

Early Childhood Sleep Problems Predict Increased Risk for the Later Development of Suicidal Thoughts

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Suicidal thoughts and behaviors in youth are an escalating and immediate public health concern. To better understand youth suicidal thoughts and behaviors, it is important to identify risk factors in early childhood that predict the later emergence of youth suicidal thoughts and behaviors. Research with adults and adolescents has identified sleep disturbances as a risk factor for suicidal thoughts and behaviors, but this has yet to be examined in early childhood. Using a prospective, 17-year longitudinal design, the current study explored the association between early childhood sleep disturbances and concurrent and later suicidal thoughts and behaviors (in separate models) across childhood and adolescence. Results indicate that sleep problems in early childhood are associated with increased probability for suicidal thoughts after age 8, even when controlling for prior and concurrent depression severity. Our findings suggest that early childhood sleep difficulties warrant increased clinical attention and management, as they may contribute to the maintenance and exacerbation of suicidal thoughts over time.

General Scientific Summary

This study found that children with sleep problems in early childhood were at increased risk for experiencing suicidal thoughts and behaviors in childhood and adolescence. These results highlight the need for increased clinical attention to and management of sleep problems in young children as possible early predictors of risk for later suicidal thoughts and behaviors.

Keywords: early childhood, sleep, suicidal thoughts and behaviors

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Suicidal thoughts and behaviors in youth are an escalating and immediate public health concern (American Academy of Pediatrics, American Academy of Child and Adolescent Psychiatry, & Children's Hospital Association, 2021). Rates of suicide in youth are rising (Curtain & Heron, 2019), and by ages 9–10 estimated rates are 6.4% for passive suicidal ideation (i.e., a wish to be dead), 6.8% for active suicidal ideation (i.e., wanting to end one's

life), and 1.3% for suicide attempts (DeVilleville et al., 2020). Although little is known about the emergence of early suicidal thoughts and behaviors, there is evidence that suicidal thoughts and behaviors can present as early as the preschool period (Luby et al., 2019; Whalen et al., 2015). Recent longitudinal work demonstrated two developmental trajectories of childhood suicidal thoughts and behaviors—one characterized by suicidal thoughts

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and behaviors that are first exhibited in early childhood and increase throughout adolescence and a second characterized by low rates of suicidal thoughts and behaviors through age 10 followed by a sharp increase in early adolescence (Whalen et al., 2021). Risk factors implicated in childhood suicide death include parent and child history of suicidal thoughts and behaviors and psychopathology as well as family conflict (Sheftall et al., 2016). However, these risk factors have been found to have poor predictive value of later suicidal thoughts and behaviors. It is thus of pressing importance to identify additional, developmentally relevant risk factors in early childhood that predict the emergence of suicidal thoughts and behaviors across childhood. This will enable us to better understand the etiology of childhood suicidal thoughts and behaviors and could help to inform early intervention efforts aimed at reducing risk for suicidal thoughts and behaviors.

Although unexplored in the early childhood literature, research focused on both youth and adults has explored sleep disturbances as a risk factor for suicidal thoughts (Littlewood et al., 2019; Liu et al., 2020; Pigeon et al., 2012) and behaviors (Littlewood et al., 2019; Liu et al., 2020; Pigeon et al., 2012). Sleep disturbances include both diagnosed sleep disorders (e.g., insomnia, parasomnias) as well as variations in sleep parameters that may lead to maladaptive outcomes (e.g., not getting enough sleep, high levels of daytime sleepiness, etc.), determined both objectively (e.g., using an actigraph) or subjectively (i.e., based on an individual's perception of their sleep). In adults, meta-analytic evidence suggests that sleep problems are associated with increased risk for suicidal ideation, suicide attempts, and suicide death (Pigeon et al., 2012), with further evidence from prospective studies with adults suggesting that sleep problems predict increased risk for later suicidal ideation (Harris et al., 2020; Liu et al., 2020), suicide attempts (Harris et al., 2020; Liu et al., 2020), and suicide death (Liu et al., 2020). Studies using Ecological Momentary Assessment (EMA) procedures with adults have further identified that on a day-to-day basis, sleep problems significantly predict next day suicidal ideation, whereas suicidal ideation *does not* predict next day sleep problems (Littlewood et al., 2019). These findings suggest a directional association, in which sleep problems lead to increased suicidal thoughts and behaviors in the short term (i.e., on a daily basis; Bernert et al., 2017; Littlewood et al., 2019), and also over longer periods of time (e.g., over months and years; Liu et al., 2020).

The association between sleep disturbances and suicidal thoughts and behaviors is also present in youth (Kearns et al., 2020), with studies focused on older children and adolescents finding that increased sleep problems are associated with higher risk for concurrent suicidal thoughts (Asarnow et al., 2020; Lopes et al., 2016) and behaviors (Lopes et al., 2016; Nrugham et al., 2008), as well as later suicidal thoughts (Wong et al., 2011) and behaviors (Nrugham et al., 2008; Wong et al., 2011). As in the adult literature, research with youths using EMA protocols suggests that subjectively-reported sleep problems in adolescents at high risk for suicidal thoughts and behaviors predict next day suicidal thoughts (Glenn et al., 2021). Similar to findings with adults (i.e., Harris et al., 2020), evidence suggests that sleep problems in youth may be more predictive of self-harm and suicidal ideation in the short-term (i.e., days to months later) than in the long-term (i.e., multiple months or years later; Asarnow et al., 2020; Harris et al., 2020), highlighting the utility of sleep disturbances as an

acute and proximal predictor of suicidal thoughts. Indeed, the evidence for an association between sleep and suicidal thoughts and behaviors has been compelling enough that sleep disturbances are included on the list of consensus warning signs of suicide risk by the American Association of Suicidology (American Association of Suicidology, 2020).

There are a number of possible mechanisms that might underlie associations between sleep and suicidal thoughts and behaviors. Research indicates that negative affect follows a circadian rhythm, with the height of negative affect occurring during nighttime hours (Emens et al., 2020). This may partially explain the association between sleep disturbances and suicidality, as individuals who are awake during the circadian night, potentially owing to circadian preference (i.e., eveningness/night owls), inability to fall/stay asleep, or work schedules, experience more negative affect, which could in turn contribute to increased suicidality and mood disturbances (Emens et al., 2020). Support for this pathway has also been found in youths, as 12- to 18-year-olds at high risk for suicide and self-harm show an overwhelming evening circadian preference (Asarnow et al., 2020). Additionally, sleep problems may directly affect the neurobiological pathways that are implicated in suicide risk (Goldstein & Franzen, 2020). More specifically, sleep problems are thought to lead to deficits in higher-order cognitive functions, including cognitive flexibility and decision making, as well as emotional reactivity and regulation processes (Astill et al., 2012; Palmer & Alfano, 2017; Turnbull et al., 2013; Van Dongen et al., 2003). Because both executive functioning deficits and increased emotional reactivity/dysregulation have been linked with risk for suicide behaviors (Esposito et al., 2003; Zlotnick et al., 2003), sleep problems may be a catalyst of risk for suicidal thoughts and behaviors through these pathways (Goldstein & Franzen, 2020; Kearns et al., 2020). Such pathways may be even more meaningful during developmental periods in which executive functioning and emotional reactivity/regulation are rapidly developing, and this has often led researchers to focus on the association between sleep disturbances and suicidality in adolescence (Goldstein & Franzen, 2020). Because early childhood is also an era of rapid neurodevelopment (Brown & Jernigan, 2012), sleep problems in this era may have lasting effects on the developmental trajectory of executive functioning and emotional regulation. Additionally, critical skills, including socioemotional abilities, self-regulation, and foundational cognitive abilities show rapid development across early childhood. Because these skills can be disrupted by sleep disturbances (Bernier et al., 2013; Breitenstein et al., 2021; Vaughn et al., 2015), and disruptions/deficits in these skills may also confer risk for later suicidal thoughts and behaviors (Ayer et al., 2020; Cha et al., 2018), these skills may reflect a candidate pathway through which sleep disturbances confer risk for later suicidal thoughts and behaviors. Given this, research is warranted to explore how sleep problems in early childhood affect both concurrent and later suicidal thoughts and behaviors. Although several studies have included children as young as 6 and 7 years (Lopes et al., 2016; Meir et al., 2019), to our knowledge, no research has focused explicitly on sleep disturbances in early childhood as a predictor of concurrent or later suicidal thoughts and behaviors. To address this gap, the current study prospectively examined how sleep problems during the preschool period put children at increased risk for experiencing both concurrent and later suicidal thoughts and behaviors, with the potential to identify

a marker that predicts the emergence of suicidal thoughts and behaviors in childhood.

Using a prospective, longitudinal sample enriched for early childhood depression, the current study explored the association between early childhood sleep and concurrent and later suicidal thoughts and behaviors. Our prospective study design, which included regular follow-up assessments throughout childhood and adolescence, addresses an important gap in the literature on the association between sleep disturbances and later suicidal thoughts and behaviors over these formative developmental periods. Moreover, our analyses control for depression (a known comorbidity with both sleep disturbances and suicidal thoughts and behaviors) in both early childhood (concurrent analysis) and in later childhood/adolescence (concurrent and prospective analysis). This enabled us to examine the predictive utility of early sleep problems for later suicidal thoughts and behaviors above and beyond established associations between sleep problems and depression. Early childhood sleep was quantified using parent-reports on a semistructured interview that assessed a variety of sleep behaviors, including total sleep times, bedtimes, sleep regularity, etc. Given prior studies demonstrating sleep problems as a predictive risk factor for suicidal thoughts and behaviors in adolescents and adults, we expected that sleep problems in early childhood would be associated with increased suicidal thoughts and behaviors in early childhood. Additionally, given research suggesting that sleep problems may developmentally precede suicidal thoughts and behaviors, we also expected early sleep problems to predict later suicidal thoughts and behaviors, even when controlling for depression. Such findings would demonstrate the utility of early sleep disturbances to serve as a predictor of risk for concurrent and later suicidal thoughts and behaviors. Previous research with older samples has explored how specific domains of sleep disturbances, including insomnia (Goldstein et al., 2008; Lopes et al., 2016; Wong et al., 2016), variability in sleep schedules (Bernert et al., 2017), and late bedtimes (Gangwisch et al., 2010), are associated with suicidal thoughts and behaviors. However, given the unique features of sleep disturbances in early childhood, we opted to broadly examine a composite measure reflecting sleep disturbances across domains. Because we did not feel there was sufficient evidence to make specific hypotheses regarding which sleep behaviors would be associated with suicidal thoughts and behaviors, we performed follow-up, exploratory analyses to examine links between suicidal thoughts and behaviors and specific sleep behaviors. Additionally, because little is known about how suicidal thoughts and behaviors relate to the various domains of sleep disturbances in early childhood, in the current study, we opted to examine a broad array of domains of sleep disturbances (e.g., sleep duration, sleep regularity), including those especially relevant to young children (e.g., bedtime resistance, reluctance to sleep alone).

Method

Participants

Participants included children enrolled in the Preschool Depression study (PDS; Luby et al., 2009). The PDS is a prospective, 17-year longitudinal study conducted by the Early Emotional

Development Program at Washington University School of Medicine (WUSM). The study was designed to investigate the longitudinal course of preschool-onset depression (see Figure 1 for overview). Parental consent and child verbal assent were obtained prior to study participation, and parents and children were re-consented at each subsequent study wave. The WUSM Institutional Review Board approved all procedures in accordance with institutional ethical guidelines. At Time 1 (baseline), children between 3 and 6 years of age ($M = 4.45$ years, $SD = .80$) and their primary caregivers were recruited from daycares, preschools, and primary care offices. The Preschool Feelings Checklist (Luby et al., 2004) was used to oversample for children who had higher levels of depression symptoms and those who had elevated disruptive behavior problems; children with no symptoms were also included for comparison. Children participated in up to 10 diagnostic/developmental assessments that occurred on a semiregular basis (between 1 and 3 years) from preschool through late adolescence (most recent data collection ages 15.3–21.7 years, $M = 18.6$ years).

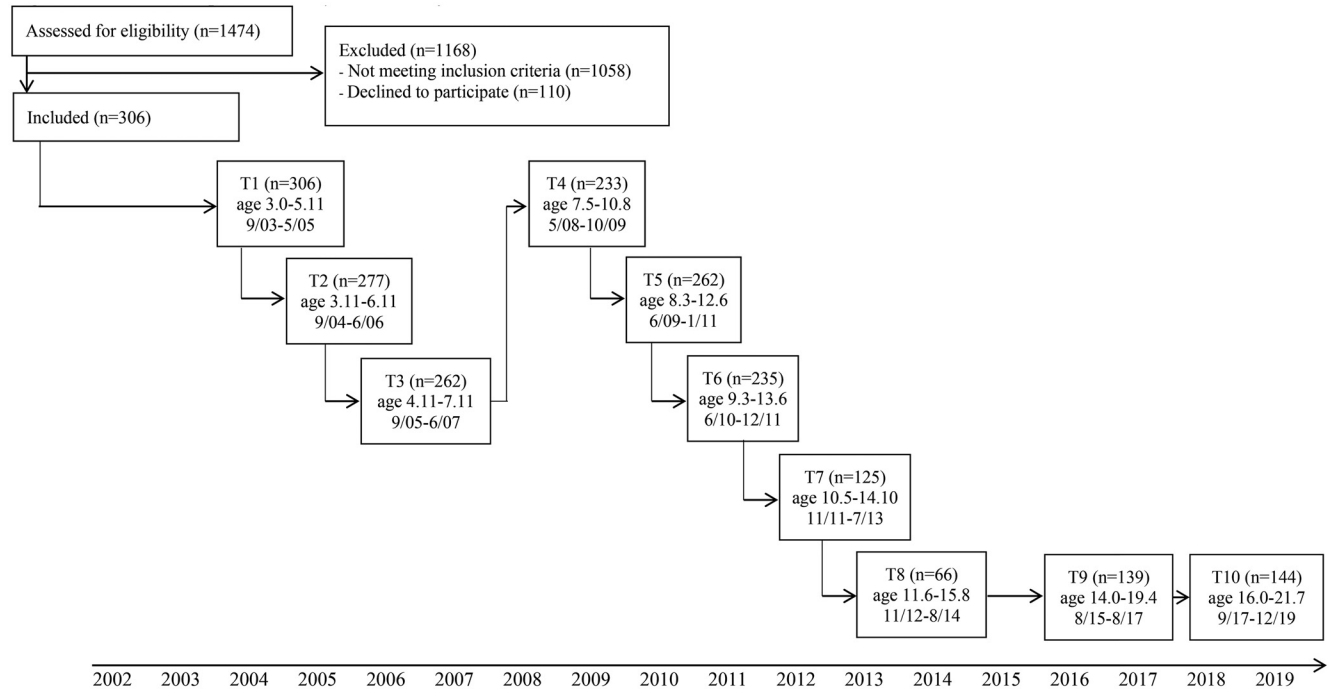
The current study focused on children whose parents reported on their sleep behaviors during at least one developmental assessment wave prior to age 8 years and who had at least one assessment in which suicidal thoughts and behaviors were assessed. This enabled us to use data from all 306 children who participated in the early childhood phase of PDS. This final sample was 48.4% female, 53.6% White (33.3% Black, 13.1% other race) and had an average income-to-needs ratio of 2.06 ($SD = 1.18$, range 0 – 3.93; indicating an average family income just over twice the federal poverty line at the first assessment). Missingness at wave of assessment is detailed in Figure 1. Additional details about study missingness at each wave is also included in Table S1 in the online supplemental materials, including an exploration of whether missing data at each age was due to demographic characteristics (e.g., sex, race, income-to-needs ratio). Study missingness was associated with income-to-needs ratio at baseline ($-.40 < \text{Cohen's } d < -.31$), such that families with lower income-to-needs ratios were more likely to have missing data at earlier waves and were less likely to have missing data at later waves ($.26 < \text{Cohen's } d < .31$).

Measures

Early Childhood Sleep

Sleep in early childhood was assessed using the sleep behaviors module of the Preschool-Age Psychiatric Assessment (PAPA; Egger et al., 2003). The PAPA is a reliable, parent-informant measure that consists of a series of developmentally-appropriate questions assessing the *DSM-IV* criteria for childhood disorders (Egger et al., 2006). The PAPA was administered in-person by trained staff during the developmental assessment waves that occurred prior to age 8 years. Each child's parent participated in between two and four PAPA assessments (14% had two assessments, 57% had three assessments, and 6% had four assessments) during early childhood. PAPA interviews were audiotaped, reviewed for reliability, and calibrated for accuracy using methods previously described (Luby et al., 2009). Raters were trained to reliability and blind to the child's previous diagnostic status. To prevent coder drift, calibration of interviews by master raters for 20% of each

Figure 1
Preschool Depression Study Assessment Flow Chart



interviewer's cases were implemented in consultation with an experienced clinician (J.L.L.) at each study wave in keeping with standard practice for this measure.

The PAPA includes a comprehensive module focused on sleep behaviors that has been used in prior sleep research (Alfano et al., 2013; Whalen et al., 2017; Willoughby et al., 2008). From the sleep behavior module, 11 variables representing commonly-assessed aspects of sleep (e.g., nighttime sleep duration, sleep regularity) were derived. These variables are described in Table 1. We also created a composite sleep index representing overall sleep problems by averaging the standardized scores of each of the 11 sleep variables. This composite

sleep index was scored such that higher scores indicated more problematic sleep. Sleep was assessed at each developmental assessment during which the PAPA was administered, ranging from 2–4 assessments per child occurring between the ages of 3.0–7.9 years. The *maximum score* for each sleep variable across the various waves was used in analysis and in the computation of the composite sleep index. Maximum scores were chosen to characterize the most severe exposure to sleep disturbances during the child's early life. The number of children with a maximum score at each study time point for each PAPA sleep variable is included in Table S3 in the online supplemental materials.

Table 1
Variable Description and Descriptive Statistics for Sleep Variables

Variable	Variable description	<i>M</i>	<i>SD</i>
Primary outcome variable			
Composite sleep index	Average of all standardized sleep variables	-.0001	.41
Secondary outcome variables			
Total daily sleep duration	Sum of total nighttime sleep duration and total daytime sleep duration in hours	11.09	1.07
Nighttime sleep duration	Nighttime sleep duration in hours	10.39	.93
Nap sleep duration	Daytime sleep duration in hours	.70	.63
Daytime sleepiness	Composite assessing parent perceptions of child sleepiness during the day	.61	1.00
Bedtime resistance	Child's regular opposition to stopping daytime activities to go to bed for the night	.78	.70
Sleep regularity	Composite assessing parent perceptions of regularity of the child's sleep schedule	4.43	.88
Bedtime	Bedtime in HH:MM	20:44	0:40
Wake time	Waketime in HH:MM	7:08	0:10
Sleep onset latency	Average number of minutes the child takes to fall asleep after being put to bed	22.04	22.16
Number of nighttime awakenings	Number of nighttime awakenings	.68	.60
Reluctance to sleep alone	Persistent reluctance or refusal to initiate sleep without being near a major attachment figure	.82	.99

Suicidal Thoughts and Behaviors

Suicidal thoughts and behaviors were measured at each assessment. Suicidal thoughts and behaviors were measured via parent-report on the PAPA when children 3.0–7.9 years and the Child and Adolescent Psychiatric Assessment (CAPA; Angold et al., 1995) when children were 8.0–8.9 years. Suicidal thoughts and behaviors were measured via both parent- and child-report on the CAPA were used when children were 9.0 and older and on the Kiddie Schedule for Affective Disorders and Schizophrenia (K-SADS; Kaufman et al., 1997) when children were 16 years and older. Parent and child report on the CAPA and K-SADS were combined by taking the most severe rating. Agreement between parent- and child-reports of suicidal thoughts and behaviors at each wave is reported in Table S2 in the online supplemental materials. Agreement was moderate-to-low at the ages in which both parents and children reported on child suicidal thoughts and behaviors, similar to DeVille et al. (2020). As with the PAPA, the raters for the CAPA and K-SADS were blind to the child's diagnostic status and the same procedures were used to obtain reliability and prevent drift.

Items comprised by measures of suicidal thoughts and behaviors included: suicidal themes in play (PAPA), suicidal thoughts or preoccupation (PAPA, CAPA, K-SADS), suicide plan (PAPA, CAPA), and suicidal behavior or attempt (PAPA, CAPA, K-SADS). The prevalence of each of these variables at each wave is included in Table 2. Given general interest in the literature in examining separable risk factors for suicidal thoughts versus suicidal behaviors, all of our analyses examined suicidal thoughts (i.e., suicidal themes in play, suicidal thoughts or preoccupation, and suicide plan) and suicidal behaviors (e.g., suicidal behavior or attempt) in separate models. Because the goals of the present study included assessing links between early childhood sleep and both concurrent and later suicidal thoughts and behaviors, early childhood suicidal thoughts and behaviors were operationalized as those occurring before 8.0 years of age (the ages when the PAPA was used to quantify suicidal thoughts and suicidal behaviors), whereas later suicidal thoughts and behaviors were those that occurred at or after age 8 (the ages when the CAPA and the K-SADS were used to quantify suicidal thoughts and behaviors).

Early Childhood Depression Severity

Depression symptoms in early childhood were measured using parent-reports on the depression module of the PAPA. Early

childhood depression severity was quantified as the number of core depression symptoms endorsed in the depression module. However, because sleep problems and suicidal thoughts and behaviors are included in the core symptoms of depression, we created an early childhood depression severity index from the PAPA that included all of the core depression symptoms *except for* insomnia/hypersomnia, fatigue, and recurrent thoughts of death and/or suicidal ideation and/or suicide attempts. This index included six items assessing: child depressed and/or irritated mood, anhedonia, cognitive disturbances (e.g., difficulty concentrating), appetite disturbances, psychomotor disturbances (e.g., increased agitation or retardation), and feelings of worthlessness and/or excess and inappropriate guilt. Early childhood depression severity was calculated at each developmental assessment that the PAPA was administered, ranging from 1–4 assessments per child occurring between the ages of 3.0–7.9 years. The *maximum* depression severity score across all waves when the subject was assessed with the PAPA was used in analysis as our measure of early childhood experiences with depression. Maximum scores were chosen to characterize the most severe exposure to depression symptomatology during the child's early life. The number of children with a maximum score at each time point for the measure of early childhood depression severity is included in Table S3 in the online supplemental materials.

MDD Diagnosis

MDD diagnosis at all the developmental assessments after age 8 was determined by computer algorithm. For assessments using the CAPA, *DSM-IV* MDD was present when at least five of the nine core MDD symptoms were endorsed at subthreshold or threshold by either the parent or the child (or both). For assessments using the K-SADS, *DSM-IV* MDD was present when at least five of the nine core MDD symptoms were endorsed at threshold by either the parent or the child (or both).

Analytic Plan

Given that we did not have specific a priori hypotheses about which domains of sleep would be associated with concurrent and later suicidal thoughts and behaviors, we focused our initial analysis on the composite sleep index. We first used linear regression to examine whether young children whose parents endorsed that they

Table 2
Prevalence of Suicidal Thoughts and Behaviors in the Sample at Each Wave

Wave	Suicidal themes in play			Suicidal thoughts or preoccupation			Suicide plan			Suicidal behavior or attempt			Any suicidal thought or behavior		
	%	<i>n</i>	Total <i>N</i>	%	<i>n</i>	Total <i>N</i>	%	<i>n</i>	Total <i>N</i>	%	<i>n</i>	Total <i>N</i>	%	<i>n</i>	Total <i>N</i>
T1	1.37	4	293	3.36	10	298	0.34	1	298	1.67	5	299	5.63	17	302
T3	0.73	2	273	5.19	14	270	0.00	0	270	0.00	0	268	5.86	16	273
T5	4.25	11	259	7.06	18	255	1.61	4	249	0.39	1	254	10.42	27	259
T6	0.00	0	31	7.30	17	233	1.04	2	193	1.29	3	232	8.58	20	233
T8	—	—	—	6.13	16	261	0.96	2	208	2.68	7	261	7.66	20	261
T10	—	—	—	3.40	8	235	1.05	2	191	3.83	9	235	6.81	16	235
T12	—	—	—	8.00	10	125	3.13	3	96	4.00	5	125	11.20	14	125
T14	—	—	—	7.58	5	66	0.00	0	53	3.03	2	66	10.61	7	66
T18	—	—	—	10.07	14	139	—	—	—	10.79	15	139	13.67	19	139
T20	—	—	—	13.97	19	136	—	—	—	11.03	15	136	18.38	25	136

had suicidal thoughts or suicidal behaviors had more concurrent problematic sleep on the composite sleep index, when controlling for early childhood depression severity (excluding sleep symptoms and suicidality items), income-to-needs ratio, and child sex. In a follow-up, exploratory analysis, we examined the association between each of the 11 sleep variables with concurrent (i.e., early childhood) suicidal thoughts or behaviors, using the same covariates as the prior analysis.

Next, to determine whether preschool sleep problems were associated with later risk for suicidal thoughts and behaviors across childhood and adolescence, we used a hierarchical generalized linear model (HGLM) with binomial distribution and logit link function. The dependent variables in these models were suicidal thoughts and suicidal behaviors as assessed at each time point at ages 8 and above. By using HGLMs, we were able to take into consideration suicidal thought and behavior measures at each assessment after age 8 (i.e., a time-varying outcome variable). In these models, the time variable was age at assessment, and age squared was included to allow for the fitting of quadratic trajectories. The composite sleep index was the independent variable, and its interaction with age was also entered into the model but then removed due to nonsignificance. Early childhood depression severity (excluding sleep symptoms and suicidality, as described above), income-to-needs ratio, and child sex were included as covariates, and then in a separate model, MDD diagnosis after age 8, income-to-needs ratio, and child sex were included as covariates. Intercept and age were modeled as both fixed and random effects with a variance components covariance structure. In a follow-up, exploratory analysis, we examined the association between each of the 11 sleep variables and later suicidal thoughts and suicidal behaviors using the same HGLM's as fitted for the analysis with the composite sleep index.

Transparency and Openness

Analyses were conducted in SAS Version 9.4. De-identified data, analysis code, and research materials are available on request

Table 3

Linear Regression Models of Early Childhood Sleep Variables by Early Childhood Suicidal Thoughts and Behaviors Controlling for Early Childhood Depression Severity and Child Sex

Variable	Suicidal thoughts				Suicidal behaviors			
	Estimate	SE	<i>t</i>	<i>p</i>	Estimate	SE	<i>t</i>	<i>p</i>
Primary analysis								
Composite sleep index	.02	.06	.35	.73	-.06	.18	-.35	.73
Secondary analyses								
Total daily sleep duration (hours)	.38	.24	1.61	.11	.05	.69	.07	.94
Nighttime sleep duration (hours)	.20	.17	1.18	.24	-.01	.49	-.02	.98
Nap sleep duration (hours)	.22	.15	1.53	.13	-.02	.42	-.05	.96
Daytime sleepiness	.21	.25	.86	.39	1.45	.71	2.04	.04
Bedtime resistance	.09	.15	.63	.53	-.31	.43	-.73	.47
Sleep regularity	-.06	.14	-.42	.67	-.00	.42	-.01	.99
Bedtime	.22	.14	1.58	.11	-.39	.40	-.97	.33
Wake time	.06	.11	.51	.61	.42	.31	1.33	.18
Sleep onset latency (minutes)	-.00	5.16	-.00	1.00	-17.41	14.94	-1.17	.24
Number of nighttime awakenings	.19	.14	1.42	.16	.55	.39	1.40	.16
Reluctance to sleep alone	.31	.21	1.48	.14	-.42	.62	-.68	.49

Note. Bolded text indicates sleep predictors significant in the model at $p < .05$.

by emailing the corresponding author. This study's design and its analysis were not preregistered.

Results

Early Childhood Sleep Problems and Early Childhood Suicidal Thoughts and Behaviors

The results of the concurrent analysis are presented in Table 3. There was no significant association between the composite sleep index and early childhood suicidal thoughts or behaviors when controlling for early childhood depression severity, income-to-needs ratio, and child sex. However, when we further examined each of the 11 sleep variables included in this composite sleep index, we found a significant association between suicidal behaviors and daytime sleepiness. Young children displaying suicidal behaviors were reported to be significantly sleepier during the day than those who did not experience suicidal behaviors. There were no significant associations between the other sleep variables and early childhood suicidal thoughts or behaviors.

Early Childhood Sleep Problems and Later Suicidal Thoughts and Behaviors

For the primary analysis focused on the composite sleep index, we found a significant association between sleep problems during early childhood and the probability of experiencing later suicidal thoughts (see Table 4). Young children who had higher scores on the composite sleep index (indicative of more disturbed sleep overall) were at increased risk for suicidal thoughts across childhood and adolescence, even when controlling for child sex, early childhood depression severity, and income-to-needs ratio. There was no association between suicidal behaviors and the composite sleep index.

The exploratory analyses focused on the 11 sleep variables from the composite sleep index are also presented in Table 4. Findings indicated a significant association between bedtime resistance,

Table 4

Early Childhood Sleep Variables Predicting Later Probability of Suicidal Thoughts and Behaviors From Childhood to Adolescence, Controlling for Child Sex, Early Childhood Depression Severity, and Income-to-Needs Ratio

Variable	Dependent variable = Suicidal thoughts				Dependent variable = Suicidal behaviors			
	Estimate	SE	t	p	Estimate	SE	t	p
Primary analysis								
Intercept	-3.63	.41	-8.95	<.001	-8.72	1.95	-4.47	<.001
Age	.00	.11	.03	.98	.67	.28	2.38	.02
Age squared	-.04	.02	-1.60	.11	-.09	.04	-2.34	.02
Female sex	-.30	.37	-.81	.42	-1.16	1.15	-1.01	.31
EC depression severity	.25	.14	1.77	.08	.98	.46	2.14	.03
EC Income-to-needs	-.21	.17	-1.25	.21	-.54	.51	-1.06	.29
Composite sleep index	1.17	.47	2.46	.01	1.05	1.32	.80	.43
Secondary analyses								
Intercept	-3.61	.41	-8.87	<.001	-8.68	1.96	-4.44	<.001
Age	-.01	.11	-.06	.96	.67	.28	2.36	.02
Age squared	-.04	.02	-1.48	.14	-.09	.04	-2.35	.02
Female sex	-.34	.38	-.91	.36	-1.24	1.15	-1.08	.28
EC depression severity	.34	.14	2.51	.01	1.05	.45	2.32	.02
EC Income-to-needs	-.27	.17	-1.59	.11	-.59	.51	-1.14	.25
Total sleep duration	-.23	.14	-1.70	.09	-.23	.37	-.62	.53
Intercept	-3.68	.41	-8.88	<.001	-8.63	1.91	-4.51	<.001
Age	.05	.12	.46	.65	.67	.28	2.37	.02
Age squared	-.03	.02	-1.33	.18	-.09	.04	-2.35	.02
Female sex	-.41	.38	-1.07	.28	-1.26	1.14	-1.10	.27
EC depression severity	.35	.14	2.55	.01	1.02	.44	2.31	.02
EC Income-to-needs	-.23	.17	-1.35	.18	-.51	.50	-1.02	.31
Nighttime sleep duration	-.63	.21	-3.06	.002	-.68	.52	-1.31	.19
Nighttime sleep duration × Age	.20	.07	2.88	.004	—	—	—	—
Intercept	-3.59	.41	-8.85	<.001	-8.79	1.98	-4.43	<.001
Age	.02	.11	.16	.87	.68	.28	2.41	.02
Age squared	-.03	.02	-1.31	.19	-.09	.04	-2.32	.02
Female sex	-.35	.38	-.93	.35	-1.23	1.16	-1.06	.29
EC depression severity	.36	.14	2.59	.01	1.09	.45	2.40	.02
EC Income-to-needs	-.27	.17	-1.58	.11	-.62	.52	-1.19	.23
Nap sleep duration	.12	.20	.60	.55	-.00	.61	-.00	1.00
Intercept	-3.60	.41	-8.85	<.001	-8.67	1.96	-4.43	<.001
Age	.01	.11	.11	.92	.67	.28	2.41	.02
Age squared	-.03	.02	-1.31	.19	-.09	.04	-2.42	.02
Female sex	-.34	.38	-.90	.37	-1.05	1.11	-.95	.34
EC depression severity	.36	.14	2.51	.01	.89	.44	2.03	.04
EC Income-to-needs	-.28	.17	-1.62	.11	-.48	.50	-.97	.33
Daytime sleepiness	-.01	.12	-.05	.96	.40	.30	1.33	.19
Intercept	-3.61	.40	-9.09	<.001	-8.76	1.95	-4.50	<.001
Age	.02	.11	.15	.88	.67	.28	2.42	.02
Age squared	-.03	.02	-1.46	.15	-.09	.04	-2.30	.02
Female sex	-.30	.37	-.81	.42	-1.17	1.15	-1.02	.31
EC depression severity	.25	.14	1.79	.07	1.01	.45	2.23	.03
EC Income-to-needs	-.32	.17	-1.90	.06	-.65	.52	-1.27	.21
Bedtime resistance	.54	.18	2.95	.003	.48	.51	.95	.34
Intercept	-3.60	.41	-8.85	<.001	-8.79	2.00	-4.40	<.001
Age	.01	.11	.10	.92	.68	.28	2.43	.02
Age squared	-.03	.02	-1.32	.19	-.09	.04	-2.32	.02
Female sex	-.34	.38	-.89	.37	-1.27	1.15	-1.11	.27
EC depression severity	.36	.14	2.61	.01	1.11	.46	2.40	.02
EC Income-to-needs	-.27	.17	-1.60	.11	-.67	.51	-1.31	.19
Sleep regularity	-.04	.20	-.17	.86	.83	.74	1.11	.27
Intercept	-3.54	.39	-8.96	<.001	-8.75	1.97	-4.43	<.001
Age	-.00	.11	-.02	.98	.68	.28	2.41	.02
Age squared	-.03	.02	-1.45	.15	-.09	.04	-2.33	.02
Female sex	-.40	.37	-1.09	.28	-1.21	1.15	-1.05	.29
EC depression severity	.32	.13	2.45	.01	1.09	.45	2.40	.02

(table continues)

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Table 4 (continued)

Variable	Dependent variable = Suicidal thoughts				Dependent variable = Suicidal behaviors			
	Estimate	SE	<i>t</i>	<i>p</i>	Estimate	SE	<i>t</i>	<i>p</i>
EC Income-to-needs	-.17	.16	-1.04	.30	-.65	.53	-1.23	.22
Bedtime	.47	.19	2.46	.01	-.18	.59	-.31	.75
Intercept	-3.60	.41	-8.83	<.001	-8.79	1.98	-4.43	<.001
Age	0.01	.11	.11	.91	.68	.28	2.41	.02
Age squared	-.03	.02	-1.31	.19	-.09	.04	-2.33	.02
Female sex	-.34	.38	-.90	.37	-1.23	1.16	-1.06	.29
EC depression severity	.36	.14	2.61	.01	1.09	.45	2.40	.02
EC Income-to-needs	-.28	.17	-1.64	.10	-.62	.52	-1.19	.23
Waketime	.02	.31	.07	.94	-.00	.90	-.00	1.00
Intercept	-3.59	.41	-8.86	<.001	-8.78	1.98	-4.43	<.001
Age	.01	.11	.11	.92	.68	.28	2.41	.02
Age squared	-.03	.02	-1.34	.18	-.09	.04	-2.33	.02
Female sex	-.33	.38	-.89	.38	-1.21	1.16	-1.05	.29
EC depression severity	.34	.14	2.36	.02	1.09	.47	2.31	.02
EC Income-to-needs	-.26	.17	-1.53	.13	-.61	.52	-1.17	.24
Sleep onset latency	.00	.01	.44	.66	-.00	.02	-.03	.97
Intercept	-3.56	.40	-8.88	<.001	-8.79	1.98	-4.45	<.001
Age	.01	.11	.06	.95	.68	.28	2.41	.02
Age squared	-.03	.02	-1.41	.16	-.09	.04	-2.31	.02
Female sex	-.36	.37	-.96	.34	-1.13	1.16	-.97	.33
EC depression severity	.39	.14	2.80	.01	1.03	.45	2.28	.02
EC Income-to-needs	-.28	.17	-1.68	.09	-.60	.51	-1.17	.24
Number of nighttime awakenings	-.31	.22	-1.37	.17	.38	.53	.71	.48
Intercept	-3.61	.40	-8.96	<.001	-8.78	1.98	-4.44	<.001
Age	.03	.11	.24	.81	.68	.28	2.41	.02
Age squared	-.03	.02	-1.44	.15	-.09	.04	-2.33	.02
Female sex	-.31	.37	-.85	.40	-1.24	1.16	-1.07	.28
EC depression severity	.31	.14	2.26	.02	1.09	.46	2.40	.02
EC Income-to-needs	-.31	.17	-1.86	.06	-.61	.52	-1.18	.24
Reluctance to sleep alone	.34	.14	2.41	.02	-.07	.39	-.18	.86

Note. EC = early childhood. Bolded text indicates sleep predictors significant in the model at $p < .05$.

bedtime, and reluctance to sleep alone and experiencing later suicidal thoughts. Specifically, young children who got less sleep at night, were more resistant at bedtime, had later bedtimes, and had more difficulty sleeping alone were at increased risk for suicidal thoughts across childhood and adolescence. We also found a significant interaction between nighttime sleep duration and age in predicting suicidal thoughts (see Figure 2). Children with shorter nighttime sleep durations in early childhood had increased probability of suicidal thoughts through midadolescence, which thereafter decreased to levels similar to children who had average and longer nighttime sleep durations in early childhood. We found no significant associations between the early childhood sleep indexes and later suicidal behavior.

We also reran these analyses examining the effect of early childhood sleep problems on suicidal thoughts and suicidal behaviors after age 8, when conservatively controlling for MDD diagnosis after age 8 along with child sex and income-to-needs ratio (see Tables S4 and S5 in the online supplemental materials). A similar pattern of significant findings emerged, in which the composite sleep index, bedtime resistance, and bedtime were significantly associated with increased probability of experiencing suicidal thoughts across childhood and adolescence. For both total sleep duration and nighttime sleep duration, significant interactions emerged, such that children getting less sleep in early childhood had increased probability of suicidal thoughts up through midadolescence (see Figure S1 in the

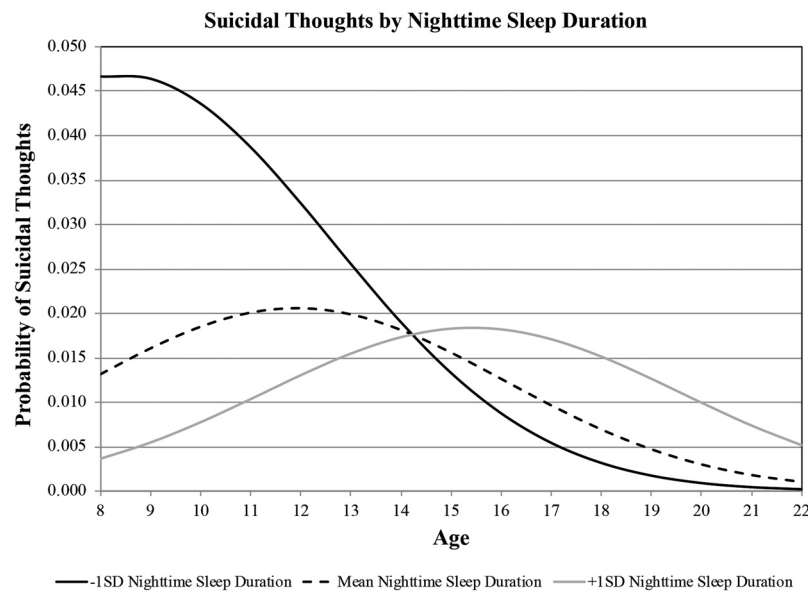
online supplemental materials), which thereafter decreased to levels similar to children who had average and longer sleep durations in early childhood. As before, no prospective associations emerged between the early childhood sleep indexes and suicidal behaviors.

Discussion

Using a prospective, longitudinal sample enriched for early childhood depression, the current study demonstrated that sleep problems in early childhood are associated with increased risk for experiencing suicidal thoughts after age 8. These findings held when controlling for early childhood depression severity and MDD diagnosis after age 8, suggesting that sleep may be an important predictor of later suicidal thoughts even beyond the documented association between sleep problems and depression symptoms. These findings highlight the potential utility of early childhood sleep problems as a risk factor for later suicidal thoughts.

Youth suicidal thoughts and behaviors are a major public health concern, and it is crucial to better understand both the co-occurring features of suicidal thoughts and behaviors in childhood, as well as risk factors that might predict which children will go on to develop suicidal thoughts and behaviors. Given evidence that early childhood suicidal thoughts and behaviors remain stable into school age and confer risk for later psychopathology (Whalen et al., 2015), and the robust effect sizes of early childhood psychosocial interventions,

Figure 2
Interaction Between Nighttime Sleep Duration and Age in Predicting Trajectory of Suicidal Thoughts Across Childhood and Adolescence, Controlling for Early Childhood Depression Severity



including those targeting depression (Luby et al., 2018) and disruptive disorders (e.g., Webster-Stratton et al., 2004) compared with the relatively modest effect sizes of such interventions delivered later in development (e.g., Cuijpers, 2017), identifying childhood risk factors for suicidal thoughts and behaviors has substantial implications for early intervention and suicide prevention in youth. In the current study, suicidal thoughts and behaviors were examined separately. Our findings demonstrate that sleep problems in early childhood may be a predictive risk factor for later suicidal thoughts. This is consistent with a growing literature that has established that sleep problems are linked to suicidal thoughts, over and above associations with depression (e.g., Glenn et al., 2021; Wong & Brower, 2012). Although our findings are the first to demonstrate such prospective associations with suicidal thoughts for early childhood sleep problems, our findings correspond with research with adolescents and adults highlighting the potential of sleep disturbances to predict and precede suicidal thoughts (Littlewood et al., 2019; Liu et al., 2020; Wong et al., 2011), and join a growing literature examining childhood associations between sleep and suicidal thoughts (Lopes et al., 2016; Meir et al., 2019) and behaviors (Lopes et al., 2016). However, we did not find a prospective association between early childhood sleep disturbances and suicidal behaviors, in contrast to prior findings with children (Lopes et al., 2016) and adolescents (Nrugham et al., 2008; Wong et al., 2011). The lack of an association could reflect the relatively low rates of suicidal behaviors in the current study, and future research focusing specifically on samples at high-risk for suicidal thoughts and behaviors would allow for a more thorough exploration of the association between early sleep disturbances and later suicidal behaviors.

In addition to disrupting neurodevelopment in brain regions and circuits underlying executive functioning and emotional regulation,

sleep disturbances in early childhood may also lead to disruptions in the development of skills associated with risk for suicidal thoughts and behaviors, including socioemotional skills (Vaughn et al., 2015), self-regulatory capacities (Bernier et al., 2013; Breitenstein et al., 2021), and the cognitive abilities critical for school success (Hoyniak et al., 2019; Touchette et al., 2007). Disrupted development in these domains earlier in life when such skills are rapidly consolidating could confer increased risk for later experiences of suicidal thoughts and behaviors and explain how sleep disturbances in early childhood had a long-term effect on suicidal thoughts and behaviors in the current study. An important next step will be to examine if within-child sleep disturbances predict within-child changes in suicidal thoughts and behaviors on a shorter timescale (e.g., day-to-day, week-to-week), as meta-analytic evidence suggests a larger effect of sleep problems on suicidal thoughts and behaviors in studies with shorter follow-up periods, highlighting the role of sleep as an acute predictor of risk for suicidal thoughts and behaviors (Asarnow et al., 2020; Harris et al., 2020). The findings of the current study suggest that the association between early sleep problems and later suicidal thoughts is worth exploring further, including on a more refined time scale.

Although we primarily focused our longitudinal analyses on the composite index of overall sleep disturbances, we also explored the domains of sleep that comprised our composite index. Within those domains, parent-reported bedtime resistance, bedtime, and reluctance to sleep alone were associated with heightened later suicidal thoughts. Late sleep schedules (often indexed by later bedtimes) can be attributable to a variety of factors, including parent/child preference, parent/child bed sharing, or lack of parent knowledge about appropriate child sleep schedules (Hoyniak et al., 2022). Whatever the cause of later bedtimes, our findings suggest

that these sleep disruptions may be risk factors for the later development of suicidal thoughts. Bedtime resistance, which occurs when a child demonstrates behavioral resistance (e.g., protest or refusal to go to bed) to caregivers with the aim of delaying bedtime, may be one of the primary ways young children express concerns about sleep to caregivers, as young children have little control over setting their own sleep schedules and may lack the verbal abilities to describe difficulties sleeping. Although bedtime resistance is associated with externalizing problems (Conway et al., 2017), resistance/refusal in the context of bedtime may also be a reflection of child nighttime fears, separation concerns, or insomnia (Blader et al., 1997). Bedtime resistance in elementary school children has been shown to be associated with suicidal thoughts (Meir et al., 2019), and thus our findings align with prior studies highlighting the potential importance of bedtime resistance as an early indicator of risk for suicidal thoughts in young children. Similarly, reluctance to sleep alone may be a manifestation of nighttime fears and separation concerns and thus may be a uniquely suitable indicator of risk for later suicidal thoughts and should be considered in future research.

Additionally, an interaction between nighttime sleep duration and age in predicting suicidal thoughts indicated that those with shorter nighttime sleep durations during early childhood evidenced a trajectory of suicidal thoughts of increased risk across childhood and into midadolescence. Later in childhood the relationship between sleep duration and suicidal thoughts decreased to levels similar to those reported by other groups. This finding raises the possibility that shorter sleep durations during early childhood specifically represent a significant risk factor at this developmental stage, contributing to more proximal risk for later suicidal thoughts (i.e., in middle childhood through early adolescence) and decreasing in effect thereafter. Loss of sleep during this critical neurodevelopmental period may concurrently escalate risk for suicidal thoughts due to impairment in cognitive, interpersonal, and emotional functioning that is on a steep developmental curve during this period. Moreover, suicidal thoughts and behaviors during early childhood exemplify a greater “deviance” from peers, as rates of suicidal thoughts and behaviors typically increase dramatically during early adolescence. Thus, young children with suicidal thoughts and behaviors may represent a distinct group, seemingly with diverging risk factors when compared with older youth and adolescents with suicidal thoughts and behaviors. Study findings suggest that short sleep duration may be one such unique risk factor. These findings underscore the need for further research, particularly exploring how early intervention among children with shorter nighttime sleep durations, as well as other sleep disturbances, might impact the trajectory of development of suicidal thoughts and behaviors across childhood into adolescence.

Within the exploratory analyses of the 11 sleep domains, we found preliminary evidence for a concurrent association between increased daytime sleepiness (often a consequence of insufficient sleep) and the presence of suicidal behaviors, when controlling for concurrent depression severity. In contrast, none of the sleep variables were associated with concurrent suicidal thoughts. This latter finding was surprising given our findings of an association between the early sleep indexes and later suicidal thoughts and may suggest that sleep problems in early childhood are more useful for long-term prediction of risk for suicidal thoughts, rather than signifying heightened concurrent risk in early childhood. In

general, there is a paucity of research on early childhood suicidal thoughts and the risk factors for suicidal thoughts and behaviors in early childhood. The results from this study indicate that daytime sleepiness may co-occur alongside early childhood suicidal behaviors. However, these findings were exploratory and additional confirmatory research will be necessary to replicate these findings. If confirmed, these findings could add to the growing literature documenting the correlates of early childhood suicidal thoughts and behaviors including: child and family psychopathology (Whalen et al., 2015), greater exposure to violent life events (Luby et al., 2019), an enhanced understanding of death (Hennefield et al., 2019), and greater reliance on violence (including suicide) to resolve conflicts (Hennefield et al., 2022). Adding early sleep difficulties to this set of correlates enhances the clinical picture of young children who experience suicidal thoughts and behaviors, and may offer a feasible target for direct, early intervention.

There are a number of important strengths in the current study. First, the 17-year prospective, longitudinal design that included 10 development assessments allowed us to examine how sleep problems in early childhood predict suicidal thoughts and behaviors well into adolescence. The design of the current study, with its long period of regular follow-up assessments, helps to elucidate questions about the long-term effects of sleep problems on suicidal thoughts and behaviors and is an important contribution to this literature. Next, we were able to incorporate both parent- and child-informants in some of our variables of interest, including suicidal thoughts and behaviors and depression symptoms. Finally, our findings of an association between early childhood sleep and suicidal thoughts and behaviors held when controlling for both early childhood and child/adolescent depression, suggesting that early sleep problems may be an important predictor of later suicidal thoughts and behaviors beyond the documented association between sleep problems and MDD. There are also limitations worth noting, including our reliance on parent-reports of sleep problems, rather than incorporating objective measures of sleep (e.g., actigraphy or polysomnography). More recent research has included objective measures of sleep (e.g., actigraphy) when exploring associations between sleep disturbances and suicidal thoughts and behaviors (Bernert et al., 2017; Glenn et al., 2021; Meir et al., 2019). Although recent meta-analytic evidence with adults did not find a significant difference between effect sizes of the association between sleep and suicidal thoughts and behaviors based on the use of objective- vs. subjective- sleep measures (Harris et al., 2020), future research on this topic should consider incorporating objective measures of sleep, especially when relying on parent-report, as is necessary with young children. A similar reliance on parent-reported suicidal thoughts and behaviors for children prior to age 8 is also a limitation; however, it is worth noting that these reports were based on a structured clinical interview, as opposed to a questionnaire assessment. By late childhood there is high discordance between parent and child-reported of suicidal thoughts and behaviors (DeVile et al., 2020), suggesting that the present study may have underestimated the presence of suicidal thoughts and behaviors in early childhood.

The results from the current study indicate that early childhood sleep problems predict suicidal thoughts and behaviors across development, even when controlling for prior levels of depression. Sleep problems are frequently noted in referrals for clinical treatments of psychological disorders in children yet may be minimized

by clinicians or bypassed as primary treatment targets. The results from this study suggest that early-onset sleep difficulties warrant increased clinical attention and management, as they can contribute to the maintenance and exacerbation of suicidal thoughts and behaviors over time. Specifically, educating parents and guardians on sleep hygiene practices, including emphasizing the importance of bedtime routines and sleep timing for young children, may be an effective approach to minimizing the impact of early-sleep problems on future suicidal thoughts and behaviors. The sleep disturbances described in the current study may be directly treatable and amenable to relatively brief interventions, or relatively simple changes in sleep hygiene which could lessen the impact that these early sleep problems have on suicidal thoughts and behaviors across development. Based on the results of this study, careful screening and assessment of early-onset sleep difficulties is warranted, especially in children who may already be showing mood disturbances, as sleep disturbances represent a novel treatment target to prevent suicidal thoughts and behaviors in childhood. Additional research is warranted to continue to refine our understanding of early childhood sleep disturbances as a risk factor for suicidal thoughts and behaviors.

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