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Examining harsh parenting as a moderator in the association between childhood irritability and adolescent suicidal behaviors

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Abstract

Background. Childhood irritability increases the risk of later suicidal behaviors, but the moderators of this association have not been identified. We investigated harsh parenting as a moderator in the association of childhood irritability with adolescent suicide attempt and self-harm, and possible sex differences in these associations.

Method. Data were from 9,480 children from the Millennium Cohort Study. We averaged parent ratings of child irritability and harsh parenting at ages 3, 5, and 7 years (range 1–3). Suicide attempt and self-harm were self-reported at age 17. Logistic regression models were used to estimate associations of irritability with suicide attempt and self-harm, adjusting for confounding factors. Interaction analyses were used to test the moderating role of harsh parenting and sex in these associations.

Results. Children with greater irritability scores were at increased risk to attempt suicide (OR=1.72, 95% CI=1.42–2.08). Interaction analyses suggested that this risk in males was elevated regardless of harsh parenting. However, high levels of harsh parenting interacted with irritability in increasing the risk of suicide attempt in females. Children with high irritability were also more at risk of self-harm (OR = 1.16, 95% CI = 1.03–1.31) but this association was not moderated by harsh parenting in either sex.

Conclusion. Parental behaviors may play an important role in the pathway to suicide attempt of children with irritability, especially for females, who may have a heightened sensitivity to interpersonal stressors. Parenting interventions may be helpful in suicide prevention among females with irritability.

Introduction

Irritability, characterized by an increased proneness to anger in response to frustration (i.e. frequent verbal or behavioral temper outbursts), is a commonly reported symptom in child psychopathology (Leibenluft et al., 2024; Stringaris, 2011). It is a symptom of 15 distinct disorders of the DSM-5 (American Psychiatric Association, 2013), including both internalizing (e.g. major depressive disorder) and externalizing (e.g. Oppositional Defiant Disorder) disorders (Stringaris, Maughan, Copeland, Costello, & Angold, 2013). While irritability is common in 3- to 5-year-old children, 2–5% of children in the general population experience persistence of chronic high levels of irritability beyond early childhood (Leibenluft et al., 2024). Such persistent levels of irritability have been associated with an increased risk of later depression, problematic substance use, and impairment in school and family life (Leibenluft et al., 2024). Irritability in childhood has also been associated with an increased risk of adolescent suicidal behavior, including suicide attempt (i.e. an act that aims to deliberately end one's life without resulting in death) and self-harm (i.e. a self-inflicted injury that can or cannot have a suicidal intent) (Orri et al., 2019; Srinivasan et al., 2024). Notably, a study by Srinivasan et al. (2024) that used data from the Millennium Cohort Study (MCS), found high irritability in childhood to be associated with an increased risk to self-harm at 14 years old. Suicidal behaviors are an important public health concern, especially among youth (Knipe, Padmanathan, Newton-Howes, Chan, & Kapur, 2022; Vos et al., 2020), as it is linked to an increased risk of suicide mortality and negative psychosocial outcomes (Orri et al., 2022;Probert-Lindström, Öjehagen, Ambrus, Skogman Pavulans, & Berge, 2022). Therefore, there is a growing interest in understanding the role of irritability in the pathway leading to suicidal behaviors (Benarous et al., 2019; Orri et al., 2019; Pickles et al., 2010). However, while the associations between childhood irritability and youth suicidal behaviors have been demonstrated

in several previous studies (Benarous et al., 2019; Orri et al., 2019; Pickles et al., 2010), little is known about the environmental characteristics that can modify this association. Such knowledge could have important clinical implications.

Harsh parenting is characterized by a variety of negative behaviors directed toward a child. These include a range of aggressive behaviors, both physical (i.e. smacking the child) and psychological (i.e. shouting at the child and neglecting the child) (Straus, Hamby, Boney-McCoy, & Sugarman, 1996). In previous studies, exposure to harsh parenting has been associated with an increased risk of suicidal behaviors in adolescence (Gu, Yao, He, & Cheng, 2023; Kingsbury, Sucha, Manion, Gilman, & Colman, 2020b). For instance, a study found that Chinese adolescents (N = 1,638) who were exposed to harsh parenting practices were more likely to engage in self-harm (Gu et al., 2023). Similarly, a study in Canadian youth (N = 9,490) found harsh/punitive parenting to be directly and indirectly (i.e. mediated by depression/anxiety, hyperactivity, conduct disorder, and social aggression) associated with increased risks of suicidal ideation and attempt in adolescence (Kingsbury et al., 2020b).

The use of harsh parenting practices in response to child temper outbursts may exacerbate the putative negative consequences of irritability on child mental health, including suicidal behavior. In support of this hypothesis, studies revealed that negative parental reactions to their child's negative affect may increase irritability in childhood (Oliver, 2015) and moderate the relationship between childhood and adolescent irritability (Ravi et al., 2023). Specifically, parental responses, such as getting angry at the child, punishment (e.g. sending child to their room), and minimization (e.g. telling the child to not 'make a big deal') were associated with persistence of irritability from childhood to adolescence (Ravi et al., 2023). Yet, it is unclear whether the exposure of harsh parenting intensifies the contribution of childhood irritability to an increased risk of suicide attempt and self-harm. Indeed, while research has identified harsh parenting and irritability as important risk factors for suicidal behaviors, studies looking at the joint contribution of harsh parenting and childhood irritability to self-harm and suicide attempts are lacking. Investigating whether exposure to harsh parenting modifies the risk of suicidal behavior of children with irritability is critical to better understand how characteristics of the rearing environment, such as parenting, can be leveraged to reduce the long-term risk of suicide.

Furthermore, sex differences have rarely been considered when investigating associations between irritability and suicidal behavior (Orri et al., 2018; Srinivasan et al., 2024). This is particularly important when interpersonal contexts, such as the parent–child relationship, are investigated. While important sex differences in reactivity to harsh parenting and interpersonal stressors have been suggested (Kingsbury, Sucha, Manion, Gilman, & Colman, 2020a; Leve, Kim, & Pears, 2005; Meier, Slutske, Heath, & Martin, 2009), results from previous studies are inconsistent. Some studies suggests that males exposed to harsh parenting are more susceptible than females to report later mental health outcomes (Leve et al., 2005), including suicidal ideation (Kingsbury et al., 2020b, 2020a), while others suggested that females are more susceptible to develop depression than males when exposed to interpersonal stressors (Shih, Eberhart, Hammen, & Brennan, 2006). Most importantly, sex differences in reaction to harsh parenting have not been clarified in the context of irritability and its association with suicidal behavior.

To fill these gaps, we investigated the role of harsh parenting in the association between childhood irritability and suicidal behaviors (i.e. self-harm and suicide attempt) in adolescence and sought to identify possible sex differences in these associations using data from the MCS. It is worth nothing that the association between childhood irritability and self-harm were explored in Srinivasan et al. (2024) in this same cohort. However, unlike Srinivasan et al.'s study, we measured self-harm at 17 years old rather than 14, we additionally investigated associations with suicide attempt, and we examined the role of harsh parenting and sex in these associations. Based on the literature, we hypothesize childhood irritability to be significantly associated with suicide attempt and self-harm, and that this would be moderated by harsh parenting. We had no hypotheses regarding sex differences since the mixed findings in the literature.

Methods

Study design and participants

The MCS is an ongoing population-based cohort study of children born in the United Kingdom (England, Wales, and Scotland) between 2000 and 2002 (Connelly & Platt, 2014; Vilma & Johnson, 2020). Data were collected from the caregivers of 18,827 children (18,552 families) at 9 months. Children were followed up at 9 months, 3 years old, 5 years old, 7 years old, 11 years old, 14 years old, 17 years old and 23 years old through parent- and self-report. The MCS received ethical approval for the study from the National Health Service Research Ethics Committee system. To participate in the study, written parental consent was obtained for their and their children's participation, and assent was also obtained from the children. All participants were free to decline participation in any part of the surveys and could withdraw from the study at any point.

Participants were retained in our study based on availability of data on the outcome variable of adolescent suicide attempt, for a total of N = 9,480 participants (52% of the original sample). Missing data for all other variables were handled using multiple imputations, in which models were estimated across 50 imputed datasets and then pooled (see Supplementary Table S1 for the extent of missing data imputed for each variable). Participants included in our analytic sample were more likely than those non-included to be female and of high socioeconomic status (Supplementary Table S2).

Exposure variable: childhood irritability

Childhood irritability was measured at ages 3, 5, and 7 using two items from the *Child Social Behavior Questionnaire* ('Cohort Member is easily frustrated' and 'Cohort Member quickly gets over being upset') (Antony, Pihlajamäki, Speyer, & Murray, 2022) and a single item from the *Strengths and Difficulties Questionnaire* (SDQ) ('Often has temper tantrums') (Goodman, 1997; Theunissen, De Wolff, & Reijneveld, 2019). A main respondent, usually the cohort member's mother, reported on the past 6-month childhood irritability by rating each item on a 3-point scale (1=not true, 2=somewhat true, 3=certainly true). The mean of the three items at each time point, where the item 'Cohort member quickly gets over being upset' was reverse scored, was computed. These scores were then averaged to quantify the total irritability score for each participant (range 1–3; Ω = 0.64–0.69).

Outcome variables: adolescent suicide attempt and self-harm in the past year

Past year adolescent suicide attempt was measured at 17 years old using self-report. Participants were asked to answer 'yes' or 'no' to

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the following question: 'In the past year, have you hurt yourself on purpose in an attempt to end your life?' (Tetkovic, Parsons, White, & Bowes, 2024). Those who answered 'yes' were considered as having attempted suicide. Past year adolescent self-harm was also assessed at age 17 using the self-reported *Self-Harm Grid*, in which participants answered the question: 'In the past year, have you hurt yourself on purpose in any of the following ways' followed by a list of 13 self-harm methods (i.e. cutting or stabbing, burning, bruising or pinching, overdosing on tablets, pulling hair, hurting oneself some other way which includes punching/hitting walls/doors/objects, punching/slapping/hitting oneself, starving/not eating/fasting, scratching oneself, banging one's head against walls/objects, biting oneself, and other) (Tetkovic et al., 2024). Participants answered 'yes' or 'no' to each option. Those who answered 'yes' to at least one item were considered to have self-harmed.

Moderator variable: Harsh parenting in childhood

Harsh parenting was measured at ages 3, 5, and 7 using items from *Murray Straus' Conflict Tactics Scale* (Speyer, Hang, Hall, & Murray, 2022). Parents reported how often they responded in the following ways when their child was naughty: ignore them, smack them, shout at them, send them to bedroom/naughty chair, take away treats from them, and tell them off. Parents rated each item on a 5-point scale (1=never, 2=rarely, 3=once a month, 4=once a week, or more, 5=daily). The mean score of the six items was measured at ages 3, 5, and 7. These scores were then averaged to quantify the total harsh parenting score for each participant (Ω =0.75–0.76).

Covariates

The following covariates, measured through parent report at 9 months, were selected for our multivariable model based on theoretical pertinence: child sex (male or female); family income (low, moderate, or high); low birth weight (<2.5 kg); ethnicity of child (white or non-white); and mental health of main and partner respondent (measured with the *Kessler Psychological Distress Scale*) (Kessler, 2002). Main/partner mental health was derived by summing the scores of the six-item questionnaire where each item was rated on a 5-point scale, which we reversed scored (4=all of the time, 3=most of the time, 2=some of the time, 1=a little of the time, 0= none of the time). Child hyperactivity/inattention and emotional symptoms, both measured at age 3 using the *caregiver-reported SDQ* (Goodman, 1997) were also included as a covariate in the multivariable model.

Statistical analyses

The analyses were conducted using R version 4.3.1. Using binary logistic regression, we examined the association between childhood irritability and suicide attempt. Odds ratios and associated 95% confidence intervals were calculated. To investigate whether this association changed as a function of exposure to harsh parenting, the interaction between childhood irritability and harsh parenting was examined. We also investigated whether sex modified these associations by introducing it in the previous models as a two-way (sex by childhood irritability) and three-way (sex by childhood irritability by harsh parenting) interaction. Significant interactions were further explored using sex-specific subgroup analyses, in which the moderator (harsh parenting) was stratified in three categories: < –1 SD from the mean (low harsh parenting), ≤1 SD to 1 SD from the mean (moderate harsh parenting), and ≥ 1 SD from the mean (high harsh parenting). The same analyses were repeated with the outcome of self-harm. Both univariable and multivariable models (adjusted on the selected covariables) were fitted. Missing data were handled using multiple imputations in which models were estimated across 50 imputed datasets and then pooled.

Results

Our analytic sample of 9,480 participants included 4,835 (51%) females and 4,645 (49%) males (Table 1, see also Supplementary Figures S1 and S2 for the distribution of irritability and harsh parenting, respectively). The comparison between the participants in the analysis sample and those lost to follow-up is presented in Supplementary Table S2. Overall, 702 participants (7.4%) reported a suicide attempt in the last year, while 2,194 participants (23%) reported to have engaged in at least one self-harm behavior in the last year (Table 2). Among the participants who reported to have attempted suicide, 554 (79%) also reported having engaged in self-harm (Supplementary Table S3). The female participants in our study have a greater rate of suicide attempt (n = 496, 10.3%) than male participants (n = 206, 4.4%), consistent with previous findings on sex differences in suicide attempt (Miranda-Mendizabal et al., 2019). Compared to male participants, more female participants reported to have self-harmed (female n = 1386, 28.7%, male n = 808, 17.4%), which is consistent with previous findings on sex differences in self-harm behaviors (Diggins et al., 2024; Lutz et al., 2023).

Male participants had higher irritability compared to female participants (μ = 1.69, SD = 0.41 vs. μ = 1.62, SD = 0.39; $p < 0.001$, d = 0.17). Males were also exposed to a greater amount of harsh parenting than females (μ = 2.86, SD = 0.53 vs. μ = 2.73, SD = 0.52; $p < 0.001$, d = 0.24), including those with an irritability score >1 SD from the sample mean (μ = 3.21, SD = 0.26 vs. μ = 3.10, SD = 0.23; $p < 0.001$, d = 0.20).

Association of irritability with suicide attempt and self-harm

Childhood irritability was significantly associated with adolescent suicide attempt, with 72% increased odds for each one unit increase in irritability (OR=1.72, 95% CI=1.42–2.08; Table 2). This association remained significant even after accounting for covariates in the multivariable model (aOR=1.50, 95% CI=0.96–2.35). However, as suggested by a nonsignificant interaction between sex and childhood irritability in both univariable (log[OR], 0.04; SE, 0.21; p=0.864) and multivariable (log[aOR], −0.001; SE, 0.21; p = 0.997) models, this association did not differ significantly between male and female participants (male: OR=1.94, 95% CI=1.38–2.73, aOR=1.44, 95% CI=0.96–2.17; female: OR=1.87, 95% CI=1.47–2.38; aOR=1.53, 95% CI=1.15–2.02).

Childhood irritability was also associated with an increased risk of self-harm in adolescence (OR=1.16, 95% CI=1.03–1.31; Table 2), with no evidence of differential associations for male and female participants (log[OR], −0.03; SE, 0.13; p = 0.828).The association between childhood irritability and adolescent self-harm was similar in the multivariable model (aOR=1.16, 95% CI=1.00–1.34), again with no evidence of differential associations between sexes (log[aOR], −0.05; SE, 0.13; p = 0.693).

Moderating role of harsh parenting in the association between childhood irritability and suicide attempt

The interaction analysis showed that the association between childhood irritability and adolescent suicide attempt was not clearly

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Table 1. Characteristics of the study sample

	Total (*N* = 9480)	Female (*N* = 4835)	Male (*N* = 4645)	*p*
Child characteristics				
Low birth weight (<2.5kg), *n* (%)	688 (7.3)	390 (8.1)	298 (6.4)	0.002
Ethnicity (non-white), *n* (%)	1745 (18.4)	894 (18.5)	851(18.3)	0.835
Irritability, mean (*SD*)	1.65 (0.40)	1.62 (0.39)	1.69 (0.41)	<0.001
Harsh parenting, mean (*SD*)	2.79 (0.53)	2.73 (0.52)	2.86 (0.53)	<0.001
Hyperactivity/attention, mean (*SD*)	3.75 (2.32)	3.46 (2.22)	4.05 (2.38)	<0.001
Emotional problems, mean (*SD*)	1.31 (1.45)	1.33 (1.45)	1.28 (1.45)	0.159
Suicide attempt, *n* (%)	702 (7.4)	496 (10.3)	206 (4.4)	<0.001
Self-harm, *n* (%)	2194 (23.1)	1386 (28.7)	808 (17.4)	<0.001
Socioeconomic environment				
Income, *n* (%)				
Low	1929 (22.1)	1018 (22.8)	911 (21.5)	0.298
Moderate	4681 (52.7)	2390 (53.5)	2291 (54.0)	0.298
High	2100 (24.1)	1059 (23.7)	1041 (24.5)	0.298
Caregiver characteristics				
Main respondent mental health, mean (*SD*)	3.11 (3.53)	3.04 (3.5)	3.17 (3.57)	0.120
Partner respondent mental health, mean (*SD*)	2.86 (3.01)	2.81 (3.03)	2.92 (3.00)	0.157
Life satisfaction, mean (*SD*)	7.82 (1.71)	7.81 (1.72)	7.84 (1.71)	0.484
Happiness, mean (*SD*)	5.74 (1.42)	5.73 (1.45)	5.75 (1.39)	0.516

Note: Life satisfaction and happiness measured at 9 months.

Table 2. Imputed associations of childhood irritability with adolescent suicide attempt and self-harm

	Rates		Associations		
	Yes (%)	No (%)	Unadjusted OR	Adjusted OR[a]	Sex interaction (*p*)
Suicide attempt					
Whole Sample	702 (74)	8778 (92.6)	1.72 (1.42–2.08)	1.50 (0.96–2.35)	0.997
Females	496 (10.3)	4339 (89.7)	1.87 (1.47–2.38)	1.53 (1.15–2.02)	
Males	206 (4.4)	4439 (95.6)	1.94 (1.38–2.73)	1.44 (0.96–2.17)	
Self-harm					
Whole sample	1194 (23)	8286 (77)	1.16 (1.03–1.31)	1.16 (1.00–1.34)	0.693
Females	386 (28.7)	4449 (71.3)	1.26 (1.07–1.48)	1.19 (0.98–1.44)	
Males	808 (17.4)	3837 (82.6)	1.22 (1.00–1.48)	1.13 (0.90–1.42)	

Note: OR, odds ratio.
[a]Adjusted for sex, income, low birth weight, ethnicity, hyperactivity/inattention problems, emotional problems, main respondent mental health, and partner respondent mental health. Imputed data.

moderated by harsh parenting (log[OR], 0.31; SE, 0.18; $p = 0.082$). However, when investigating the role of child sex in a three-way interaction, a clear statistically significant interaction between sex, childhood irritability, and harsh parenting was found in the association with suicide attempt in both univariable (log[OR], −0.85; SE, 0.42; $p = 0.046$) and multivariable (log[aOR], −0.85; SE, 0.42; $p = 0.050$) models. Specifically, as shown in sex-specific analyses, the interaction between childhood irritability and harsh parenting was observed in female (log[OR], 0.612; SE, 0.23; $p < 0.001$) but not male (log[OR], −0.23; SE, 0.35; $p = 0.506$) participants. Similar results were found in the multivariable model (females: log[aOR], 0.57; SE, 0.23; $p = 0.013$; males: log[aOR], −0.33; SE, 0.35; $p = 0.340$). More specifically, the risk of suicide attempt was elevated among females with greater irritability scores who were also exposed to high levels of harsh parenting (Figure 1). This was also observed in the secondary subgroup analyses, which showed a dose-response association between childhood irritability and suicide attempt, as the level of exposure to harsh parenting increased from low (OR=0.99, 95% CI=0.42–2.37) to moderate (OR=1.68, 95% CI=1.19–2.37) and high (OR=2.67, 95% CI=1.51–4.94; Supplementary Table S4). Similar

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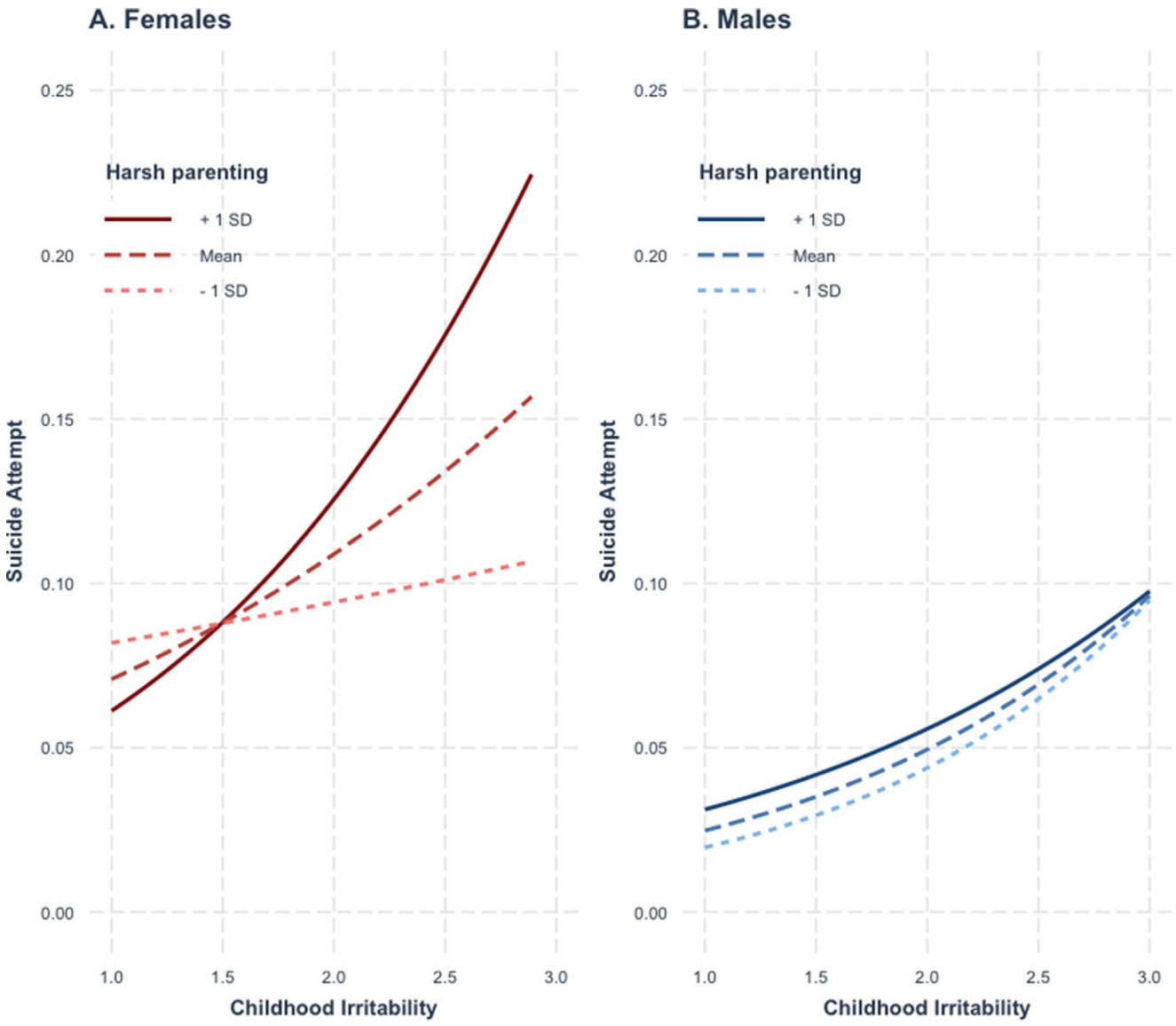

Figure 1. Interaction between childhood irritability and harsh parenting in the association with adolescent suicide attempt, stratified by sex.

results were observed in the multivariable model. In contrast, males with greater irritability scores were more at risk to attempt suicide regardless of exposure to harsh parenting (OR=1.77, 95% CI=1.20–2.61; aOR=1.41, 95% CI=0.91–2.21; Figure 2). Models run with (Supplementary Tables S4 and S5) and without imputation of missing data (Supplementary Tables S6 and S7; n in the non-imputed models = 4621) yielded similar results.

Moderating role of harsh parenting in the association between childhood irritability and self-harm

The association between childhood irritability and self-harm was not moderated by harsh parenting in either the univariable (log[OR], 0.15; SE, 0.12; $p = 0.190$) or multivariable (log[aOR], 0.11; SE, 0.12; $p = 0.353$) model. There was also no significant three-way interaction between child sex, childhood irritability, and harsh parenting in the association with self-harm (log[OR], −0.140; SE, 0.24; $p = 0.570$). The multivariable model indicated similar results (log[aOR], −0.16; SE, 0.25; $p = 0.502$). Furthermore, sex-stratified analyses suggested no significant interaction between childhood irritability and harsh parenting in female (log[OR], 0.14; SE, 0.18; $p = 0.440$) or male (log[OR], 0.14; SE, 0.20; $p = 0.50$) participants (Figure 3). In the sensitivity analyses, associations were estimated using irritability and harsh parenting at each time point (3, 5, and 7 years), which are reported in Supplementary Table S8.

Discussion

The purpose of this study was to examine the role of harsh parenting in the association of childhood irritability with adolescent suicide attempt and self-harm while investigating potential sex differences in these associations. Using a large, population-based cohort, we found that children with higher irritability scores were more at risk to attempt suicide in adolescence regardless of sex. When examining harsh parenting as a potential moderator of the association between childhood irritability and adolescent suicide attempt, significant sex differences emerged. The risk of suicide attempt was particularly elevated among female participants with greater childhood irritability scores who were also exposed to high

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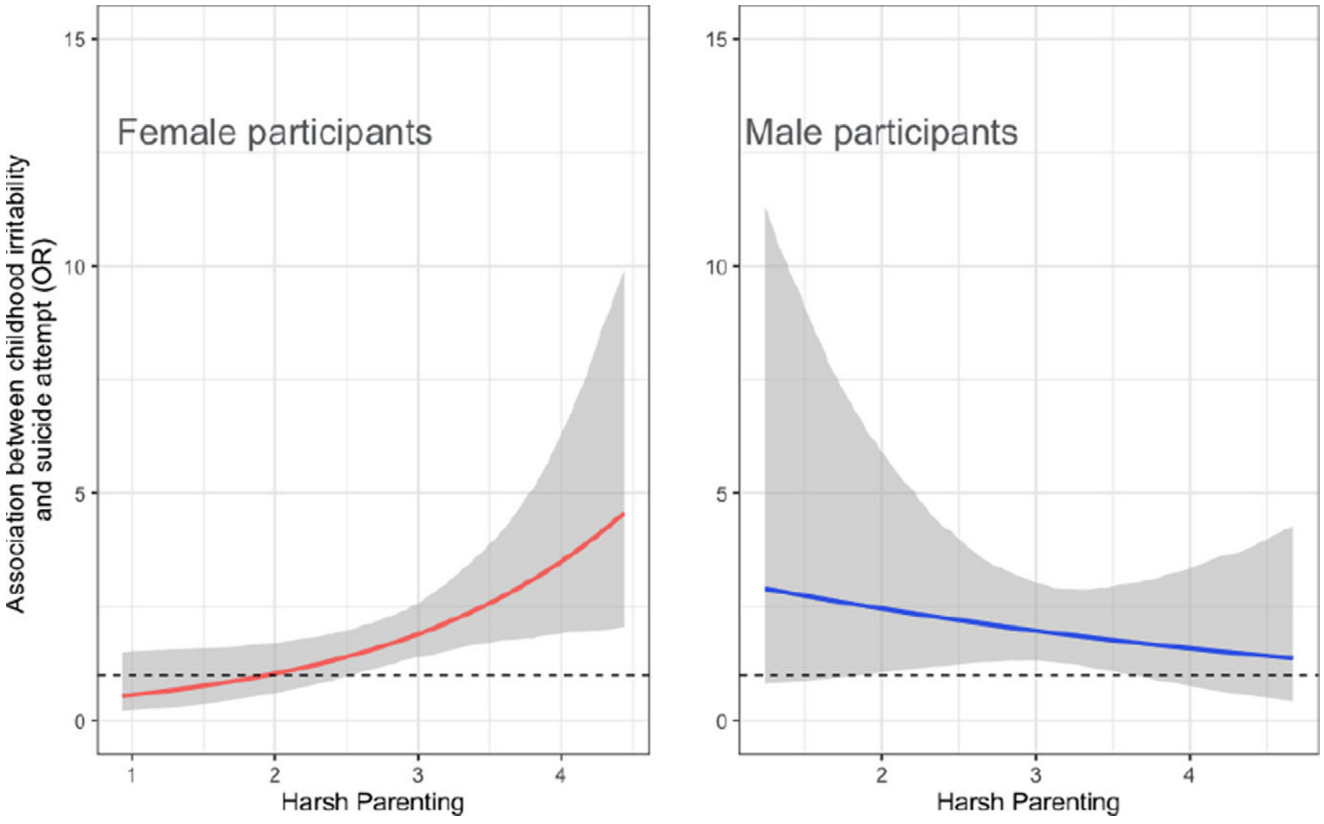

Figure 2. Association between childhood irritability and adolescent suicide attempt (OR) in females and males, as a function of harsh parenting.

levels of harsh parenting. In male participants, childhood irritability was associated with suicide attempt regardless of the exposure to harsh parenting. We also found that regardless of sex, children with greater irritability scores were more at risk to engage in self-harm in adolescence. However, in contrast to suicide attempt, harsh parenting did not moderate the association between childhood irritability and adolescent self-harm.

Our findings are consistent with previous studies that show childhood irritability to be associated with adolescent suicide attempt and self-harm in both males and females (Orri et al., 2019; Srinivasan et al., 2024). However, a study by Srinivasan et al. (2024) found that, compared to females with relatively high irritability, males with similar irritability scores were significantly more at risk to self-harm at 14 years old. This difference could be attributed to the age that self-harm was measured, thus suggesting that this increasing tendency of males with irritability to self-harm compared to females fades away in later phases of adolescence. It is also important to compare our findings on the interplay between harsh parenting and childhood irritability on suicide-related outcomes with other research on harsh parenting and suicide-related outcomes. A study by Kingsbury et al. (2020a) found exposure to harsh parenting at 6- to 7-year-old to be predictive of later suicidal ideation specifically among males. This suggests that the role of harsh parenting in suicide-related outcomes may be sex-specific, which is consistent with our results. Our study adds to the literature that females with irritability, but not males, are more susceptible to harsh parenting with respect to suicide attempt risk.

Several mechanisms can explain the associations found in our study. Children with greater irritability scores may be more at risk to attempt suicide due to a persistence of childhood irritability into adolescence, a relationship that has been found to be moderated by negative parenting behaviors (Ravi et al., 2023). More specifically, as suggested by a gene-environment correlation, children with high irritability may evoke the use of harsher parenting practices in their parents, who may themselves be at risk for irritability given its heritability (Roberson-Nay et al., 2015), thereby increasing their susceptibility to developing psychopathology (Barrios, Bufferd, Klein, & Dougherty, 2017; Kingsbury et al., 2020b). Children may also develop irritability because of harsh parenting. In fact, a study by Oliver (2015) showed that twins exposed to harsh parenting practices demonstrated more childhood irritability than their co-twins, highlighting the important role of non-shared environments in the relationship between harsh parenting and childhood irritability. Exposure to harsh parenting behaviors may also model maladaptive reactions, such as insufficient social skills and ineffective emotion regulation strategies. This may result in a perpetual cycle where harsh parenting by irritable parents reinforces irritable behaviors in their children, leading to even harsher parenting behaviors, which may exacerbate or maintain irritability into adolescence (Chang, Schwartz, Dodge, & McBride-Chang, 2003; Gu et al., 2023).

The moderating role of harsh parenting in the association of childhood irritability and adolescent suicide attempt may be explained by stress reactivity (including hypothalamic–pituitary–adrenal axis dysregulation). Harsh parenting and childhood irritability may jointly contribute to elevated reactivity to stress in children, ultimately increasing the risk of adolescent suicide attempts (Berardelli et al., 2020; O'Connor, Ferguson, Green, O'Carroll, & O'Connor, 2016; Steinberg & Mann, 2020). In our study, this interaction was observed only in female participants, which may be due to differences between sexes in response to psychosocial stimuli (Conley & Rudolph, 2009; Kendler, Thornton,

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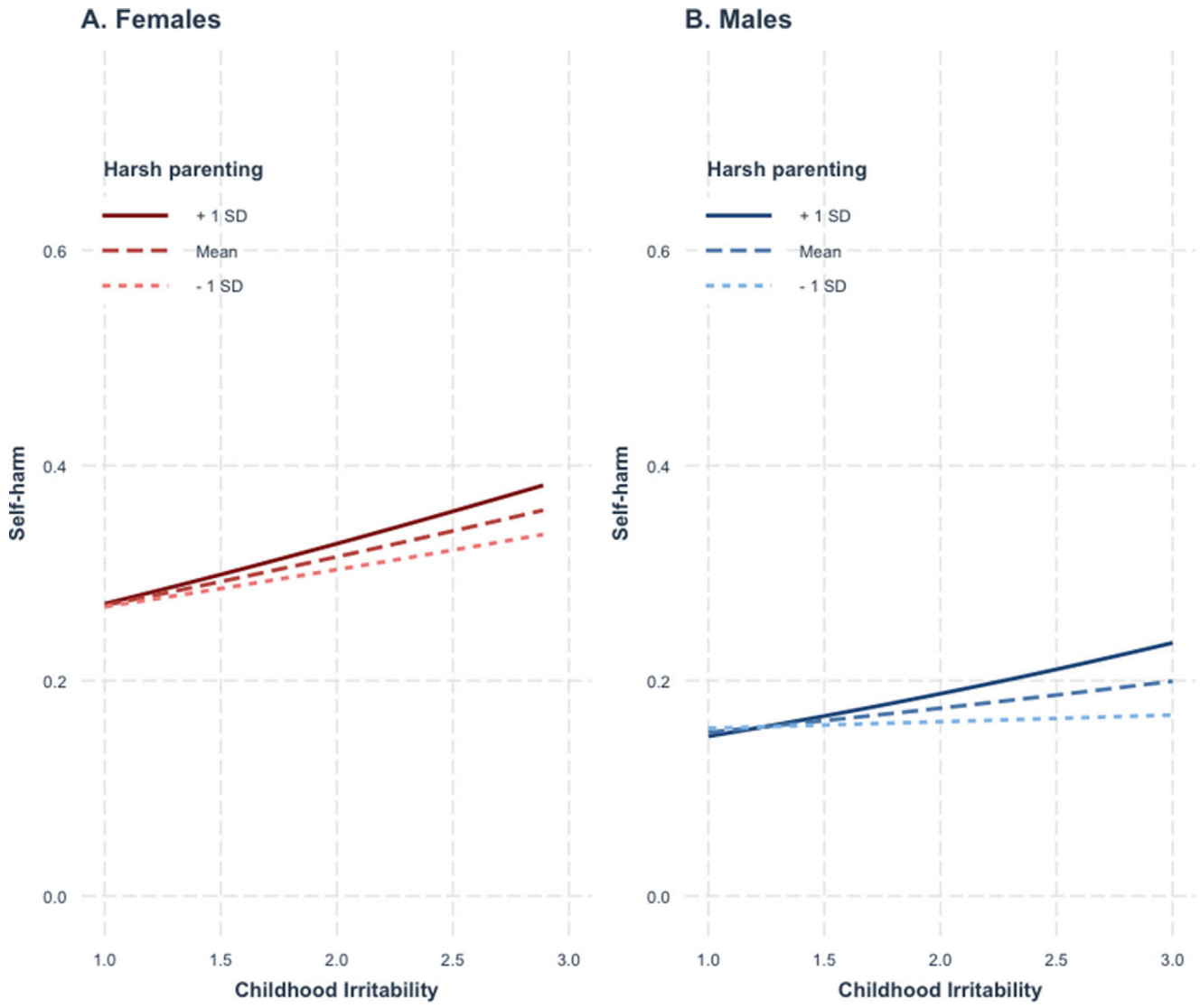

Figure 3. Interaction between childhood irritability and harsh parenting in the association with adolescent self-harm, stratified by sex.

& Prescott, 2001; Shih et al., 2006). For example, a study found that interpersonal stressors were predictive of adolescent depression in females but not in males (Shih et al., 2006). This may suggest that females, compared to males, are more sensitive to interpersonal stressors (i.e. their relationship with others), possibly making them more vulnerable to exposure to harsh parenting. Further research is required to understand the sex-specific associations between harsh parenting and later suicide-related outcomes among irritable children, also considering that the exposure to harsh parenting of male and female children can be quantitatively and qualitatively different.

We found that harsh parenting did not moderate the association between childhood irritability and adolescent self-harm, which may reflect different etiological mechanisms underlying suicide attempt and self-harm. Specifically, studies have proposed that individuals who self-harm use different coping mechanisms (dissociative vs. reactive) compared to individuals who attempt suicide (Reichl et al., 2019). For instance, while suicide attempt is motivated by a desire for relief through death, self-harm is motivated by a reduction in physiological arousal (i.e. affect regulation) (Nock & Muehlenkamp, 2014). Such different coping strategies may also be applied to cope with interpersonal stressors, such as harsh parenting, resulting in different associations with self-harm versus suicide attempt. Clarifying these differences in future studies would be informative for tailoring interventions to prevent self-harm and suicide attempt among irritable youth.

Our results have implications for youth suicide prevention. In line with previous research (Benarous et al., 2019; Orri et al., 2019), our study identified childhood irritability as a predictor of later suicide attempt and self-harm, suggesting the importance of behavioral interventions targeting childhood irritability. Improving social skills, coping mechanisms, and emotion regulation strategies in children with irritability can have long-term positive effects on reducing adolescent suicide risk (Forte et al., 2021; Srinivasan et al., 2024). Although our study only measured irritability in childhood, future studies should measure irritability across development (i.e. throughout childhood, adolescence, and adulthood) as its persistence is associated with psychopathology (Eshel & Leibenluft, 2020). Moreover, given the important role of harsh parenting, interventions for suicide prevention in irritable children should adopt a multidimensional approach in which child and parent(s) are both engaged to simultaneously reduce irritability in the child

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and modify parenting practices (Li et al., 2023; Oliver, 2015; Ravi et al., 2023). While such approaches may be effective in reducing self-harm and suicide attempt risk in both males and females, our findings highlight the importance of addressing harsh parenting as a modifiable risk factor in families with irritable children, particularly females, to reduce the risk of suicide outcomes. These associations, however, were not observed in males, suggesting the need to explore alternative pathways and male-specific moderators in the association between childhood irritability and suicide attempt.

Strengths and limitations

Our study is based on a large longitudinal population-based cohort in which participants were followed from 9 months to 23 years of age. Childhood irritability and harsh parenting were measured at multiple time points (3, 5, and 7 years old), guaranteeing a more robust measure than assessments at a single time point. Measures of adolescent self-harm also probed 13 different methods, thus capturing a wide range of self-harm behaviors. Despite these strengths, our study has limitations. Our study relies on self-reported measures, which can be subject to reporting bias. For instance, parents may inaccurately report their own harsh behaviors, often underestimating their harshness or severity due to social desirability. Similarly, suicide attempt and self-harm may have been underreported by adolescents because of stigma. Measures of harsh parenting and childhood irritability were both reported by parents, which may have introduced bias related to shared method variance. Furthermore, as in a previous study using the same data (Srinivasan et al., 2024), the internal consistency of childhood irritability measures were low. Items of childhood irritability were chosen to reflect its clinical definition, but the low reliability of the measure may be due to the items originating from different questionnaires. It is also important to recognize that our measure of childhood irritability primarily captures phasic rather than tonic irritability. While these dimensions are highly correlated (DeGroot, Silver, Klein, & Carlson, 2024), this distinction is important to consider when interpreting our findings. Future research, particularly suicide research, should aim to examine both irritability dimensions, as prior studies (Liu & Cole, 2021; Liu, Nestor, & Cole, 2021) have demonstrated that tonic and phasic irritability may differentially predict suicidal outcomes. Expanding this line of research could provide a more nuanced understanding of the mechanisms linking irritability to suicidality. Missing data due to attrition may have affected the generalizability of our findings as the analysis sample was different from the initial representative sample. Finally, while we were able to control for many covariates, some confounding factors remain uncontrolled for. This includes genetics, which likely partially explain the correlation between childhood irritability and harsh parenting (Ayoub et al., 2019). Therefore, it is unclear to what extent our associations reflect causal mechanisms.

Conclusion

This study found that childhood irritability contributed to an increased risk of suicide attempts later in adolescence. For males, the risk increased similarly regardless of the presence of harsh parenting. However, for females with greater irritability scores, the risk was substantially higher if they were also exposed to high levels of harsh parenting. This suggests that females with irritability may be more sensitive to the social environment than males. For both sexes, irritability was also associated with an increased risk of self-harm, irrespective of exposure to harsh parenting. Suicide prevention interventions targeting both childhood irritability and harsh parenting practices, particularly in females, may be beneficial in reducing risk of later suicidal behaviors among irritable children.

Supplementary material. The supplementary material for this article can be found at http://doi.org/10.1017/S0033291725000704.

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Author contribution. Ms. Rosialda, Ms. Zephirin, and Dr. Orri conceptualized the study. Ms. Rosialda and Ms. Zephirin conducted the statistical analyses and Ms. Rosialda wrote the initial draft of the manuscript. Dr. Orri supervised the study in its entirety. All authors contributed to data interpretation and drafting of the final manuscript.

Ethical standard. Prior to the distribution of surveys, letters were distributed to outline an overview on information about participation. Written consent was also obtained from parents for their involvement and that of their children. Parental consent was also requested to collect data from health, education, and economic records, as well as from teachers.

When parental consent was given for their child(ren)'s participation in any part of a survey, the child's assent and cooperation were also required. Throughout the duration of the study, participants had the right to decline participation in any survey element or to withdraw from the study at any time, regardless of any previously given consent or assent, simple by expressing their desire to do so.

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