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Cybervictimization in adolescence and its association

with subsequent suicidal ideation/attempt beyond face-to-face victimization:

a longitudinal population-based study

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Abstract

Background: Cross-sectional associations have been documented between cybervictimization and suicidal risk; however, prospective associations remain unclear.

Methods: Participants were members of the Quebec Longitudinal Study of Child Development (QLSCD), a prospective birth cohort of 2,120 individuals followed from birth (1997/98) to age 17 years (2014/15). Cybervictimization and face-to-face victimization experienced since the beginning of the school year, as well as serious suicidal ideation and/or suicide attempt were self-reported at ages 13, 15 and 17 years.

Results: In cross-sectional analyses at 13, 15 and 17 years, adolescents cybervictimised at least once had, respectively, 2.3 (95% CI = 1.64–3.19), 4.2 (95% CI = 3.27–5.41) and 3.5 (95% CI = 2.57–4.66) higher odds of suicidal ideation/attempt after adjusting for confounders including face-to-face victimization, prior mental health symptoms and family hardship. Sensitivity analyses suggested that cybervictimization only and both cyber- and face-to-face victimization were associated with a higher risk of suicidal ideation/attempt compared to face-to-face victimization only and no victimization; however, analyses were based on small *n*. In prospective analyses, cybervictimization was not associated with suicidal ideation/attempt 2 years later after accounting for baseline suicidal ideation/attempt and other confounders. In contrast, face-to-face victimization was associated with suicidal ideation/attempt 2 years later in the fully adjusted model, including cybervictimization.

Conclusions: The cross-sectional association between cybervictimization and suicidal ideation/attempt is independent from face-to-face victimization. The absence of a prospective association suggested short-term effects of cybervictimization on suicidal ideation/attempt.

Keywords: Adolescence; longitudinal cohort; suicidal ideation; suicide attempt; Quebec Longitudinal Study of Child Development.

Introduction

Peer victimization, including bullying, is a modifiable risk factor for suicidal ideation and attempt across the life span (Klomek, Sourander, & Elonheimo, 2015). To date, much of the research has focused on face-to-face victimization (i.e. intentional harm caused verbally, physically and emotionally); however, little is known about the role of a novel form of victimization, cybervictimization, on suicidal risk (Van Geel, Vedder, & Tanilon, 2014).

Cybervictimization is expressed through electronic forms of communication such as emails, texts or social media. Common examples of cybervictimization include posting compromising material such as insulting comments, spreading rumours on social media or harassing someone through instant messaging. Although there are overlaps between face-to-face and cybervictimization, the latter has unique features including (a) the absence of time and space boundaries leads to victims being targeted anytime anywhere, (b) a large audience witnessing victimization through live or shared content and (c) the perpetrator's anonymity making cybervictimization difficult to stop (Pingault & Schoeler, 2017). Thus far, research with varying age groups showed that 4%–36% of girls and 2%–28% of boys reported having been cybervictimized in the last year (Brochado, Soares, & Fraga, 2017). Despite variation in estimates, the occurrence of at least one experience of cybervictimization is not uncommon.

Cybervictimization has attracted considerable attention with several mediatized high-profile cases of adolescent suicides reportedly linked to cybervictimization (Wolke, 2017). Cross-sectional studies indicated that adolescents who have been cybervictimized were more likely to report concurrent suicidal ideation (Bauman, Toomey, & Walker, 2013; Bonanno & Hymel, 2013; Elgar et al., 2014; Hay & Meldrum, 2010; Hinduja & Patchin, 2010; Hirschtritt, Ordonez, Rico, & LeWinn, 2015; Kodish ~ et al., 2016; Messias, Kindrick, & Castro, 2014; Sampasa-Kanyinga, Roumeliotis, & Xu, 2014; Schneider, O'donnell, Stueve, & Coulter, 2012) or to attempt suicide (Elgar et al., 2014; Messias et al., 2014; Sampasa-Kanyinga et al., 2014; Schneider et al., 2012), even after controlling for other types of victimization. Additionally, two studies have reported stronger cross-sectional associations with suicide ideation for both cybervictimization and face-to-face victimization combined compared with cybervictimization only or face-to-face victimization only (Messias et al., 2014; Schneider et al., 2012). However, very few prospective studies have examined whether cybervictimization carried a suicidal risk in the longer term and the findings are unclear (Bannink, Broeren, van de Looij-Jansen, de Waart, & Raat, 2014; Wright, 2016). To the best of our knowledge, no study examined whether cybervictimization assessed throughout adolescence from 13 to 17 years is associated with suicidal ideation/attempt, both cross-sectionally and prospectively. This is important because this period is marked by increased suicidal ideation and attempt (Cha et al., 2018).

In the present study, we aimed to (a) describe the prevalence of cybervictimization from early to late adolescence in a representative population-based sample and (b) test whether cybervictimization was associated with suicidal ideation/attempt beyond face-to-face victimization and key confounders (e.g. pre-existing mental health and family problems) both cross-sectionally and prospectively.

Methods

Participants

Participants were members of the Quebec Longitudinal Study of Child Development (QLSCD) which is conducted by the Quebec Statistics Institute (ISQ). This a representative population study includes 2,120 individuals born in the Canadian province of Quebec in 1997/98 who were followed up from birth to age 17 years. Further details about the cohort can be found online (<https://jesuisjeserai.stat.gouv.qc.ca>). The sample size available for cross-sectional and prospective analyses ranged from 1,228 to 1,426 and 1,160 to 1,192 participants, respectively, with measures of peer victimization and suicidal ideation/attempt, and representing 55%–67% of the original cohort. We applied inverse probability weighting to account for potential selection bias that could arise from sample attrition. Weights were derived from a logistic regression model for the binary outcome of being included in the adolescent data collection at 13–17 years (vs. missing at any time point) from the following predictors: sex, maternal depression at age 5 months, and internalizing and externalizing behaviour at age 6 years. As shown in Table S1 in the Supporting Information, our samples at 13, 15 and 17 years did not differ in terms of key characteristics.

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

Measures

Exposure to victimization was assessed at ages 12, 13, 15 and 17 years using a modified version of the Self-Report Victimization Scale (Cronbach's $\alpha = .88$ to $.91$) (Ladd & Kochenderfer-Ladd, 2002) administered in the second half of the school year (February to June). Adolescents were asked about the frequencies ('never', 'rarely', 'sometimes', 'often', 'very often') since the beginning of the school year of 6 different victimization experiences (e.g. 'a child at school pushed, hit or kicked you?') and a cybervictimization experience ('how many times were you the victim of cyberbullying (insults, threats and intimidation) on the Internet or by cell phone'; 'never', 'once', 'few times', 'often', 'very often'; see Appendix S1).

In accordance with our previous work (Geoffroy et al., 2016), adolescents were considered victims of face-to-face victimization if they answered 'often' or 'very often' to at least one of six items reflecting face-to-face victimization. Since the prevalence of cybervictimization was low in the sample, adolescents who were 'never' cybervictimised were distinguished from those cybervictimised either 'once', 'a few times', 'often' or 'very often'. A similar approach of coding cybervictimization has been used in other studies (Bannink et al., 2014; Elgar et al., 2014). Cybervictims additionally reported whether cyberbullying originated from 'students attending their school', 'students not attending their school', 'unknown identity' or 'other'.

We measured suicidal ideation/attempt in terms of having serious thoughts of wanting to die (as indicated by an affirmative answer to the question, 'Did you ever seriously think of attempting suicide?'; 'yes', 'no') or making a suicide attempt (and if so, 'How many attempts', 'never', 'once', 'more than once') in the past 12 months. We combined suicidal ideation and

suicide attempt given their, respectively, low prevalence as mutually exclusive groups (2.1%–4.3% for suicidal ideation, 2.4%–2.8% for suicidal attempt between 13 and 17 years).

As in our past publications (Geoffroy et al., 2018; Geoffroy et al., 2016), we controlled for prior mental health and family hardship characteristics associated with victimization and suicidal ideation/attempt. Depressive symptoms in the past 2-weeks were self-reported using the Children Depression Inventory (CDI, short-form) (Allgaier et al., 2012) rated on a 3-point scale at age 10 and 12 years. Other mental health symptoms were assessed with the Behaviour Questionnaire (BQ), a validated scale used in the Canadian National Longitudinal Study of Children and Youth (Statistics Canada & Human Resources Development Canada. National Longitudinal Survey of Children and Youth: Overview of Survey Instruments for 1994–1995 Data Collection Cycle 1, 1995), which incorporates items from the Child Behaviour Checklist (Achenbach, Edelbrock, & Howell, 1987), the Ontario Child Health Study Scales (Offord, Boyle, & Racine, 1989), and the Preschool Behaviour Questionnaire (Tremblay, Desmarais-Gervais, Gagnon, & Charlebois, 1987). Oppositional/defiance was assessed with four items ($\alpha = .92$ and $.91$) (e.g. ‘defiant/refused to comply’) and inattention/hyperactivity with nine items ($\alpha = .95$ and $.94$) (e.g. ‘could not sit still’) through teacher ratings at 6–12 years and anxiety symptoms with three items ($\alpha = .72$ and $.83$) (e.g. ‘fearful/nervous’) at 10 and 12 years through self-reports. All items were rated on a 3-point scale (0 = ‘never or not true’; 1 = ‘sometimes or somewhat true’; and 2 = ‘often or very true’). Family socioeconomic status was measured as an aggregate of annual gross income, parental education level and occupational prestige (Willms & Shields, 1996) at 6–12 years; family functioning ($\alpha = .84$) (i.e. communication, problem resolution and control of disruptive behaviour) was assessed with the McMaster Family Assessment (Statistics Canada & Human Resources Development Canada. National Longitudinal Survey of Children and Youth: Overview of Survey Instruments for 1994–1995 Data Collection Cycle 1, 1995) at 6–12 years; family structure (biological parents/blended/single) was reported at 12 years; and hostile-reactive parenting ($\alpha = .59$) (e.g. corporal punishment, raising voice) was assessed with four items (Boivin et al., 2005) at 6–12 years.

Statistical analyses

We estimated cross-sectional associations between cybervictimization and suicidal ideation/attempt at ages 13, 15 and 17 years using logistic regressions. Model 1 adjusted for sex, Model 2 additionally adjusted for prior mental health symptoms (6–12 years) (depression, anxiety, oppositional/defiance and inattention/hyperactivity symptoms) and family hardship (socioeconomic status, family functioning and structure, and hostile reactive parenting), and Model 3 additionally adjusted for concurrent face-to-face victimization. The same analyses were conducted using face-to-face victimization as the exposure in order to compare the relative effects of both forms of victimization on suicidal ideation/attempt. Second, we estimated prospective associations between cybervictimization and suicidal ideation/attempt using logistic regressions with cybervictimization at either 13 or 15 years as the exposure and subsequent suicidal ideation/attempt 2 years later at 15 or 17 years as the outcome. In the prospective analyses, Model 1 accounted for sex, Model 2 and Model 3 for mental health and family confounders, and face-to-face victimization, respectively, and Model 4 for baseline suicidal

ideation/attempt (e.g. suicidal ideation/attempt at age 13 years for prospective association between cybervictimization at 13 years and suicidal ideation/attempt at 15 years). The prospective analyses were also conducted using face-to-face victimization as the exposure. We additionally tested statistical interactions between sex and cybervictimization in the cross-sectional and prospective logistic regressions. No significant sex-by-cybervictimization interaction was found ($ps > .05$ across cross-sectional and prospective analyses); therefore, our analyses combined both sexes.

In sensitivity analysis, we estimated both cross-sectional and prospective models using cybervictimization frequency entered as a continuous variable (scale ranging from 0 to 4), rather than binary (yes/no), to test dose-response associations. The results of this analysis in our cross-sectional and prospective models are reported as a p-value for trend. Lastly, we created a categorical variable with the following exclusive categories: face-to-face victimization only, cybervictimization only, cyber- and face-to-face victimization, and no victimization to estimate the single and combined role of the two different forms of victimization on suicidal ideation/attempt.

Missing data on confounding variables (<11% for all variables) were imputed using multiple imputation by chained equation (Azur, Stuart, Frangakis, & Leaf, 2011); thus, all models were estimated across 50 imputed datasets and the results were pooled.

Results

Prevalence of cybervictimization and suicidal ideation/attempt

Most adolescents who reported being cybervictimised were victimised ‘once’ (4.1%–10.4%), and less than 1% were cybervictimised ‘often or very often’ since the beginning of the school year (Table 1). Overall, 45.9%–53.1% of adolescents who were cybervictimised at least once (7.3%–15.9% of the entire sample) were also exposed to face-to-face victimization. Most adolescents reported being cybervictimised by students attending the same school (56.8%–71.6%) or another school (19.7%–25.5%), while 14.8%–24.0% reported they never knew who cybervictimised them; Table 1. Cybervictimization was more common in girls than boys, except at 12 years (Table 2).

Cross-sectional associations between cybervictimization and suicidal ideation/attempt

Overall, prevalence of suicidal ideation/attempt increased from 3.4% ($n = 42$), 3.5% ($n = 42$) and 5.8% ($n = 62$) for those never cybervictimised at 13, 15 and 17 years, respectively, to 13.3% ($n = 14$), 19.3% ($n = 44$) and 25.5% ($n = 22$) for those exposed to cybervictimization in given school year. Cybervictimization, experienced at least once, was associated with suicidal ideation/attempt after adjustment for prior mental health symptoms and family hardship (Model 2, Table 3). The associations remained significant when face-to-face victimization was added to the model at 13 years (Model 3, Table 3; OR = 2.29, 95% CI = 1.64–3.19; p -trend for frequency of cybervictimization entered continuously <.001), 15 years (OR = 4.20, 3.27–5.41; p -trend <.001) and 17 years, (OR = 3.46, 2.57–4.66; p -trend <.001). In these same models, face-to-face victimization was also associated with suicidal ideation/attempt after adjustment for prior

mental health symptoms, family hardship and cybervictimization (OR = 2.61, 1.92–3.56, at 13 years; OR = 2.16, 1.67–2.81, at 15 years; and OR = 2.09; 1.54–2.84, at 17 years). However, at both 15 and 17 years the odds were significantly smaller for face-to-face victimization compared with cybervictimization $p < .001$ and $p < .01$, respectively).

Suicidal ideation/attempt prevalence by victimization exposure category was 2.7% ($n = 24$), 2.7% ($n = 28$) and 4.6% ($n = 44$) for no victimization at 13, 15 and 17 years; 9.9% ($n = 18$), 10.7% ($n = 14$) and 12.6% ($n = 14$) for face-to-face victimization only at 13, 15 and 17 years; 22.7% ($n = 22$) and 40.6% ($n = 13$) for cybervictimization only at 15 and 17 years; and 26.1% ($n = 12$), 27.1% ($n = 22$) and 25.7% ($n = 9$) for cybervictimization and face-to-face victimization combined at 13, 15 and 17 years. Figure 1 shows odds ratio (ORs) and 95% CIs at 15 and 17 years for face-to-face victimization only, cybervictimization only, cyber- and face-to-face victimization versus no victimization. We found that adolescents exposed to either cyber- and face-to-face victimization only or to both forms of victimization had higher risk of suicidal ideation/attempt than nonvictim at both ages. Further comparisons showed that odds of suicidal ideation/attempt was higher for adolescents exposed to cybervictimization only (OR = 2.00, 95% CI = 1.37–2.90 and OR = 2.02, 95% CI = 1.31–3.10) and cyber- and face-to-face victimization combined (OR = 1.68, 1.16 and 2.43, and OR = 1.74, 95% CI = 1.11– 2.71) than those exposed to face-to-face victimization only at 15 and 17 years, respectively.

Prospective associations between cybervictimization and suicidal ideation/attempt

Cybervictimization at 13 and 15 years was prospectively associated with suicidal ideation/attempt 2 years later at 15 and 17 years (Table 4) after controlling for mental health symptoms, family hardship and face-to-face victimization (Model 3, Table 4) (respectively, OR = 1.79, 1.30–2.44; p -trend for frequency of cybervictimization entered continuously $< .001$, and OR = 1.34, 1.01–1.78; p -trend = .12). However, these associations were no longer significant after baseline suicidal ideation/ attempt was accounted for (Model 4, Table 4; $ps > .05$). In contrast, face-to-face victimization at age 13 and 15 years was associated to suicidal ideation/attempt 2 years later (OR = 2.45, 1.82– 3.29; OR = 2.06, 1.56–2.72, respectively) even after accounting for childhood confounders and baseline cybervictimization and suicidal ideation/attempt (Model 4, Table 4). We re-estimated all models without inverse probability weighting; patterns of results were similar to ones based on multiple imputation alone (see Tables S2 and S3).

Discussion

To our knowledge, this is the first population-based study examining the cross-sectional and prospective associations between cybervictimization and serious suicidal ideation/attempt across adolescence in the context of other forms of victimization and key confounders. We found that cybervictimization mostly occurred ‘once’ in a given year and often co-occurred with face-to-face victimization. Additionally, we found that over and beyond co-occurring exposure to face-to-face victimization, being cybervictimized increased the risk of suicidal ideation/attempt cross-sectionally, but not prospectively. Suicidal ideation/attempt risk was higher among adolescents who were exposed to cybervictimization only, and cyber- and face-to-face victimization

combined compared with adolescents who were exposed to no victimization or face-to-face victimization only.

In our sample, 6.9%–15.9% of adolescents aged 12 to 17 years reported being cybervictimimized at least once during the given school year. While some studies have reported highly heterogeneous cybervictimization prevalence rates, others reported prevalence estimates in adolescents consistent with the present study (Bannink et al., 2014; Bauman et al., 2013; Bonanno & Hymel, 2013; Kodish et al., 2016). As previously reported, the prevalence of cybervictimization tends to increase from 12 to 15 years (Messias et al., 2014; Schneider et al., 2012), which differs from face-to-face victimization which has been found to decrease (Geoffroy et al., 2018). Furthermore, the decreasing prevalence of cybervictimization after 15 years might reflect that later in adolescence youth might have learned more advanced perspective-taking skills and understand the effects of their aggressive acts on the Internet. As reported previously, girls were more likely to be exposed to cybervictimization than boys (Messias et al., 2014; Sampasa-Kanyinga et al., 2014), which is opposite to what is observed for face-to-face victimization (Arseneault, 2018). This could be partly explained by some evidence showing that girls tend to use more indirect ways of aggression, through social media, for example (Waasdorp & Bradshaw, 2015). We found that most victims can identify the perpetrators as students from the same school or other known peers (76.6%–91.8% between ages 12 and 17 years). The highest proportion of anonymous perpetrators was 24% at 12 years and decreased to 18% at 17 years. This is similar to a study showing that most students knew their perpetrator's identity (Waasdorp & Bradshaw, 2015), and another showing that 12.6% of cybervictimimized high school students did not know the identity of their perpetrators (Ybarra, Diener-West, & Leaf, 2007). Although the range of reported perpetrator's anonymity seems to vary with age, this remains a unique feature of cybervictimization with perceived anonymity leading to more potential perpetration (Ybarra et al., 2007).

Our study documents a strong association between cybervictimization and cross-sectional suicidal ideation/attempt beyond face-to-face victimization while accounting for important confounders. Adjusted odds ratios indicated that cybervictimimized adolescents had 2.29- to 4.20-folds higher odds to report suicidal ideation/attempt compared with non-victimimized adolescents. This finding is in line with a recent meta-analysis of cross-sectional studies reporting odds ratios of 2.15 for suicidal ideation and 2.57 for suicidal attempt (John et al., 2018). However, the associations with suicidal attempt reported in the meta-analysis did not control for face-to-face victimization and other confounders.

Our analyses suggest a unique concurrent effect of cybervictimization regardless of whether it is experience alone or in combination with face-to-face victimization. Indeed, concurrent associations show that adolescents experiencing cybervictimization only and both cyber- and face-to-face victimization were at higher risk of suicidal ideation/attempt compared to adolescents experiencing no victimization and adolescent experiencing face-to-face victimization only. No study had reported higher odds for cyber- and face-to-face victimization combined compared with face-to-face victimization or higher odds for cybervictimization only compared with face-to-face victimization only. For the first time, these findings indicate that

cybervictimization, whether it is experienced alone or combined with face-to-face victimization, represents a higher concurrent risk for suicidal ideation/attempt compared with face-to-face victimization only. However, these findings need to be interpreted with caution given the low prevalence of suicidal ideation/attempt across subgroups and further studies are needed to replicate these results.

The prospective analyses in the current study showed that adolescents exposed to cybervictimization did not have a higher risk of showing suicidal ideation/attempt 2 years later, after adjusting for face-to-face victimization, prior mental health symptoms, family hardship and baseline suicidal ideation/attempt. Conversely, adolescents exposed to face-to-face victimization had an increased risk of suicidal ideation/attempt 2 years later when similar confounders were controlled for including cybervictimization. Differential prospective associations between cyber- versus face-to-face victimization may indicate that these two types of victimization have different developmental processes regarding suicidal ideation/attempt. One hypothesis is that cybervictimization may lead to an immediate suicidal risk, as shown by the cross-sectional association in the current study, which might persist overtime. This may explain why the prospective associations were nonsignificant when baseline suicidal ideation/attempt was taken into account. In addition, cybervictimization may be less likely to be repeated while face-to-face victimization is more chronic (Geoffroy et al., 2018) and potentially contributes to a stronger prospective association. This pattern is consistent with one prior study which found no association between cybervictimization and suicidal ideation from 12 to 14 years after adjusting for baseline suicidal ideation (Bannink et al., 2014).

Our study was conducted using a large representative birth cohort of children followed up to 17 years of age, with repeated assessments of cybervictimization, face-to-face victimization, suicidal ideation/attempt and a range of childhood confounders. Despite these strengths, study limitations need to be acknowledged when interpreting the results. First, cybervictimization was based on a single item. This item gave similar examples of cybervictimization exposure; ‘insults, threats, intimidation by Internet or by cell phone’, to a well-known and widely used measure of cybervictimization in the Olweus Bully/Victim Questionnaire; ‘mean or hurtful messages, calls or pictures or other ways on my mobile phone or the Internet’ (Olweus, 1996). However, our measure did not assess intention, repetition and power imbalance as measured by the Olweus Bully/Victim Questionnaire. In addition, given the low frequencies of cybervictimization, we categorized adolescents as cybervictimized if they reported cybervictimization at least ‘once’ while we categorized adolescents as having been victimized face-to-face if they reported face-to-face victimization ‘often/very often’. This must be taken into account when the two exposures are compared. Despite this limitation, stronger associations were seen for cybervictimization than face-to-face victimization in cross-sectional but not in prospective analyses. Our conclusions were further supported by the trend analyses using cybervictimization as a continuous variable (i.e. ‘never’ to ‘very often’) for cross-sectional associations. The trend analyses showed that the more often adolescents are exposed to cybervictimization the greater the risk of suicidal ideation/attempt. Additionally, the categorization is consistent with previous studies, thus increasing comparability between the available findings (Bannink et al., 2014; Elgar et al., 2014; Hirschtritt et al., 2015; Kodish et al., 2016; Messias et al., 2014; Sampasa-Kanyinga

et al., 2014; Sinclair, Bauman, Poteat, Koenig, & Russell, 2012). Second, our victimization exposure was self-reported and may be influenced by current mental state, hence possibly inflating our effect sizes with suicidal ideation/attempt. Self-reported victimization is being used in most prior studies (John et al., 2018) as most adolescents do not disclose to their teacher/parents if they have been victimized (Bowes, Joinson, Wolke, & Lewis, 2015). Third, due to low statistical power we did not investigate whether cybervictimization was distinctively associated with suicidal ideation and suicide attempt. Some prior studies suggested that association of cybervictimization was stronger for suicide attempt than for suicidal ideation (Kim, Colwell, Kata, Boyle, & Georgiades, 2018; Schneider et al., 2012), but others showed the opposite finding (Kodish et al., 2016; Sinclair et al., 2012). Fourth, the present study data did not include information on genetics; therefore, the study could not account for genetic confounding. A prior study using a twin cohort has shown that victimized adolescents were more likely to report suicidal ideation even after accounting for genetic vulnerabilities (via a monozygotic twin design) and other pre-existing vulnerabilities, although the association with suicidal attempt was explained by genetic vulnerabilities (Baldwin et al., 2019).

Last, as in most longitudinal cohorts, attrition occurred overtime, especially amongst the most vulnerable participants, for example adolescents who were cybervictimized. However, the use of multiple imputations and weights reduced such selection bias.

Conclusion

Our findings indicate that cybervictimization is an important risk factor for concurrent serious suicidal ideation/attempt throughout adolescence that is independent from prior mental health symptoms, family hardship and face-to-face victimization. A significant proportion (7%–16%) of adolescents are victimized by their peers on electronic platforms and mostly targeted by other students attending the same or another school. Cybervictimization may be reduced through interventions, which may be highly cost-effective from a public health perspective. A recent review on school-based interventions against cybervictimization identified programs including educating youth on communication and social skills, empathy, coping and responsible use of technology as effective targets in reducing its prevalence (Hutson, Kelly, & Militello, 2018). However, it is essential to examine whether prevention efforts against cybervictimization in adolescence translates into a measurable reduction of suicidal risk and cybervictimization. Future studies should also aim to investigate protective factors such as family factors or peer support that could promote resilience to cybervictimization.

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Key points

- Cybervictimized adolescents (aged 13–17 years) were 2 to 4 times more likely to experience concurrent suicidal ideation/attempt regardless of exposure to face-to-face victimization and other key confounders including prior mental health symptoms and family hardship.
- Concurrent subgroup analyses showed that adolescents that were cybervictimized only or exposed to both cyber- and face-to-face victimization were more at-risk for suicidal ideation/attempt compared to adolescents that were not victimized or victimized face-to-face only.
- Face-to-face victimization was associated with suicidal ideation/attempt 2 years later; however, no longitudinal association was found for cybervictimization.
- Cybervictimization is an important concurrent risk factor for serious suicidal ideation/attempt throughout adolescence and may be reduced through interventions, which may be highly cost-effective from a public health perspective.

Table 1: Frequencies of cybervictimization experiences since the beginning of the school year and the percentages of types of cybervictimization perpetrators from ages 12 to 17 years (y)^{a, b, c}

Ages	Frequency of cybervictimization n(%)				Cybervictimization originated from n(%) ^d			
	Never	Once	A few times	Often/ Very often	Students at my school	Other young people who don't go at my school	I never knew whom	Other
12y	1248(93.2)	63(4.6)	26(1.8)	7(0.5)	50(56.8)	19(19.8)	23(24.0)	7(7.5)
13y	1119(90.2)	67(6.1)	30(2.5)	15(1.2)	72(71.6)	23(20.2)	17(14.8)	6(5.4)
15y	1211(84.0)	142(10.4)	63(4.3)	19(1.2)	146(66.5)	46(19.7)	34(15.2)	20(9.2)
17y	1137(92.8)	50(4.1)	32(2.6)	7(0.5)	51(58.8)	22(25.5)	17(18.1)	11(14.6)

a. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998-2015), Québec Government, Institut de la Statistique du Québec

b. Sample sizes were 1344 at 12y, 1231 at 13y, 1435 at 15y, and 1226 at 17y

c. Percentages are based on weighted data

d. Multiple responses were permitted

Table 2: Sex differences in the prevalence of having been cybervictimimized at least once from ages 12 to 17 years (y)^{a, b}

Ages	Prevalence of cybervictimization			
	All	Girls	Boys	Sex differences
	n(%)	n(%)	n(%)	p-values
12y	96(6.8)	54(7.1)	42(6.4)	.60
13y	112(9.8)	75(11.6)	37(6.8)	.005
15y	224(16.0)	152(19.3)	72(10.7)	.000
17y	89(7.2)	58(8.3)	31(5.3)	.044

a. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998-2015), Québec Government, Québec Statistics Institute

b. Percentages are based on weighted data

Table 3: Odds ratios (ORs) and 95% confidence intervals (CIs) for concurrent associations between cyber versus face-to-face victimization and suicidal ideation/attempt from ages 13 to 17 years (y)^{a, b, c}

	Suicidal ideation/attempt		
	Model 1	Model 2	Model 3
Cybervictimization			
13y	4.27 (3.16-5.76)	2.92 (2.12-4.03)	2.29 (1.64-3.19)
15y	6.00 (4.81-7.48)	5.40 (4.27-6.83)	4.20 (3.27-5.41)

17y	5.30 (4.09-6.87)	4.43 (3.35-5.86)	3.46 (2.57-4.66)
Face-to-face victimization			
13y	5.23 (3.98-6.86)	3.06 (2.27-4.13)	2.61 (1.92-3.56)
15y	4.13 (3.31-5.15)	3.52 (2.27-4.47)	2.16 (1.67-2.81)
17y	3.39 (2.26-4.40)	2.83 (2.14-3.74)	2.09 (1.54-2.84)

a. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998-

2015), Québec Government, Institut de la Statistique du Québec

b. Sample sizes were 1426 at 13y, 1245 at 15y, and 1245 at 17y

c. ORs and 95% CIs are based on weighted data

Model 1 adjusted for sex

Model 2 additionally adjusted for prior family socioeconomic status (6-12y), family structure (12y), family functioning (6-12y), hostile-reactive parenting (6-12y), depressive symptoms (10-12y), anxiety symptoms (10-12y), oppositional-defiant symptoms (6-12y), inattention/hyperactivity symptoms (6-12y). Multiple imputation by chained equation has been employed to impute missing information on childhood confounders

Model 3 additionally adjusted for face-to-face victimization or cybervictimization at each given age

Table 4: Odds ratios (ORs) and 95% confidence intervals (CIs) for prospective associations between cyber versus face-to-face victimization at 13 or 15 years and suicidal ideation/attempt 2 years later at 15 or 17 years (y)^{a, b, c}

	Suicidal ideation/attempt			
	Model 1	Model 2	Model 3	Model 4
Cybervictimization				
13y	3.02 (2.28-4.00)	2.30 (1.70-3.12)	1.79 (1.30-2.44)	1.37 (0.97-1.93)
15y	2.23 (1.74-2.86)	1.82 (1.40-2.37)	1.34 (1.01-1.78)	0.98 (0.73-1.33)
Face-to-face victimization				
13y	4.26 (3.34-5.43)	3.08 (2.36-4.03)	2.78 (2.11-3.67)	2.45 (1.82-3.29)
15y	2.95 (2.33-3.73)	2.50 (1.94-3.23)	2.26 (1.72-2.97)	2.06 (1.56-2.72)

a. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998-

2015), Québec Government, Institut de la Statistique du Québec

b. Sample sizes were 1160 at 15y and 1192 at 17y

c. ORs and 95% CIs are based on weighted data

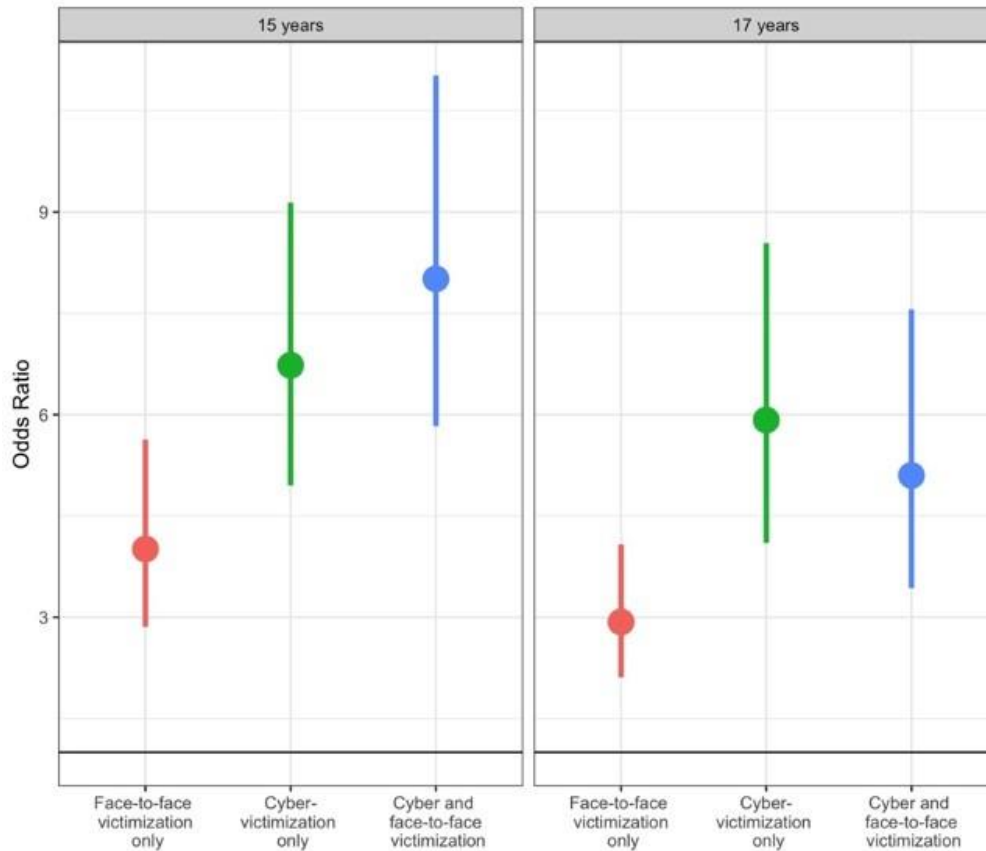
Model 1 adjusted for sex

Model 2 additionally adjusted for prior family socioeconomic status (6-12y), family structure (12y), family functioning (6-12y), hostile-reactive parenting (6-12y), depressive symptoms (10-12y), anxiety symptoms (10-12y), oppositional-defiant symptoms (6-12y), inattention/hyperactivity symptoms (6-12y). Multiple imputation by chained equation has been employed to impute missing information on childhood confounders.

Model 3 additionally adjusted for face-to-face victimization or cybervictimization at each given age

Model 4 additionally adjusted for suicidal ideation and attempt at baseline

Figure 1: Odds ratio and 95% confidence intervals for suicidal ideation/attempt by cybervictimization only, face-to-face victimization only, and cybervictimization with face-to-face victimization ^{a, b, c, d}



a. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998-2015), Québec Government, Institut de la Statistique du Québec

b. Sample sizes were 1431 at 15y, and 1219 at 17y. Sample sizes for no victimization: 28 at 15y and 44 and 17y; for face-to-face victimization only: 14 at 15y and 14 at 17y; for cybervictimization only: 22 at 15y and 13 at 17y and for cybervictimization and face-to-face victimization combined: 22 at 15y and 9 at 17y. Estimates at 13 years were not available, because a cell was based on fewer than 5 participants.

c. Odds ratios (95% CI) for (1) face-to-face victimization only; (2) cybervictimization only; (3) both cyber- and face-to-face victimization compared to “no victimization”

d. The fully adjusted model included sex, prior family socioeconomic status (6-12y), family structure (12y), family functioning (6-12y), hostile-reactive parenting (6-12y), depressive symptoms (10-12y), anxiety symptoms (10-12y), oppositional-defiant symptoms (6-12y), inattention/hyperactivity symptoms (6-12y).

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TableS1: Descriptives statistics on key characteristics of participants by age in years (y)^{a,b}

	Age, years (y)			
	13y	15y	17y	p-value
n (%)				
No. of participants, unweighted	1228	1426	1245	
Sex (female)	665 (62.5)	747 (61.1)	675 (63.0)	.55
Family structure at 12y				
<i>Biological parents</i>	757 (65.7)	843 (63.1)	750 (67.7)	.41
<i>Single parent</i>	224 (17.6)	232 (16.9)	204 (16.8)	.33
<i>Blended</i>	214 (16.7)	223 (16)	194 (15.5)	.36
Mean [SD]^c				
Socioeconomic status at 6-12y	-.002 [1.0]	.005 [1.0]	.035 [0.9]	.60
Hyperactivity/inattention at 6-12y	-.001 [0.8]	-.008 [0.8]	-.027 [0.8]	.70
Oppositional/defiance at 6-12y	-.001 [0.8]	-.007 [0.8]	-.022 [0.8]	.80
Depression at 10-12y	.005 [0.8]	.004 [0.8]	.007 [0.8]	.99
Anxiety at 10-12y	-.018 [0.8]	-.020 [0.8]	-.017 [1.0]	.99
Hostile-reactive parenting at 6-12y	-.001[0.8]	-.008 [0.8]	-.030 [0.8]	.61
Family functioning at 6-12y	.011 [0.8]	-.011 [0.8]	-.001 [0.8]	.78

a. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998-2015), Québec Government, Institut de la Statistique du Québec

b. Estimates are based on weighted data

c. All continuous variables are Z-scores (Mean=0; SD=1)

TableS2: Odds ratios (ORs) and 95% confidence intervals (CIs) for cross-sectional associations between cyber versus face-to-face victimization and suicidal ideation/attempt from ages 12 to 17 years (y), unweighted^{a, b}

	Suicidal ideation/attempt (multiple imputations only)		
	Model 1	Model 2	Model 3
Cybervictimization			
13y	3.52 (1.85-6.71)	2.46 (1.24-4.90)	1.84 (0.90-3.75)
15y	6.04 (3.82-9.55)	5.39 (3.32-8.74)	4.31 (2.57-7.22)
17y	5.44 (3.14-9.45)	4.49 (2.51-8.03)	3.87 (2.09-7.18)
Face-to-face victimization			
13y	5.22 (3.00-9.08)	3.16 (1.72-5.81)	2.80 (1.49-5.26)
15y	3.91 (2.47-6.19)	3.28 (2.02-5.35)	2.00 (1.17-3.42)
17y	2.69 (1.60-4.52)	2.20 (1.28-3.80)	1.54 (0.85-2.81)

a. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998-2015), Québec Government, Institut de la Statistique du Québec

b. Sample sizes ranged from 1151-1228 at 13y, 1228-1426 at 15y, and 1068-1219 at 17y

Model 1 adjusted for sex

Model 2 additionally adjusted for prior family socioeconomic status (6-12y), family structure (12y), family functioning (6-12y), hostile-reactive parenting (6-12y), depressive symptoms (10-12y), anxiety symptoms (10-12y), oppositional-defiant symptoms (6-12y), inattention/hyperactivity symptoms (6-12y). Multiple imputation by chained equation has been employed to impute missing information on childhood confounders

Model 3 additionally adjusted for face-to-face victimization or cybervictimization at each given age

TableS3: Odds ratios (ORs) and 95% confidence intervals (CIs) for prospective associations between cyber versus face-to-face victimization at 13 and 15 years (y) and serious suicidal ideation/attempt 2 years later at 15 and 17 years (y), unweighted^{a, b}

	Suicidal ideation/attempt (multiple imputations only)			
	Model 1	Model 2	Model 3	Model 4
Cybervictimization				
13y	2.62 (1.41-4.86)	2.01 (1.03-3.91)	1.57 (0.78-3.13)	1.29 (0.62-2.71)
15y	2.30 (1.35-3.90)	1.84 (1.06-3.22)	1.43 (0.78-2.61)	1.06 (0.56-2.02)
Face-to-face victimization				
13y	3.62 (2.17-6.03)	2.58 (1.47-4.54)	2.37 (1.32-4.25)	2.01 (1.08-3.75)
15y	2.73 (1.65-4.52)	2.24 (1.31-3.82)	1.98 (1.11-3.52)	1.85 (1.03-3.32)

a. Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998-2015), Québec Government, Institut de la Statistique du Québec

b. Sample sizes ranged from 1094-1160 at 15y and 1054-1192 at 17y

Model 1 adjusted for sex.

Model 2 additionally adjusted for prior family socioeconomic status (6-12y), family structure (12y), family functioning (6-12y), hostile-reactive parenting (6-12y), depressive symptoms (10-12y), anxiety symptoms (10-12y), oppositional-defiant symptoms (6-12y), inattention/hyperactivity symptoms (6-12y). Multiple imputation by chained equation has been employed to impute missing information on childhood confounders

Model 3 additionally adjusted for face-to-face victimization or cybervictimization at each given age

Model 4 additionally adjusted for suicidal ideation and attempt at baseline