of reporting a history of suicide behavior. Interestingly, neither emotion dysregulation nor impulsivity moderated the association between PLE total score and suicide behavior in the adjusted models. When considering PLEs distress scores the pattern of significant main and interaction effects was primarily the same as the pattern for PLE total scores for both adjusted and unadjusted models, with PLE distress models predicting suicide behavior being a better representation of the observed data than the PLE total models. Within the unadjusted models (see Table S2), emotion dysregulation was significantly associated with suicide behavior for both the PLE total and PLE distress models. Notably, while the association remained significant when each of the covariates was added individually, the strength of the association reduced when including either financial adversity or race/ethnicity in the model. In addition, the interaction between impulsivity and PLE total was also significantly associated with suicide behavior, consistent with the adjusted results for suicide ideation (Table S2). This association remained significant when covariates were added individually.

4 Discussion

Suicide rates are increasing in younger children, and understanding factors that contribute to childhood suicide is vital. This is the first study, to our knowledge, to examine how PLEs are associated with suicide ideation and behavior in middle childhood. As predicted, findings indicated that children aged 9–10 with a history of PLEs are more likely to report a history of suicide ideation and behavior, consistent with research examining adults retrospective

reports (Bromet et al., 2017). This relationship was beyond the association with depression alone, supporting evidence in adolescents and adults (DeVylder et al., 2015; Honings et al., 2016; Nishida et al., 2014). However, these results do not support findings from at least one previous study in adolescents (Sullivan et al., 2015), which found depression to be a stronger predictor of suicide behavior than PLEs. Our data suggests that PLEs relate to suicide independently from their relationship to depression in middle childhood. When controlling for emotion dysregulation and impulsivity, the impact of depression remained for suicide ideation but not behavior, indicating depression symptoms may be less relevant than dysregulated behavior or impulsivity when predicting suicide behavior in middle childhood.

As predicted, impulsivity and emotion dysregulation were associated with suicide ideation, and impulsivity was associated with suicide behavior in middle childhood. This is in keeping with findings that emotion dysregulation is related to suicide ideation in adolescents (Heffer & Willoughby, 2018), and that impulsivity is related to suicide ideation and behavior in young people (Carballo et al., 2019). This data builds on past findings suggesting impulsivity is particularly important to consider for youth suicide prevention (Beckman et al., 2019). However, our study did not find evidence for a relationship between emotion dysregulation and suicide behavior, unlike past findings in young adults with FEP (Grattan et al., 2019). When co-variables were removed from the models, emotion dysregulation was associated with suicide behavior. In particular, financial adversity or race/ethnicity appeared to explain some of the variance within this relationship. It may be that those of a minority race and/or ethnicity, or those experiencing financial adversity are more likely to experience both suicide behavior and emotion dysregulation. Additionally, the lack of a significant finding when co-variables are included could be attributed to low statistical power, given the relatively low rates of suicide behavior reported during middle childhood.

The relationship between PLE total score and suicide ideation was moderated by impulsivity in the present study, while the relationship between PLE distress score and suicide ideation was moderated by both impulsivity and emotion dysregulation. Emotion dysregulation may be more relevant to the relationship between PLE distress scores and suicide ideation because the ability to regulate one's emotional response to PLEs might contribute more to the distress one experiences. Interestingly, variation in suicide ideation due to impulsivity and emotion dysregulation appears to be strongest when people are experiencing low levels of or no PLEs. One interpretation of this finding is that while emotion dysregulation and impulsivity are associated with suicide ideation, if children are experiencing PLEs, this has such a substantial impact on suicide ideation that variation in dysregulation and impulsivity may be less important. This finding adds to other literature that found PLEs in young people are associated with suicide ideation above and beyond the effect of other predictors such as co-morbid mental health symptoms, trauma and substance use (Capra, Kavanagh, Hides, & Scott, 2015; Nishida et al., 2010; Yates et al., 2019). In addition, for those who are less impulsive or dysregulated, experience of PLEs is more influential in terms of suicide ideation. More specifically, for children who are well regulated in general, high distress from PLEs may indicate an unusual and impactful experience. In contrast, highly dysregulated children likely experience distress in many areas and thus PLE distress may not be as consequential. However, this finding differs from research in young adults experiencing psychotic symptoms, where emotion dysregulation is associated with increased suicide

ideation (Grattan et al., 2019; Palmier-Claus, Taylor, Gooding, Dunn, & Lewis, 2012), and thus this finding may be specific to children or psychotic-like experiences. Findings will need to be further examined longitudinally.

Unexpectedly, the relationship between PLEs and suicide behavior was not moderated by emotion dysregulation or impulsivity. This suggests a young person's emotion dysregulation and impulsivity may be more important when considering how PLEs are associated with suicide ideation. However, this finding may also be due to power issues given the relative rarity of suicide behavior compared to ideation. Supporting this idea, the interaction between PLE total score and impulsivity was significantly associated with suicide behavior when covariates were removed. It is also possible that the type of impulsivity or emotion dysregulation may be relevant. For example, self-reported impulsivity is distinct from laboratory measures such as response inhibition (Friedman et al., 2020) and these predict different types of psychopathology. Follow-up studies could examine whether alternative types of impulsivity or emotion dysregulation moderate the relationship between PLEs and suicide behavior.

These results have important implications when considering suicide prevention in children. Primarily, screening for PLEs in middle childhood may highlight a group who are at risk for suicide ideation and behavior. This group will be important to monitor, and may be a useful population to target with preventative therapy efforts to prevent later suicide attempts and deaths by suicide. It is note-worthy that 61.3% of 9–10 year olds reported at least one PLE. This highlights how common these experiences are in young people, and thus the importance of monitoring the contribution of PLEs to negative outcomes such as suicide. However, given the high prevalence of PLEs, distinguishing between normative healthy experiences and more clinically-relevant PLEs will be essential. Interestingly, the findings indicate it may be particularly important to measure PLEs for children that are generally functioning well (i.e. are not impulsive or dysregulated). Emotion dysregulation and impulsivity may also be useful to screen for and treat in order to prevent suicide ideation, particularly for youth who are not experiencing PLEs. Given emotion dysregulation and depression were not related to suicide behavior when controlling for these other factors, targeting PLEs, suicide ideation or impulsivity may be the most helpful for preventing suicide behavior in young people.

A particular strength of this study was that it included a large demographically diverse sample of 9 to 10-year-olds. However, as with all studies the findings should be considered within the context of certain methodological limitations. Firstly, these results are examining cross-sectional relationships between the variables of interest. The temporal ordering of PLEs and suicide variables is currently unclear due to the use of historical lifetime reports. In order to better understand how to prevent suicide in children, longitudinal modeling of these relationships will be a useful next step. Being able to predict suicide ideation and behavior using emotion dysregulation, impulsivity and PLEs will indicate the importance of these variables for prevention treatment development. Secondly, given the relative rarity of suicide ideation and behavior outcomes in this large sample, statistical modeling was unable to account for both random effects of site and family due to convergence issues. Instead, the model using the random effect that explained the most variance was used. It is important to

consider the rarity of these factors when considering replicability of the study findings. Further research with other samples and older age groups (when suicide behavior is more common; (Curtin & Heron, 2019) will be important to support these findings, particularly in examining which factors are associated with suicide behavior. Thirdly, other possible moderators and mediators of this relationship were not considered here. Other developmental factors such as family stress or bullying may be important to consider in the relationship between PLEs and suicidality in children.

To our knowledge, this is the first study to examine if PLEs are associated with suicide ideation and behavior in middle childhood (ages 9 and 10), and whether other factors such as impulsivity and emotion dysregulation moderate this association. Presented is preliminary evidence that, as in adults and adolescents, PLEs are associated with reports of suicide ideation and behavior in children. When the impact of emotion dysregulation and impulsivity was also considered, both were found to independently associate with suicide ideation, but were less important for children experiencing greater PLEs. Emotion dysregulation was not related to suicide behavior, however impulsivity and PLEs were. Clinically this suggests understanding relationships between PLEs, emotion dysregulation, and impulsivity in younger children may assist development of suicide prevention procedures.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Data used in the preparation of this article were obtained from the Adolescent Brain Cognitive Development (ABCD) Study (<https://abcdstudy.org>), held in the NIMH Data Archive (NDA). This is a multisite, longitudinal study designed to recruit more than 11,500 children age 9-10 and follow them over 10 years into early adulthood. The ABCD Study is supported by the National Institutes of Health and additional federal partners under award numbers U01DA041022, U01DA041025, U01DA041028, U01DA041048, U01DA041089, U01DA041093, U01DA041106, U01DA041117, U01DA041120, U01DA041134, U01DA041148, U01DA041156, U01DA041174, U24DA041123, and U24DA041147. A full list of supporters is available at <https://abcdstudy.org/nih-collaborators>. A listing of participating sites and study investigators can be found at <https://abcdstudy.org/principal-investigators.html>. ABCD consortium investigators designed and implemented the study and/or provided data but did not necessarily participate in analysis or writing of this report. This manuscript reflects the views of the authors and may not reflect the opinions or views of the NIH or ABCD consortium investigators. The ABCD data repository grows and changes over time. The data used in this report came from DOI [10.15154/1460410](https://doi.org/10.15154/1460410).

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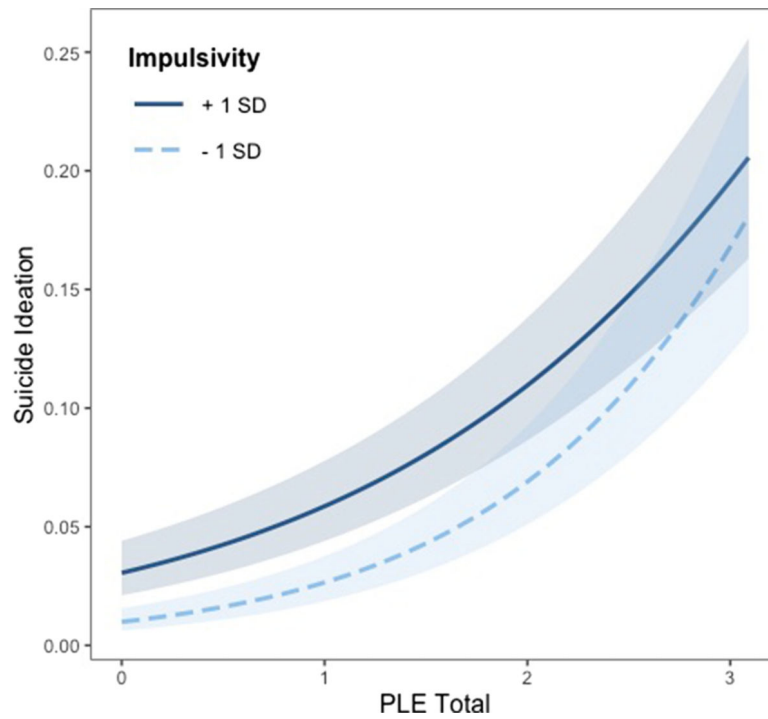


Fig. 1. Association between likelihood of reporting suicide ideation and total psychotic like experiences moderated by impulsivity. Note: PLE Total indicates psychotic like experiences total score on log-transformed scale. Figure indicates that variation in suicide ideation due to impulsivity is less apparent for those with higher PLE total scores.

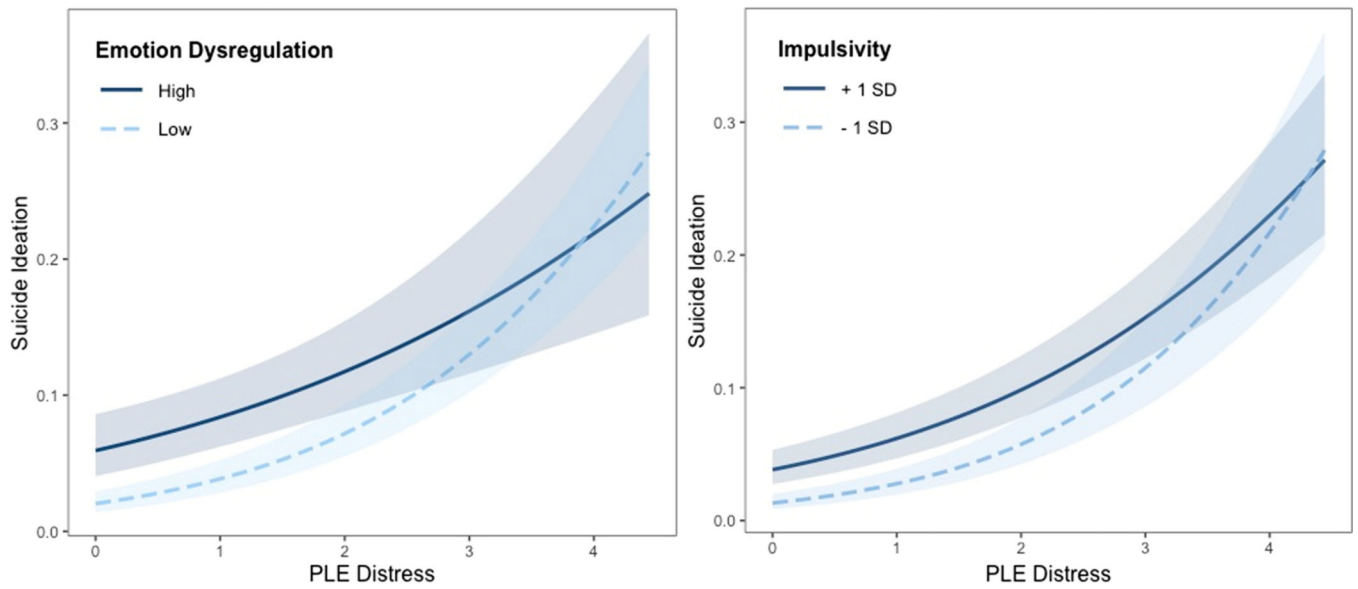


Fig. 2.

Association between likelihood of reporting suicide ideation and distressing psychotic like experiences moderated by emotion dysregulation or impulsivity. Note: PLE Distress indicates psychotic like experiences distress score on log-transformed scale. Figure indicates that variation in suicide ideation due to emotion dysregulation and impulsivity is less apparent for those with higher PLE distress scores.

Table 1Demographic characteristics of the subsample $N = 11452$

		PLE reported ($n = 7015$)	No PLE reported ($n = 4437$)
Sex *	Female	3282 (46.8%)	2204 (49.7%)
Race ^	Caucasian *	4963 (70.7%)	3571 (80.5%)
	African American *	1719 (24.5%)	704 (15.9%)
	Asian *	403 (5.7%)	318 (7.2%)
	American Indian or Alaska Native *	283 (4.0%)	106 (2.4%)
	Native Hawaiian or Pacific Islander	45 (0.6%)	28 (0.6%)
	Other *	536 (7.6%)	215 (4.8%)
Ethnicity *	Hispanic	1539 (21.9%)	775 (17.5%)
Suicide *	Ideation only	625 (8.9%)	114 (2.6%)
	Behavior and Ideation	128 (1.8%)	15 (0.3%)
Age *	Mean years (SD)	9.90 (0.62)	9.94 (0.63)
SES *	Mean financial adversity score (SD)	0.55 (1.18)	0.34 (0.93)

* Groups significantly differed after controlling for multiple comparisons

^ Participants could identify as more than one race

PLE = Psychotic like experiences, SES = Socioeconomic status

Table 2

Models predicting suicide ideation and behavior from PLEs total score, controlling for depression

Dependent Variable	B [95% CI]	AOR	P-Value	AIC
<u>Suicide Ideation</u>				5642.5
PLEs (total) [#]	0.86 * [0.75, 0.99]	2.36	< 0.001	
<u>Depression</u>	0.17 * [0.11, 0.22]	1.19	< 0.001	
<u>Suicide Behavior</u>				907.1
PLEs (total) [#]	0.63 * [0.28, 1.01]	1.88	0.002	
Depression	0.15 * [0.03, 0.28]	1.16	0.021	
<u>Suicide Ideation</u>	5.67 * [4.38, 7.05]	290.03	< 0.001	
<u>Suicide Ideation</u>				5655.7
PLEs (distress) [#]	0.63 * [0.55, 0.73]	1.88	< 0.001	
<u>Depression</u>	0.15 * [0.10, 0.21]	1.16	< 0.001	
<u>Suicide Behavior</u>				899.9
PLEs (distress) [#]	0.53 * [0.28, 0.88]	1.70	< 0.001	
Depression	0.13 [-0.01, 0.26]	1.14	0.047	
<u>Suicide Ideation</u>	5.60 * [4.38, 7.41]	270.43	< 0.001	

B = unstandardized co-efficient

AOR = Adjusted odds ratio; models control for age, sex at birth, financial adversity and ethnicity/race

AIC = Akaike information criterion; this provides an indication of model goodness of fit and can be used to compare models with the same dependent variable but different set of independent variables.

[#] Values are log transformed

* Value was significant when controlling for multiple comparisons with a .05 false discovery rate.

PLE = Psychotic like experiences

Table 3

Full models predicting suicide ideation and behavior from PLEs total score, controlling for depression

Dependent Variable	B [95% CI]	AOR	P-Value	AIC
<u>Suicide Ideation</u>				5508.7
PLEs (total) [#]	0.87 * [0.75, 1.00]	2.39	< 0.001	
Impulsivity	0.22 * [0.17, 0.27]	1.25	< 0.001	
Emotion Dysregulation	1.07 * [0.64, 1.44]	2.92	< 0.001	
Depression	0.14 * [0.09, 0.19]	1.15	< 0.001	
PLEs [#] * Impulsivity	-0.06 * [-0.09, -0.03]	0.94	< 0.001	
<u>PLEs[#] * Emotion Dysregulation</u>	-0.25 [-0.47, 0.01]	0.78	0.04	
<u>Suicide Behavior</u>				875.6
PLEs (total) [#]	0.57 * [0.18, 1.07]	1.77	0.009	
Impulsivity	0.34 * [0.14, 0.60]	1.40	0.003	
Emotion Dysregulation	0.61 [-0.68, 1.92]	1.84	0.317	
Depression	0.09 [-0.02, 0.20]	1.09	0.118	
Suicide Ideation	5.03 * [4.08, 6.95]	152.93	< 0.001	
PLEs [#] * Impulsivity	-0.08 [-0.21, 0.02]	0.92	0.148	
<u>PLEs[#] * Emotion Dysregulation</u>	0.32 [-0.31, 1.02]	1.38	0.339	
<u>Suicide Ideation</u>				5510.1
PLEs (distress) [#]	0.66 * [0.57, 0.76]	1.93	< 0.001	
Impulsivity	0.21 * [0.16, 0.26]	1.23	< 0.001	
Emotion Dysregulation	1.11 * [0.75, 1.46]	3.03	< 0.001	
Depression	0.13 * [0.08, 0.18]	1.14	< 0.001	
PLEs [#] * Impulsivity	-0.05 * [-0.07, -0.03]	0.95	< 0.001	
<u>PLEs[#] * Emotion Dysregulation</u>	-0.28 * [-0.46, -0.11]	0.76	0.001	
<u>Suicide Behavior</u>				871.4
PLEs (distress) [#]	0.42 * [0.14, 0.77]	1.52	0.004	
Impulsivity	0.22 * [0.06, 0.43]	1.25	0.012	
Emotion Dysregulation	0.85 [-0.27, 1.86]	2.34	0.089	
Depression	0.07 [-0.04, 0.19]	1.07	0.246	
Suicide Ideation	4.97 * [4.10, 6.77]	144.03	< 0.001	
PLEs [#] * Impulsivity	-0.02 [-0.09, 0.07]	0.98	0.679	
<u>PLEs[#] * Emotion Dysregulation</u>	0.15 [-0.25, 0.65]	1.16	0.512	

B = unstandardized co-efficient

AOR = Adjusted odds ratio; models also control for age, sex at birth, financial adversity and ethnicity/race

AIC = Akaike information criterion; this provides an indication of model goodness of fit and can be used to compare models with the same dependent variable but different set of independent variables.

* Value was significant when controlling for multiple comparisons with a .05 false discovery rate.

Values are log transformed

PLE = Psychotic like experiences

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