Identifying environmental pathways between irritability during childhood and suicidal ideation and attempt in adolescence: findings from a 20-year population-based study

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Abstract

Background. Irritable children are at increased risk of suicidal ideation and suicide attempt, but the underlying environmental mechanisms accounting for these associations are largely unknown. We aimed to investigate the mediating role of peer victimization and harsh parenting in the association between childhood irritability and adolescent suicidal ideation and attempt.

Method N=1483 participants from the Québec Longitudinal Study of Child Development followed up from 5 months until 20 years of age (2018) with annual or biannual assessments. Irritability was operationalized using assessments of teacher-reported temper tantrums and reactive aggression. Suicidal ideation and suicide attempt at ages 13, 15, 17, 20 years were self-reported. Peer victimization (self-reported at age 13) and harsh parenting (mothers reported at age 13) were considered as potential mediators.

Results. We identified four trajectories of teacher-reported irritability symptoms from 6 to 12 years: low (74.8%), rising (12.9%), declining (7.3%), and persistent (4.9%). In adjusted models, children in the persistent and rising trajectories had respectively 2.81-fold (CI, 1.27-6.22) and 2.14-fold (CI, 1.20-3.81) increased odds of suicide attempt in adolescence, but not suicidal ideation. We found that a significant proportion of the association between irritability trajectories and suicide attempt was mediated by peer victimization (33% and 35% for rising and persistent, respectively), but there was no mediation via harsh parenting.

Conclusions. Our findings suggest that peer victimization may be a key mechanism explaining the increased suicide attempt risk of children presenting with persistently high or increasing irritability. Interventions to reduce peer victimization may be helpful to reduce suicide risk among irritable children.

Keywords: Irritability, suicidal ideation, suicide attempt, adolescence, longitudinal, birth cohort.

Introduction

Suicide among youth is a main cause of mortality worldwide, and the second cause in the 15-24 age range (Khan et al., 2018; Ray, Guttmann, Silveira, & Park, 2020; WHO, 2016). While mortality rates declined across most major causes of death from 1999 to 2002 and 2012 to 2015, suicide for 10-24 year-olds remained stable or even increased (Khan et al., 2018). Serious suicidal ideation and suicide attempt are among the strongest and most consistently identified risk factors for recurrent suicide attempt and suicide mortality (Geoffroy, Orri, Girard, Perret, & Turecki, 2020; Hawton et al., 2020; Turecki et al., 2019). Therefore, the identification of modifiable risk factors for suicidal ideation and suicide attempt might be key to prevent suicide, especially among vulnerable adolescents.

Prior studies pointed at irritability in childhood as important factor contributing to suicidal ideation and attempt in adolescence (Conner, Meldrum, Wieczorek, Duberstein, & Welte, 2004; Orri et al., 2019; Orri, Galera, et al., 2018; Orri, Perret, Turecki, & Geoffroy, 2018; Pickles et al., 2010). Irritability manifest with frequent temper outbursts typically occurring in response to frustration and can be verbal or and behavioral (e.g., aggressive reaction toward people or objects) (American Psychiatric Association, 2013; Leibenluft, 2017a; Orri, Galera, et al., 2018). Irritability is more frequent in toddlerhood and decreases with age (Leibenluft & Stoddard, 2013). However, several studies demonstrated that the course of irritability is highly heterogeneous and identified groups of children showing persistently high, declining, or rising irritability symptoms during childhood (Caprara, Paciello, Gerbino, & Cugini, 2007; Orri et al., 2019; Orri, Galera, et al., 2018; Wiggins, Mitchell, Stringaris, & Leibenluft, 2014). These studies also showed that children following different trajectories of irritability have different risk of experiencing mental health problems in adolescence (Orri et al., 2019; Orri, Perret, et al., 2018; Wiggins et al., 2014).

In a recent study based on the Quebec Longitudinal Study of Child Development (QLSCD), we found that children showing persistently high and rising irritability levels during middle childhood were more likely to report suicidal ideation and/or suicide attempt at ages 13-17 years

(Orri et al., 2019). This study also pointed at depression in early adolescence as important mediator of this association (Orri et al., 2019). However, the environmental mechanisms explaining why children with irritability are at increased risk of suicidal ideation and/or attempt are largely unknown. Given the role of environmental factors in the development of suicidal behavior (Turecki et al., 2019; Turecki, Ernst, Jollant, Labonté, & Mechawar, 2012), it is important to identify environmental mechanisms that can be modified via preventive interventions, as these could reduce suicidal risk among irritable children. In this study, we investigated the role of two potential environmental mechanisms: peer victimization and harsh parenting.

We focused on these two putative mechanisms for three reasons. First, the Disruptive Mood Dysregulation Disorders, a syndrome whose main feature is severe irritability (American Psychiatric Association, 2013), may lead to impairment in interpersonal functioning. In fact, irritable children are more likely to be exposed to negative interpersonal experiences, including peer victimization and harsh parenting (Barker et al., 2008; Barker & Salekin, 2012; M. Boivin & Hymel, 1997; Michel Boivin, Hymel, & Hodges, 2000; Pellegrini, Bartini, & Brooks, 1999; Toblin, Schwartz, Hopmeyer Gorman, & Abou-ezzeddine, 2005). Several studies reported associations between childhood irritability and parenting behaviors, such harshness and hostility (Michel Boivin et al., 2005; Kiff, Lengua, & Zalewski, 2011; Oliver, 2015). It was documented that irritability may drive negative parenting in middle childhood, suggesting a specific pathway linking childhood irritability to negative parenting (Deater-Deckard, 2000; Oliver, 2015). Second, both peer victimisation (Barzilay et al., 2017; M.-C. Geoffroy et al., 2016; Gini & Espelage, 2014; van Geel, Vedder, & Tanilon, 2014) and harsh parenting (Connor & Rueter, 2006; Donath, Graessel, Baier, Bleich, & Hillemacher, 2014; Lai & McBride-Chang, 2001) have been consistently identified as risk factors for suicidal ideation and attempt. Third, both peer victimization and harsh parenting are modifiable risk factors. Evidence-based psychosocial interventions are available for the reduction of peer victimization (Bonell et al., 2018; Flannery et al., 2016; La Greca, Ehrenreich-May, Mufson, & Chan, 2016; Ttofi

& Farrington, 2011) and for parenting support and training (Barlow, Bergman, Kornør, Wei, & Bennett, 2016; Dawson-McClure et al., 2015; Furlong et al., 2013; Moon, Damman, & Romero, 2018). To the best of our knowledge, no study to date has investigated whether peer victimization and harsh parenting mediate the association between irritability and suicidal ideation and attempt.

In this study, we tested the putative role of peer-victimization and harsh parenting in the association between childhood irritability and suicidal ideation and attempt in adolescence. As for previous studies from our group, we relied on longitudinal data from the QLSCD to examine a research question not previously investigated (Orri et al., 2019). Further, we integrated data recently collected (in 2018) on suicidal ideation and suicide attempt when participants were 20 years of age. This enabled us to examine longer-term associations of irritability with suicidal ideation and attempt (our prior publications used data collected up to 17 years of age) and to increase our sample size in order to examine distinctive associations of irritability with suicidal ideation and attempt (instead of combining ideation/attempt).

Methods

Participants

Participants were from the QLSCD, conducted by the Institute de la Statistique du Québec. This cohort included 2120 children born in 1997/1998, selected with a stratified random procedure, from a mother residing in the Canadian province of Québec (Orri, Boivin, et al., 2020). Mothers were included if gestation lasted from 24 to 48 weeks and they were able to speak French or English. Children were followed up from 5 months until 20 years of age (2018) with annual or biannual assessments. Analyses were based on 1483 children (representing 70% of the original sample) for which information on suicidal ideation and suicide attempt at ages 13, 15, 17, and 20 years (at least one data point) and irritability at ages 6, 7, 8, 10 and 12 years (at least one data point) were available. Table 1 shows the main sociodemographic characteristics of the children included in the analysis

sample, who were more likely to be male and less likely to come from socioeconomically disadvantaged families than those nonincluded. To account for these differences, analyses were performed using inverse probability weighting, in which weights were estimated from variables independently predicting missingness at follow up (i.e., sex, socioeconomic status, oppositional behavior at age 17 months).

Measures

Trajectories of childhood irritability. Teachers rated children on the Behavior Questionnaire at 6, 7, 8, 10, and 12 years of age. The Behavior Questionnaire was created for the Canadian National Longitudinal Study of Children and Youth and incorporates items from the Child Behavior Checklist, the Ontario Child Health Study Scales, Preschool Behavior Questionnaire (Murray, Eisner, & Ribeaud, 2019). In line with our prior publications (Orri et al., 2019; Orri, Galera, et al., 2018), irritability was operationalized as temper tantrums and reactive aggression and measured with 4 items, three of which assessing reactive aggression; "reacted in an aggressive manner when teased," "reacted in an aggressive manner when contradicted," and "reacted in an aggressive manner when something was taken away from him/her" in addition to one item assessing temper tantrum: "had temper tantrums/hot temper". Items were rated using a 3-point Likert scale according to the frequency of the behavior in the past 6 months (0 indicates never; 1, sometimes; and 2, often). As in prior publications (Orri et al., 2019; Orri, Galera, et al., 2018), we calculated the irritability score by averaging the 3 items measuring reactive aggression (because they measure the same behavior in different contexts) and then summing the single item measuring temper tantrum. In this way, these two components have the same weight in the final score (see Supplementary material for additional information). To account for the heterogeneous development of irritability, we used latent class growth analysis to distinguish four developmental trajectories of childhood irritability from 6 to 12 years (Figure 1; detailed elsewhere) (Orri et al., 2019): (1) low (n=1,110, 74.8%), showing low levels of irritability at all ages; (2) rising (*n*=191, 12.9%), initially showing low levels of irritability which

gradually increased over time; (3) declining (*n*=109, 7.3%), initially showing high levels of irritability gradually declining over time; (4) persistent (*n*=73, 4.9%), showing stable high levels of irritability at all time points. Our trajectories capture changes in behavioral manifestation of irritability (temper outburst and reactive aggression), rather than mood, as our measure of irritability was based on teacher-reports (self-reports were not available).

Suicidal ideation and suicide attempt by age 20 years. At age 13, 15, 17, and 20 years participants were asked: "in the past 12 months, did you ever seriously think of attempting suicide" and, if yes, "how many times did you attempt suicide" (Côté et al., 2017; Geoffroy et al., 2016). At age 20 years, they were additionally asked if they "ever went to the emergency department for a suicide attempt", and if they "have ever been hospitalized for a suicide attempt". Lifetime (i.e., by age 20) suicidal ideation and suicide attempt were derived based on participants' responses: (a) *serious suicidal ideation,* if they reported any serious suicidal ideation at any age, but never attempted suicide, and (b) *suicide attempt* if they reported having attempted suicide (and/or hospitalization/emergency visit for a suicide attempt) at any age.

Potential mediators. Two potential mediators were considered: peer victimization and harsh parenting. Peer victimization since the beginning of the school year (most participants were in their first year of secondary school) was self-reported at around age 13 years using a modified version of the Self-report Victimization Scale (Ladd & Kochenderfer-Ladd, 2002). The scale measures the children perception about being targeted by the aggressive behaviors of other children. Specifically, the 7 items (Cronbach alpha, 0.81), administered in the second half of the school year (February to June), assessed 4 types of victimization: physical (e.g., "pushed/hit/kicked you"), verbal (e.g., "called you names/said mean things"), relational (e.g., "being excluded from groups") and cybervictimization (e.g., "insulted/ threatened/ intimidated you on the Internet and cell phone"). Their frequency was reported using a 4-point Likert scale (never to very often). Harsh parenting, reported by the mother at age 13 years, was assessed using 4 items (Cronbach alpha, 0.64) from

Strayhorn and Weidman's Parent Practices Scale, previously used in the Canadian National Longitudinal Survey of Children and Youth. The items measure harsh/coercive behaviors such as giving punishments that depend on the parents' mood, and using physical punishment (e.g., "In the past 12 months, how often did you hit him/her when he/she was difficult?", "In the past 12 months, how often did you get angry when you punished him/her?"). The frequency of these behaviors in the last year was reported using a 5-point Likert scale (e.g., 1–2 times/week to several times/day).

Covariates. The following covariates, measured at baseline (6 years), were considered as adjustment variables in the models: sex; socioeconomic status (SES), measured with an aggregate of 5 items regarding parental education, parental occupation, and annual gross income (range -3 [low] to 3 [high], 0 centered) (Willms & Shields, 1996); externalizing (e.g., aggression/opposition) and internalizing (e.g., anxiety/depression) symptoms, respectively measured using 9 and 7 items assessed by teachers using the Social Behavior Questionnaire (Murray et al., 2019). We additionally adjusted for baseline peer-victimization and harsh parenting, assessed with the same items used at age 13 years (except for the cyber-victimization item, not administered at age 6).

Data analysis

We conducted a mediation analysis in Mplus version 7.3 statistical software. To take into account the categorical nature of the outcomes, liability-threshold models were estimated. Missing data on the covariates and on the mediators were handled using Full Information Maximum Likelihood, and standard errors were calculated using the robust Huber-White estimator to account for non-normal distributions. The model enabled us to estimate the direct, indirect, and total associations of irritability trajectories with suicidal ideation and suicide attempt, as follows (MacKinnon, Fairchild, & Fritz, 2007): (a) total association is the unadjusted association between irritability trajectories and suicide-related outcomes, (b) indirect association is the association between irritability trajectories and outcomes that passes through (is explained by) a putative mediator, and (c) direct association is the association between irritability trajectories and outcomes that is not explained by the putative

mediator (i.e., the remaining association once we adjusted for the effect of the mediator). The total association corresponds to the sum of the direct and indirect associations. We also estimated the proportion of the total association accounted for by each mediator using the ratio between indirect and total associations, which represents the effect of the exposure on the outcome attributable to the mediator. Mediation models were estimated for the outcomes for which we found evidence of total association. In the first step, we estimated simple mediation models, in which each putative mediator was considered separately. In a second step, both mediators were considered in the same model with 2 parallel mediators. The models were all adjusted for the selected covariates and were reported for boys and girls combined (*Ps* for sex interaction>0.5).

Ethics approval

The Ethics Committee of the Institut de la Statistique du Québec and the Research Ethics Board of the CHU Sainte-Justine Research Center approved each phase of the study, and informed consent was obtained.

Results

Association of irritability trajectories with suicidal ideation and suicide attempt

Rates of suicide attempt were higher among children in the persistent and rising irritability trajectories, compared with those in the low and declining trajectories (Table 2). Children in the persistent and rising trajectories, compared to those in the low trajectory, had respectively 2.57-fold (odds ratio [OR], 2.57; 95% confidence interval [CI] 1.29-5.12) and 2.03-fold (OR, 2.03; CI, 1.21-3.40) increased odds for suicide attempt. Associations with suicide attempt remained and even strengthen in models adjusting for covariables: 2.81-fold (adjusted OR, 2.81; CI, 1.27-6.22) for the persistent trajectory and to 2.14-fold (adjusted OR, 2.14; CI, 1.20-3.81) for the rising trajectory. No increased risk of suicide attempt was observed for the declining trajectory in the unadjusted (OR, 0.92; CI, 0.43-1.98), and adjusted model (adjusted OR, 0.95; CI, 0.42-2.15).

For suicidal ideation, there was no association with the irritability trajectories in both unadjusted and adjusted models. Specifically we did not observe increased odds of suicidal ideation for children in the persistent (adjusted OR, 1.31; CI, 0.53-3.23), rising (adjusted OR, 1.07; CI, 0.61-1.89), and declining (adjusted OR, 1.09; CI, 0.52-2.31) trajectories, compared to children in the low trajectory (Table 2).

Association of peer victimization and harsh parenting with suicidal ideation and suicide attempt

We found a significant association between peer victimization and both suicide attempt (adjusted OR for 1-SD increase in peer victimization, 1.66; CI, 1.38-1.99) and suicidal ideation (adjusted OR for 1-SD increase in peer victimization, 1.28, CI, 1.04-1.28)). Moreover, we found an association between harsh parenting and suicide attempt (adjusted OR for 1-SD increase in harsh parenting, 1.25, CI, 1.03-1.54), but not suicidal ideation (adjusted OR for 1-SD increase in harsh parenting, 1.18, CI, 0.96-1.46).

Indirect associations between irritability trajectories and suicide attempt

Mediation analyses were used to decompose the association between persistent and rising irritability trajectories and suicide attempt into direct and indirect associations. In fully adjusted models, we found that children in these trajectories experienced higher levels of peer victimization at age 13 years than children in the low trajectory (Rising, B, 0.49; SE, 0.10, $P < 0.01$; Persistent, B, 0.75; SE, 0.20, $P < 0.01$). Children in the persistent trajectory also experienced harsher parenting (B, 0.36; SE, 0.02, $P = 0.049$) than children in the low trajectory, but the association between rising trajectory and harsh parenting was only significant at a trend level (B, 0.16; SE, 0.08, $P = 0.060$). Compared to children in the low trajectory, children in the declining trajectory experienced higher levels of peer victimization (B, 0.27; SE, 0.12; $P = 0.026$), but not higher level of harsh parenting (B, 0.13; SE, 0.12; $P = 0.286$), compared to children in the low trajectory.

The model investigating the mediating role of peer victimization is depicted in Figure 1A. We found that peer victimization mediated a significant proportion of the association between rising and persistent irritability trajectories and suicide attempt (indirect effects: adjusted OR, 1.42; CI, 1.13-1.81 for the persistent trajectory; adjusted OR, 1.26; CI, 1.11-1.43 for the rising trajectory; Table 3). The proportion of the association mediated by peer victimization was 33% and 35.1% for the rising and persistent trajectory, respectively. Conversely, we found that harsh parenting mediated only a small proportion of the association between rising (4.3%) and persistent (7.0%) irritability trajectories and suicide attempt, with indirect effects not reaching the conventional significance threshold (adjusted OR for the indirect effect, 1.07; CI, 0.97-1.19 for the persistent trajectory; OR, 1.03; CI, 0.99-1.08 for the rising trajectory; Figure 1B).

The multiple mediation model where both mediators were analyzed jointly showed virtually identical results (Table 3).

Discussion

The aim of this study was to investigate the role of two putative environmental mediators, peer victimization and harsh parenting, in the pathway linking childhood irritability to suicidal ideation and attempt in adolescence. Using a prospective 20-year birth cohort from the Canadian province of Québec, we found that peer victimization mediated a significant proportion of the association between irritability and suicide attempt, but not suicidal ideation. Specifically, we found that children following rising and persistent trajectories of irritability in childhood were more likely to attempt suicide in adolescence, and that 33-35% of this risk was explained by exposure to peer victimization. We did not find evidence for a mediating role of harsh parenting in the association between rising and persistent irritability trajectories and suicide attempt. Moreover, we found that children in the declining trajectory were not at higher risk of suicidal ideation and attempt, as previously reported for an earlier age (Orri et al., 2019).

To our knowledge, this is the first study showing that peer victimization, a putative psychosocial environmental mediator, explain part of the association between childhood irritability and suicide attempt in adolescence. This finding is in line with the failure model (Patterson & Stoolmiller, 1991), stating that children showing reactive aggressive behaviors caused by heightened irritability exhibit poorer social skills, greater levels of rejection by peers, and received lower levels of social support. In turns, these peer-related problems put them at risk for negative outcomes such as suicidal ideation and attempt. For instance, Barker and colleagues showed a link between irritability in childhood, peer victimization, and internalizing psychopathology at the beginning of adolescence (Barker & Salekin, 2012). Our study extends this finding by showing that peer victimization mediates the association between irritability and suicide attempt up until late adolescence.

It is plausible that irritability and behavioral reactivity trigger hostile and conflicting relationships with peers exacerbating irritable symptoms, lowering self-esteem, and in the context of emotionally and behaviorally reactive youths leads to suicide attempt rather than just suicidal ideation. This might explain recent findings on the association between irritability and suicidal behavior (Benarous et al., 2019; Orri et al., 2019), which suggested that irritable children might have a higher risk for suicide attempt because irritability lead to "impulsive–reactive aggressive" behaviors which are an important pathway to suicide attempt. Our findings add to this model by suggesting that peer victimization may be a mechanism underlying this pathway (Benarous et al., 2019; Brezo, Paris, & Turecki, 2006; McGirr et al., 2008).

In line with previous findings (Oliver, 2015), we found that children with persistent irritability experienced harsher parenting practices than children with low levels of irritability. However, we did not find a mediation effect of harsh parenting in the association between irritability and suicide attempt, suggesting that this is not a mechanism accounting for the heightened suicidal risk of irritable children. However, the relations between parenting practices and child behavior are

complex and involve bidirectional effects that need to be clarified to better understand the links to suicidal behavior (Kiff et al., 2011). In particular, in our study, parenting was assessed when participants were 13 years of age, which may have a different developmental meaning and different effects on child behavior than parenting measured in early or middle childhood. Future studies investigating the role of parenting in different developmental stages are necessary to understand whether, and at which time point, parenting may have a role in the association between irritability and suicide attempt.

Noteworthy, we did not find an association between irritability and suicidal ideation by adolescence, which differs from a previous report showing associations with suicidality (defined as reporting suicidal ideation and/or attempt) during adolescence (13-17 years) (Orri et al., 2019). This may indicate that the previously reported association with suicidality was mainly driven by increase in suicide attempt risk, rather that suicidal ideation.

Our findings have implications for prevention of suicide attempt among irritable children. For example, as novel and more specific psychotherapeutic approaches for irritability are emerging (Haller et al., 2018), these should also target relationship problems with peers, such as victimization. Improving social skills in irritable children may be a way to prevent negative relationships with peers, in turn reducing later suicide risk (Lee & DiGiuseppe, 2018; Sukhodolsky, Smith, McCauley, Ibrahim, & Piasecka, 2016), but a better understanding of why irritable children are more prone to experiencing peer victimization is necessary to inform such interventions. Moreover, further studies are needed to clarify whether currently available treatments for irritability, both pharmacological (Towbin et al., 2020) and psychotherapeutic (Benarous et al., 2017), might be effective to additionally reduce suicide-related outcomes in adolescents. Importantly, these studies should consider both mood and behavioral aspects of irritability, as only considering one of theme is likely to only partially address this problem.

The present study relied on a large population sample followed from birth to 20 years with prospective assessments of irritability by different schoolteachers and self-reports of suicidal ideation and suicide attempt over 5 years. Given the key role of teachers in youth suicide prevention strategies (Wasserman et al., 2015), our findings confirm that kindergarten and early elementary school teachers are an important resource for identifying and perhaps helping them. Additionally, the repeated assessments of irritability allowed us to identify at-risk children according to their developmental trajectory of irritability. However, limitations should be acknowledged. First, as in most longitudinal cohorts, attrition occurred, thus affecting our capacity to generalize our findings to the initial population. However, weights were used in all analyses to increase the representativeness of the sample. Second, at the 15, 17 and 20-year assessments we measured recall of the past 12 months for suicidal ideation and attempt. This means that we potentially missed cases that occurred during the 16th, 18th and 19th year, thus underestimating our associations. This bias might have been partially addressed by the lifetime questions at age 20 years. Third, the irritability items reflect the DSM-5 definition of Disruptive Mood Dysregulation Disorders (American Psychiatric Association, 2013), and provide an assessment which is psychometrically sound (Orri, Perret, et al., 2018), but comparisons between our findings and other studies should take into account differences in how the irritability construct is measured. Furthermore, it can be argued that the present study focused mainly on phasic irritability/reactive aggression (temper outbursts that usually occur in response to frustration), rather than tonic irritability (long lasting mood) (Leibenluft, 2017b). However, our irritability measures relied on teacher-reports, thus on behaviors exhibited in the school context rather than clinical mood evaluations. Indeed, as external assessors, teachers evaluated observed behavior (e.g., tantrum, over-reactivity) from which mood was infered, and not mood itself (i.e., an inner experience of being angry). We were not able to assess irritable mood in those cohort, as in childhood self-reports were not available. For this reason, it may be difficult to precisely differentiate between irritability and other overlapping constructs such as impulsive or reactive aggression (Orri,

Geoffroy, et al., 2020; Orri, Perret, et al., 2018; Toohey & DiGiuseppe, 2017). The current development of specific measures of pediatric irritability (Wiggins et al., 2018), as opposed to the reliance on items from existing questionnaires as in our and other's studies (e.g., Wiggins et al. 2014), will enable a more precise assessment of this construct in the future. Fourth, both peer victimization and suicidal ideation and attempt were self-reported, which may potentially introduce bias due to common-method variance. Finally, it is important to note the peer victimization was self-reported and should be interpreted as a perception of being the target of aggressive behaviors. Such perception may therefore be influences by the child own mental state, personality, and psychopathology (Singham et al., 2017).

Conclusion

We found that peer victimization explains a significant proportion of the association between persistent and rising irritability during childhood and suicide attempt by late adolescence. Professionals, both clinicians and gatekeepers (such as teachers), should be aware that irritability has important interpersonal consequences for peer relationships, which could in turn put irritable children at risk for later suicidal behavior. Further research is needed to understand how to translate our findings into interventions aiming at reducing exposure to victimization among irritable children within the context of suicide prevention.

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Key points and relevance

- Prior studies pointed at irritability in childhood as important factor contributing to suicidal ideation and attempt
- In this population-based cohort, we found that children following rising and persistent trajectories of irritability during childhood (6-12 years) were more likely to attempt suicide by age 20 years, and that 33-35% of this risk was explained by exposure to peer victimization (13 years).
- Exposure to peer victimization partially explains why irritable children are more at risk of later suicide attempt, suggesting that interventions to reduce peer victimization among irritable children may reduce suicide risk.
- Professionals, both clinicians and gatekeepers should be aware that irritability has important interpersonal consequences for peer relationships, and that this can put irritable children at risk for later suicidal behavior.

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Table 1. Sociodemographic characteristics of the sample

	Included N=1483	**Non included** N=639	p-value for differences included vs excluded
Child sex, n (%)	703 (47.4)	377 (59.2)	<.001
Low birth weight, *n* (%)	47 (3.2)	24 (3.8)	.570
Maternal age at child's birth, mean (sd)	29.37 (5.18)	29.13 (5.33)	.340
Paternal age at child's birth, mean (sd)	32.27 (5.48)	32.24 (6.02)	.919
Maternal, no high school diploma, n (%)	245 (16.5)	140 (22.0)	.003
Paternal, no high school diploma, n (%)	267 (19.5)	131 (23.4)	.064
Sufficiency of family income, *n* (%)	1151 (78.5)	420 (68.2)	<.001
Intact family, *n* (%)	1209 (81.8)	497 (78.4)	.078
Family dysfunction, mean (sd)	1.70 (1.44)	1.72 (1.50)	.756

Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2018), ©Gouvernement du Québec, Institut de la statistique du Québec

Table 2. Predictive associations of childhood irritability trajectories with suicide ideation and suicide attempt by early adulthood (N=1483)

	Descriptive statistics		Odds Ratio (95% Confidence interval)		
	Yes, n (%)	No, n (%)	Unadjusted	Sex-adjusted	Fully adjusted [a]
Suicide attempt					
Whole sample	123 (8.3)	1360 (91.7)	-	-	-
Persistent	11 (15.1)	62 (84.9)	2.57 (1.29-5.12)	3.51 (1.69-7.32)	2.81 (1.27-6.22)
Declining	8 (7.3)	101 (92.7)	0.92 (0.43-1.98)	1.04 (0.48-2.26)	0.95 (0.42-2.15)
Rising	23 (12.0)	168 (88.0)	2.03 (1.21-3.40)	2.37 (1.38-4.08)	2.14 (1.20-3.81)
Low	81 (7.3)	1029 (92.7)	1 [Reference]	1 [Reference]	1 [Reference]
Suicidal ideation					
Whole sample	133 (9.0)	1350 (91.0)	-	-	-
Persistent	7 (9.6)	66 (90.4)	1.09 (0.48-2.45)	1.38 (0.60-3.17)	1.31 (0.53-3.23)
Declining	9 (8.3)	100 (91.7)	1.00 (0.48-2.10)	1.10 (0.52-2.33)	1.09 (0.52-2.31)
Rising	17 (8.9)	174 (91.1)	0.96 (0.55-1.68)	1.09 (0.62-1.91)	1.07 (0.61-1.89)
Low	100 (9.0)	1010 (91.0)	1 [Reference]	1 [Reference]	1 [Reference]

[a] Fully adjusted model was adjusted for sex, family socioeconomic status at childbirth, and externalizing and internalizing symptoms at 6 years.

Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2018), ©Gouvernement du Québec, Institut de la statistique du Québec

Table 3. Direct and indirect associations of irritability trajectories with suicide attempt by early adulthood (N=1483)

Model Irritability trajectory	**Mediator**	**Indirect association**	**Direct association**	**% mediated**
Single mediation models				
Rising	Peer victimization	1.26 (1.11-1.43)	1.61 (0.86-3.01)	33.0
	Harsh parenting	1.03 (0.99-1.08)	2.02 (1.14-3.59)	4.3
Persistent	Peer victimization	1.42 (1.13-1.8)	1.91 (0.83-4.42)	35.1
	Harsh parenting	1.07 (0.97-1.19)	2.46 (1.1-5.49)	7.0
Multiple mediation models				
Rising	Peer victimization	1.25 (1.1-1.42)	1.56 (0.83-2.91)	32.9
	Harsh parenting	1.02 (0.98-1.06)		1.5
Persistent	Peer victimization	1.41 (1.12-1.78)	1.73 (0.74-4.03)	36.5
	Harsh parenting	1.05 (0.96-1.15)		5.2

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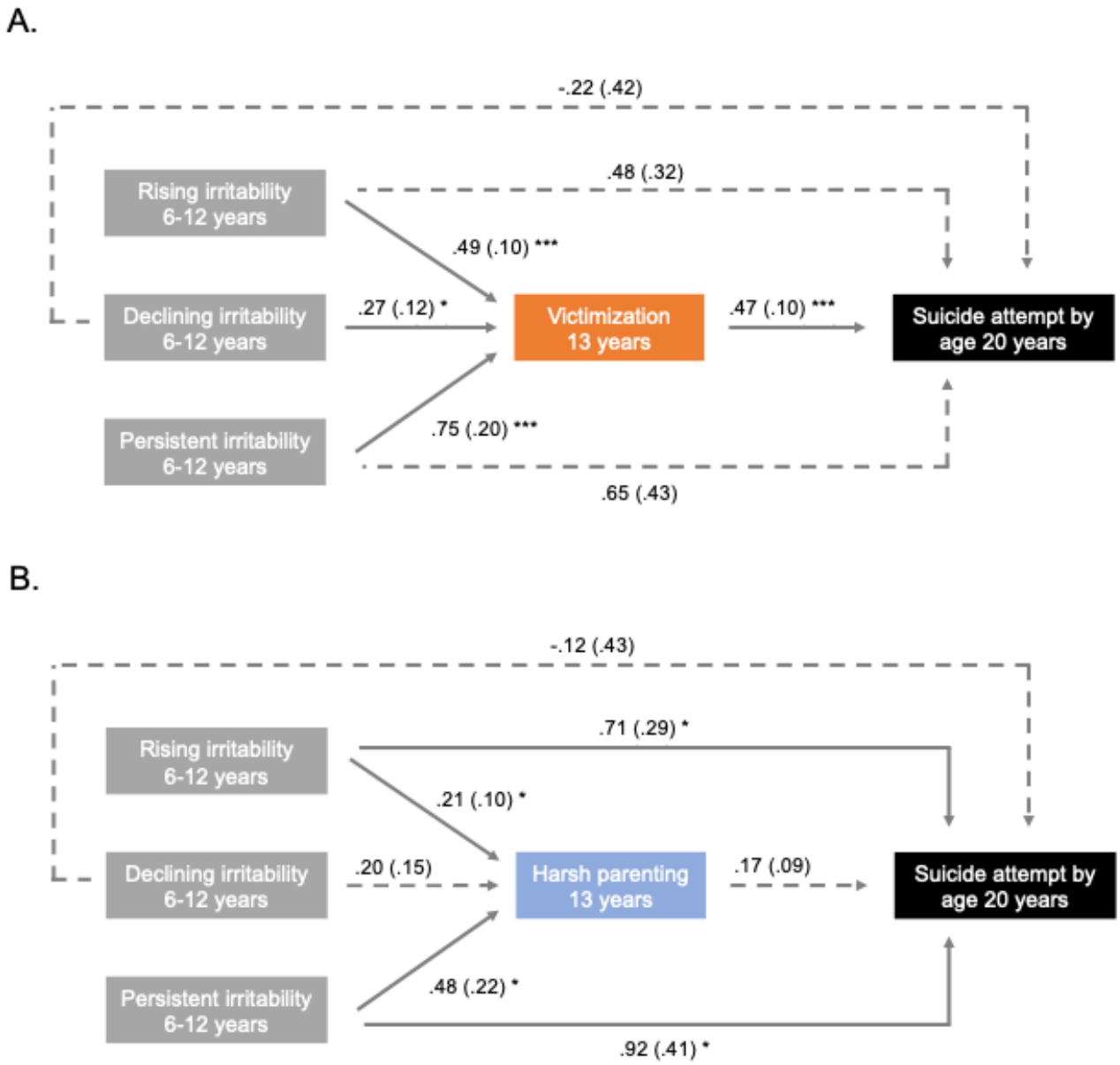
Fully adjusted model was adjusted for sex, family socioeconomic status at childbirth, and externalizing and internalizing symptoms at 6 years, harsh parenting and peer victimization at 6 years.

Figure 1. Representation of the estimated mediation models



Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2018), ©Gouvernement du Québec, Institut de la statistique du Québec

Mediation models for victimization (part A) and harsh parenting (part B). Mean and standard deviation of the variable Victimization at baseline are: Persistent 3.21 (2.17); Declining 2.17 (3.33); Rising 3.1 (2.46); Low 3.33 (3.1); *P*=0.002. Mean and standard deviation of the variable Harsh parenting at baseline are: Persistent 3.11 (1.2); Declining 1.2 (3.2); Rising 3.07 (1.63); Low 3.2 (3.07); *P*<0.001. The paths between irritability trajectories and suicide attempt, and between the mediators and suicide attempt are log odds ratios (standard errors); the paths between the irritability trajectories and the mediator are B coefficients (standard errors). Solid line represents statistically significant paths (p<0.05), dotted line represents nonsignificant paths (p≥0.05) in the final fully adjusted model.

* P < .05
** P < .001
*** P < .0001