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Pathways of association between disordered eating and mental health outcomes in youth during COVID-19

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Abstract:	Objective: The COVID-19 pandemic has been associated with increased mental health problems. We investigated 1) associations between disordered eating in adolescence and mental health problems after one year of the pandemic and 2) the mechanisms explaining associations. Method: We analysed data from a population-based birth cohort in Quebec, Canada (557 males and 759 females). High and low levels of disordered eating symptom trajectories were previously estimated (age 12, 15, 17 and 20 years). Anxiety, depression, non-suicidal self-injury and suicidal ideation were assessed at 23 years (winter-spring 2021). Putative mediators included loneliness and social media use (age 22 years, summer 2020). Analyses controlled for mental health and socio-economic status at age 10-12 years and were conducted for males and females separately. Results: Females in the high level disordered eating symptom trajectory were at increased risk for non-suicidal self-injury (OR 1.60; 95% CI 1.02-2.52) and suicidal ideation (2.16, 1.31-3.57), whereas males were at increased risk for severe anxiety

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	(2.49, CI 1.11-5.58). Males and females in the high level trajectory were more likely to report severe depression (2.26; 1.14-5.92 and 2.15, 1.36-3.38 respectively). Among females, associations were partially explained (17-35%) by loneliness during the first 4 months of the pandemic. Conclusion: Young adults who experienced disordered eating as adolescents were at increased risk of mental health problems during the pandemic. Loneliness partially mediated the effect, suggesting that pandemic mitigation resulting in increased social isolation may have exacerbated mental health problems among women with a history of disordered eating.

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June 6th 2022

Douglas Novins
Editor-in-Chief
Journal of the American Academy of Child and Adolescent Psychiatry

Dear Dr. Novins,

I wish to submit a New Research Article for publication in the *Journal of the American Academy of Child and Adolescent Psychiatry* titled **Pathways of association between disordered eating and mental health outcomes in youth during COVID-19.**

Emerging adults who experienced disordered eating symptoms in adolescence may be at heightened risk for mental health problems during the COVID-19 pandemic, but longitudinal evidence is scarce. Using a large Canadian population-based birth cohort from the province of Québec, we found that males and females with a history of disordered eating in adolescence (12, 15, 17 and 20 years old) were at greater risk for experiencing severe symptoms of anxiety and depression at 23 years old. Females who were in the high risk disordered eating symptom trajectory group were additionally more likely to have suicidal thoughts and self-harm behaviors. Further we found that among females, these associations were explained in part by loneliness during pandemic lockdowns (22 years old). This suggests that pandemic mitigation influenced a particularly relevant risk factor for young women with disordered eating behaviors in adolescence.

Further, we believe that this paper will be of interest to the readership of the *Journal of the American Academy of Child and Adolescent Psychiatry* because it is a longitudinal birth cohort study on the development of mental health problems spanning from childhood to young adulthood and includes recent data collection during the COVID-19 pandemic. We focused on risk factors of clinically relevant outcomes, namely severe anxiety, severe depression, and suicidal behaviors. Men have historically been excluded from the littereature on disordered eating but we included over 500 and brought to light sex differences. Our study can directly inform public policy and prevention efforts to aid those with a history of disordered eating in adolescence through stressful times, such as the recent pandemic context.

As is the case with most high-quality longitudinal birth cohorts, subsets of data have yielded hundreds of articles, all of which have distinct objectives from the current manuscript. The cohort profile and resulting publications are presented in the following article, which is cited in our manuscript: Orri M, Boivin M, Chen C, et al. Cohort Profile: Quebec Longitudinal Study of Child Development (QLSCD). Soc Psychiatry Psychiatr Epidemiol. 2021;56(5):883-894. doi:10.1007/s00127-020-01972-z. As stated in our manuscript, the disordered eating symptom trajectories used in our study were previously calculated. In our manuscript we cited the corresponding conference presentation: Breton E, Dufour R, Côté S, et al. Trajectories of eating disorder symptoms from early adolescence to young adulthood in a community sample. International Conference on Eating Disorders. 2022. The manuscript detailing trajectories is currently under review by the *Journal of Child Psychology and Psychiatry*. The manuscript on trajectories focuses exclusively on the calculation of trajectories from age 12 to 20 and does not include other indicators of mental health or data from other waves of data collection.

After considering the aspects detailed above, we state that this manuscript has not been published or presented elsewhere in part or in entirety and is not under consideration by another journal. All study participants provided informed consent, and the study design was approved by the appropriate ethics review board. The current manuscript was formatted according to the STROBE guidelines for reporting of cohort studies in addition to all other guidelines provided by the journal. Funding sources have been acknowledged on the title page. There are no conflicts of interest to declare.

Thank you for your consideration. I look forward to hearing from you.

Sincerely,
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TITLE PAGE

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Pathways of association between disordered eating and mental health outcomes in youth during COVID-19

Objective: The COVID-19 pandemic has been associated with increased mental health problems. We investigated 1) associations between disordered eating in adolescence and mental health problems after one year of the pandemic and 2) the mechanisms explaining associations.

Method: We analysed data from a population-based birth cohort in Quebec, Canada (557 males and 759 females). High and low levels of disordered eating symptom trajectories were previously estimated (age 12, 15, 17 and 20 years). Anxiety, depression, non-suicidal self-injury and suicidal ideation were assessed at 23 years (winter-spring 2021). Putative mediators included loneliness and social media use (age 22 years, summer 2020). Analyses controlled for mental health and socio-economic status at age 10-12 years and were conducted for males and females separately.

Results: Females in the high level disordered eating symptom trajectory were at increased risk for non-suicidal self-injury (OR 1.60; 95% CI 1.02-2.52) and suicidal ideation (2.16, 1.31-3.57), whereas males were at increased risk for severe anxiety (2.49, CI 1.11-5.58). Males and females in the high level trajectory were more likely to report severe depression (2.26; 1.14-5.92 and 2.15, 1.36-3.38 respectively). Among females, associations were partially explained (17-35%) by loneliness during the first 4 months of the pandemic.

Conclusion: Young adults who experienced disordered eating as adolescents were at increased risk of mental health problems during the pandemic. Loneliness partially mediated the effect, suggesting that pandemic mitigation resulting in increased social isolation may have exacerbated mental health problems among women with a history of disordered eating.

Key words: COVID-19, longitudinal cohort, disordered eating, mental health, suicide

Pathways of association between disordered eating and mental health outcomes in youth during COVID-19

1. Introduction

The COVID-19 pandemic has been associated with millions of deaths, drastic mitigation measures,[1] and major concerns for its impact on mental health around the world.[2] According to the conclusions of a recent World Health Organization (WHO) scientific brief on the plethora of research conducted on the impact of COVID-19 on mental health, symptoms of anxiety and depression increased from before to during the pandemic in the general population. [3,4] Pooled effects of mostly cross sectional studies suggested that suicidal ideation and behaviors among youth have increased during the pandemic.[5] Moreover, evidence shows that females and individuals who are younger are at greater risk for mental health problems during the COVID-19 pandemic. Yet, high quality longitudinal research investigating mental health outcomes of potentially vulnerable populations is still lacking.[6]

Restrictions during lockdowns have exacerbated risk factors for disordered eating, such as isolation and fixation on one's body image.[7] Although both males and females would be affected, there are substantial differences between sexes in the disordered eating literature that should be noted. For instance, the prevalence of eating disorders is consistently higher among females than among males with for example 56% of 14 year old girls and 28% of boys reporting at least one disordered eating behavior.[8] The social stigma associated with disordered eating is higher among males which may lead them to be more secretive about their condition and seek treatment less often than females. [9] Body image concerns are as prevalent among males as

compared to females but the preferred body type often differs (i.e. muscular versus thin). Prevalence of specific eating disorder symptoms may also differ. For instance, males are more likely than females to instate rigid excessive exercise routines in pursuit of the ideal body characteristics but are less likely to present purging behaviours such as vomiting or excessive laxative use. [10] Nevertheless, males are under-represented in the disordered eating literature and more research with male participants is needed. [9]

Cross-sectional research found that disordered eating problems during the COVID-19 pandemic were associated with increased mental health problems including symptoms of anxiety [11–13] and depression [14,15] but the direction of the association is difficult to establish using cross-sectional data. To our knowledge, only one longitudinal study to date (The Avon Longitudinal Study of Parents and Children, UK) has showed that young adults (N= 2,657) with disordered eating problems prior to the pandemic (age 25 years) were at increased risk of anxiety, depression and lower levels of well-being during the pandemic (age 28 years) independently of pre-pandemic mental health and well-being (age 22-24 years). [16] Yet, the mechanisms behind these associations remain unclear. Understanding these mechanisms could allow for the identification of targets for prevention of mental health problems among adolescents and young adults.

Many studies suggest that mitigation measures during the COVID-19 pandemic (e.g. distancing, lockdowns) increased youths' feelings of loneliness which were more pronounced among young adults [17,18] and have been associated with a wide range of physical and mental health problems [19] including depression and suicidal ideation. [18] Further, there is mounting evidence that social media use increased during the lockdown.[20] Prior studies have shown that heavy social media

use can be associated with adverse mental health outcomes (e.g. anxiety, depression) because it often provokes comparisons, jealously and low self-esteem. [20,21] Content frequently includes body-centric messaging (e.g. thin/fit body ideals, sexualizing content, glorification of diets and exercise) which is particularly detrimental for people with disordered eating vulnerabilities.[7] Many studies have shown that exposure to these types of messages can provoke body image concerns, negative affect and disordered eating behaviors among men and women. [22–26] Taken together, this evidence supports the hypothesis that increased loneliness and social media use during lockdowns may partially explain increases in mental health challenges during the pandemic among those with prior disordered eating symptoms.

Using a large population-based cohort from the Canadian province of Québec, our first aim was to investigate the association between disordered eating problems from age 12 to 20 years (2010-2018) and mental health problems (namely, anxiety, depression, non-suicidal self-injuries and suicidal ideation) at age 23 years, one year after the onset of the COVID-19 pandemic (winter and spring 2021). Our second aim was to estimate to what extent perceived loneliness and social media use first the 4 months of the pandemic mediated these associations. Given the importance of sex-based differences related to disordered eating, associations were investigated in males and females separately.

2 .Methods

2.1. Sample

Participants were drawn from the Québec Longitudinal Study of Child Development (QLSCD) which is conducted by the Institut de la Statistique du Québec; a population-based birth cohort of

children born in the province of Quebec in Canada in 1997 and 1998, and followed-up annually or biannually until now. [27] Of the 2120 participants (*n* female=1040; 49.1%) initially included in the cohort, we retained participants with information on disordered eating symptoms with data from at least one time point (12-20 years) and mental health assessment at age 23 years. Analysed data included 759 females and 557 males. As in other studies conducted with this cohort, participants who were more likely to be excluded from our study sample were males, came from families with lower socio-economic status and had mothers experiencing higher rates of depression at childbirth, and who were younger at the time of birth of their first child (see **table S1**, available online). Thus, to minimize bias due to the fact that more vulnerable participants were excluded from analyses, we applied inverse probability weighting.

The QLSCD was approved by the Institut de la statistique du Québec. The 23 years data collection was also approved by the Douglas Research Center Ethics Committee and by the CHU Ste-Justine research ethics committee. Informed consent was obtained from participants and-or their parents at each data collection.

2.2. Measures

Exposure: Disordered eating trajectories from 12 (2010) to 20 (2018) years.

Disordered eating problems were measured at age 12, 15, 17 and 20 years using the 5 item self-report questionnaire Sick, Control, One stone, Fat, Food (SCOFF) [28] which has been validated in French. [29] The SCOFF assesses the presence of disordered eating behaviours (yes vs no) during the past year including purging (*do you make yourself sick because you feel uncomfortably full?*), loss of control (*do you worry that you have lost control over how much you eat?*), weight loss (*have you recently lost at least 6 kg in a 3 month period?*), feeling overweight (*do you believe*

yourself to be fat when others think you are too thin?) and attributing importance to food (*would you say that food dominates your life?*). Behaviours were summed up to create a total score ranging from 0 to 5. We used group-based trajectories that were calculated in a previous study currently under review.[30] Participants were included if they had at least one measurement between 12 to 20 years old. As such, some females (n=188) and males (n=284) were excluded from analyses. Two trajectories best fit the data indicative of high and low level trajectories. 12% of males (n=67) and 37% of females (n=278) were assigned to the high level trajectory. Note that the average number of disordered eating symptoms were higher among females than among males.[30]

Mental health outcomes: Anxiety, depression, non-suicidal self-injury and suicidal ideation at 23 years old

Mental health outcomes were measured between March-June 2021 when participants were 23 years old. At the time of data collection, participants were in a provincial wide lockdown which included closures of all non-essential services (e.g. restaurants, gyms, theatres) and schools with learning moved to virtual platforms.

Anxiety symptoms. Participants reported their symptoms over the past 2 weeks using the *Generalized Anxiety Disorder 7 (GAD-7) scale* (α=.91). Scores >14 indicate severe symptoms. [31]

Depressive symptoms. Participants reported their symptoms over the past week using the short form of the *Center for Epidemiological Studies-Depression Scale (CES-D)* (α=.87). Scores >20 indicates severe symptoms. [32,33]

Non-suicidal self-injury was measured with the item: "*In the past 12 months, did you ever deliberately harm yourself but not mean to take your life?"* (1=yes, 0=no). [34,35]

Suicidal ideation was measured with the item: *In the past 12 months, did you ever seriously consider taking your own life or killing yourself?* (1=yes, 0=no). [34,35]

Mediators during the COVID-19 pandemic (22 years old)

Mediators were measured from July-August 2020 during the first wave of the COVID-19 pandemic at age 22 years.

Loneliness was measured with the *UCLA loneliness scale* which is a valid and reliable (α=.84) self-report measure with three items (feeling left out; feeling isolated from others; lack of companionship). Participants are prompted to rate frequency of their feelings over the last two weeks (1=almost never; 3=often). To ease interpretation, total scores were calculated and converted into a standardized scale ranging from 0 to 10. [36]

Social media use was measured with two single item questions. Participants reported how much time per day between mid-march and mid-June 2020 they estimated using social media (e.g.

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Facebook, Instragam, TikTok) (1=no use; 5= over 6 hours per day) and the average time per day they estimated consulting COVID-19 related news on social media (e.g. Youtube, Instagram, Facebook, Twitter, Reddit) (1=never; 7=more than 4 hours).

Confounders

Confounders were measured at 10 and 12 years old and averaged. Family socioeconomic status (SES) was measured with an aggregate of five items regarding parental education, parental occupation, and annual gross income (range - 3 [low] to 3 [high], 0 centered). [37] Externalizing (3 items: inattention-hyperactivity, conduct problems, aggression) and internalizing (2 items: anxiety, depression) symptoms were self-reported using the Social Behavior Questionnaire [38].

2.3. Data Analyses

All statistical analyses were conducted using SPSS, version 26 (software manufactured by IBM headquartered in Chicago, Illinois). First we present descriptive statistics for all key variables. Second, prospective associations (i.e. total association) between disorder eating trajectories and mental health outcomes were estimated using logistic regressions. To conduct mediation analyses, we used the macro PROCESS v4 (model 4). [39] This model allowed us to partition the total association into an indirect association (i.e., the part of the total association explained by the hypothesized mediator) and a direct association (i.e., the remaining part of the total association not explained by the hypothesized mediator). Effect size of the indirect association was calculated using the ratio between indirect and total associations (indicating the % of association mediated). We tested mediation models if disordered eating trajectories were associated with the mediator, and if the mediator was associated with the outcome (**figure 1**). [40] We used the

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expectation maximization algorithm to handle missing data in the mediators and confounding variables. All regression based analyses are presented with and without adjusting for confounding factors. Statistical tests were two-tailed and considered significant for $P < .05$. As recommended,[39] 95% confidence intervals for the direct and indirect associations were calculated with 10,000 bootstrapped samples.

3. Results

Descriptive statistics are presented in **table 1.** For males, 6.5% reported severe anxiety problems, 6.8% severe depression, 8.1% non-suicidal self-injury, and 7.2% reported suicidal ideation. For females, 11.1% reported severe anxiety problems, 11.5% severe depression, 11.7% non-suicidal self-injury and 9.2% reported suicidal ideation.

3.1. Prospective associations between disordered eating trajectories and mental health problems (total association)

Males or females in the high level disordered eating trajectory reported higher levels of non-suicidal self-injury, anxiety and depression than males or females in the low level trajectory. Females in the high level trajectory reported higher levels of suicidal ideation than females in the low level trajectory, whereas this differences did not reach statistical significance among males. In adjusted models, females in the high level disordered eating trajectory were more likely to engage in non-suicidal self-injury (OR 1.60; 95% CI 1.02 to 2.52) and to think about suicide during the COVID-19 pandemic (OR 2.16 95% CI 1.31 to 3.57), whereas males in the high level

trajectory were more likely to report severe anxiety (OR 2.49 95% CI 1.11 to 5.58). Both males and female in the high level trajectory groups were more likely to report severe depression (OR 2.26; 95% CI 1.14 to 5.92 and OR 2.15; 95% CI 1.36 to 3.38 respectively) (**table 2**).

3.2 Association of disordered eating trajectories with loneliness and social media use

We used Student's t test to compare mean levels of loneliness and social media use among males and females in the high versus low level trajectories. Males in the high level trajectory scored significantly higher than males in the low level trajectory on loneliness. The same significant differences were observed among females, but effect sizes appeared larger. There were no significant differences in social media use in the high and low trajectories (**table 2**).

3.3. Loneliness as a mediator between trajectories and mental health problems

Mediation models were tested based on previously stated requirements.[40] Among females, we found significant indirect effects of loneliness in the association between disordered eating trajectory and all our outcomes (**table 3**). The proportion of the association explained by loneliness was 35.2% for severe anxiety, 23.1% for severe depression, 16.8% for non-suicidal self-injury, and 18.1% for suicidal ideation. After accounting for the mediators, significant direct effects for all outcomes except anxiety were still observed. However, no significant indirect effect of loneliness was found for males on any of the mental health problems (**table 3**).

4. Discussion

Drawing on a large population-based cohort born in the Canadian province of Québec, we found that males and females with high levels of disordered eating symptoms from age 12 to 20 years were more likely to experience severe levels of anxiety and depression symptoms during the COVID-19 pandemic. This converges with longitudinal findings [16] and cross-sectional research on associations between disordered eating and symptoms of depression [14,15] and anxiety. [12,14] We also found that females with prior disordered eating problems were at increased risk of suicidal ideation and non-suicidal self-injury during the pandemic. The same pattern in prevalence was also observed among males, but differences were not statistically significant. One possible explanation is that the number of males with non-suicidal self-injury and suicidal ideation was low, which could lead to a lack of statistical power to detect a true effect. Another possibility is that males in the high level disordered symptom trajectory group had a lower intensity of symptoms than females in the high risk group. This lower level of intensity could explain in part why there were no significant associations with suicidal ideation and self-harming behaviors among men. Collectively these associations show that youth with prior disordered eating are at greater risk for experiencing mental health problems during stressful contexts such as the COVID-19 pandemic.

Loneliness during lockdown explained a part of the association between prior disordered eating and mental health problems among women, but not among men. Feelings of loneliness are a well-established risk factor for physical and mental health problems.[19] Experts highlight that research on individuals with disordered eating vulnerabilities, whether within or apart from the pandemic context, should focus on loneliness and related concepts such as social support that contribute to the development and maintenance of disordered eating symptoms.[7] Those with

disordered eating patterns tend to alienate themselves from others which would be associated with the often secretive nature of problem eating behaviors (e.g. food restriction, binging, purging), low self-esteem and negative perceptions of others. [41] In the context of COVID-19, increased feelings of loneliness have been well documented in general populations and associated with mental health problems especially among young women.[17–19,42] Though young women with prior disordered eating may have been at greater risk for experiencing loneliness and mental health problems in young adulthood regardless of the pandemic, our study highlighted that COVID-19 mitigation measures may have impacted a highly relevant risk factor among those with a disordered eating history which would exacerbate the problem.

Loneliness did not appear to play a mediating role in the association between prior disordered eating and mental health problems among males. We can advance several possible explanations for our findings, keeping in mind that males are often neglected in the disordered eating literature and more research on the topic is flagrantly needed. First, associations between feelings of loneliness or lack of social support and anxiety, depression, suicidal ideation and self-harming behaviors tend to be stronger among young females than among males. [43,44] The weaker associations observed among males could explain in part why our study did not evidence loneliness as a mediator. Second, a few studies evidenced that factors implicated in disordered eating behaviours would be similar across both sexes, but that the underlying mechanisms would differ. [9] For instance, males would be more likely than females to binge eat because of body image concerns and less likely to restrict eating to cope with negative affect. [10] Our results might suggest that loneliness is an important mechanism underlying associations between disordered eating symptoms and other mental health problems that would be pertinent to females

specifically. Alternatively, the finding could be a false negative result due to the lower statistical power in our male sample.

Contrary to our hypotheses, we did not find that social media use during lockdown explained the associations between disordered eating symptoms and mental health problems. This hypothesis was mostly grounded in research conducted outside of the pandemic context and theoretical arguments supporting its relevance during COVID-19.[7] Though empirical research is scarce, one longitudinal study conducted during the pandemic evidenced that time spent on Facebook was associated with increased body image and weight concerns. These associations were explained by maladaptive Facebook use and passive social connection (e.g. scrolling posts) but not passive social comparison (e.g. viewing profiles).[45] Outside of the pandemic context multiple studies revealed both positive and negative effects of social media use on wellbeing. For instance, passive use could increase envy and negative affect whereas active use (e.g. private chats with friends) could enhance social ties and decrease loneliness. [21] Our measure of social media use relied on a single item which did not allow us to distinguish between different types of use nor indicate the specific platforms used (e.g. Instagram versus Reddit) which may contribute to why we did not observe an association. Longitudinal event level studies could be an interesting design to better ascertain the phenomenon. For instance, using a smart phone application, researchers could additionally take daily measures of multiple facets of social media use daily and monitor participants' subsequent feelings.

Our study should be interpreted in light of several limitations. First, as in all longitudinal studies, participants with certain characteristics were more likely to drop out which could lead to an

underrepresentation of these individuals. In order to minimize this bias, we applied inverse probability weighting on key variables. Second, despite the use of a longitudinal design, definitive conclusions about causality between disordered eating and mental health problems and the underlying processes cannot be ascertained as non-included confounding factors could influence results. However, as we adjusted analyses for important confounding factors, namely socio-economic status and prior mental health problems, that source of bias is thought to be minimal. As the majority of our cohort was of Caucasian decent,[27] generalization of our results to gender (vs sex), minority groups such as the LGBTQ+ community or to diverse socio-cultural environments is unclear and it would be important to conduct research on the topic.

Main strengths of our study include reliance on representative longitudinal cohort data with several assessment time points spanning from infancy to young adulthood. We were able to adjust for confounding variables in childhood including socio-economic status and mental health problems, which allows us to better establish causal inferences. By making use of disordered eating trajectories that were calculated in another study, we were able to capture the phenomenon over the course of adolescence rather than relying on a sole time point which reduces measurement error. We used validated tools to measure mental health problems with excellent psychometric properties and evaluated clinically relevant outcomes (e.g. severe anxiety and depression, suicidal ideation, non-suicidal self-injury). Further, we measured mental health outcomes in 2021, a year after the outbreak of the COVID-19 pandemic. Males are often neglected and under-represented in the eating disorder literature, but we were able to include over five hundred men in analyses and highlight sex-based differences. To our knowledge, we conducted the second longitudinal study on prior disordered eating as a vulnerability factor

leading to anxiety and depression during the pandemic, but were the first to include measures of self-harm and suicidal ideation in the design. We were also the first to pinpoint loneliness as an explanatory factor which can allow us to implement evidence based strategies to mitigate mental health problems during the pandemic among women with prior disordered eating.

In conclusion males and females with a history of disordered eating during their adolescence were at higher risk for experiencing mental health problems during the stressful period of the COVID-19 pandemic. Researchers and policy makers should be attentive to this group and implement evidence based strategies to help support at risk individuals. According to the WHO, effective interventions in the COVID-19 context include programs focused on self-help, cognitive behavioral training, psycho-education and relaxation which can be delivered in person or via online platforms.[6] Our findings evidenced that loneliness could be a potential target for the prevention of anxiety, depression, non-suicidal self-injury and suicidal ideation among females with prior disordered eating symptoms. Effective cognitive behavioral techniques to decrease loneliness include addressing maladaptive cognitive beliefs (e.g. negative evaluations of others, lack of interpersonal trust), training in social skills, encouraging socialization and community involvement (e.g. volunteering) and increasing opportunities for socialization. [46,47] Though we found that loneliness explained 17 to 35% of the associations among females, more research would be needed in order identify explanatory mechanisms among males and better understand sex-related differences. Further research would be needed to better ascertain the longer lasting effects of the pandemic on the individuals in our cohort and how the effects may carry over to their offspring.

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Table 1. Descriptive statistics for key variables in high and low level disordered eating trajectories for males and females separately [a]

	All	Low risk	High risk	*p*
Males (N = 557)		*N*=490	*N*=67	
Mediators				
Loneliness *(M, SD)*	2.48 (2.52)	**2.39 (2.41)**	**3.123 (3.20)**	**.025**
Social media *(M, SD)*	3.05 (.81)	3.05 (.81)	2.99 (.75)	.567
COVID news *(M, SD)*	2.62 (1.16)	2.58 (1.15)	2.87 (1.24)	.053
Outcomes				
Severe Anxiety *(N, %)*	36 (6.5%)	**26 (5.3%)**	**10 (14.9%)**	**.003**
Severe Depression *(N, %)*	38 (6.8%)	**28 (5.7%)**	**10 (14.9%)**	**.005**
Self-harm *(N, %)*	45 (8.1%)	36 (7.3%)	9 (13.4%)	.086
Suicidal ideation *(N, %)*	40 (7.2%)	32 (6.5%)	8 (12.1%)	.099
Females (N=759)		*N*=481	*N*=278	
Mediators				
Loneliness *(M, SD)*	3.33 (3.12)	**3.00 (2.95)**	**3.91 (3.32)**	**<.001**
Social media *(M, SD)*	3.46 (.81)	3.42 (.80)	3.53 (.83)	.074
COVID news *(M, SD)*	2.66 (1.35)	2.61 (1.33)	2.74 (1.39)	.215
Outcomes				
Severe Anxiety *(N, %)*	84 (11.1%)	**45 (9.4%)**	**39 (14.1%)**	**<.001**
Severe Depression *(N, %)*	87 (11.5%)	**40 (8.3%)**	**47 (17.0%)**	**<.001**
Self-harm *(N, %)*	89 (11.7%)	**47 (9.8%)**	**42 (15.1%)**	**<.001**
Suicidal ideation *(N, %)*	70 (9.2%)	**32 (6.6%)**	**38 (13.7%)**	**<.001**

[a]Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2022). Significant results in bold. ©Gouvernement du Québec, Institut de la statistique du Québec. P<.05 in bold.

Table 2. Prospective associations between high and low level disordered eating trajectories and mental health problems at age 23 [a]

	Severe anxiety	Severe depression	Non suicidal self-injury	Suicidal ideation
High risk trajectory (reference=0)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Males				
Unadjusted	**3.06 (1.40 to 6.67)**	**2.80 (1.29 to 6.09)**	1.96 (.90 to 4.28)	1.98 (.88 to 4.47)
Adjusted [b]	**2.49 (1.11 to 5.58)**	**2.26 (1.14 to 5.92)**	1.69 (.761 to 3.77)	1.62 (.70 to 3.76)
Females				
Unadjusted	**1.59 (1.01 to 2.51)**	**2.24 (1.43 to 3.52)**	**1.636 (1.05 to 2.56)**	**2.26 (1.37 to 3.71)**
Adjusted [b]	1.52 (.96 to 2.41)	**2.15 (1.36 to 3.38)**	**1.60 (1.02 to 2.52)**	**2.16 (1.31 to 3.57)**

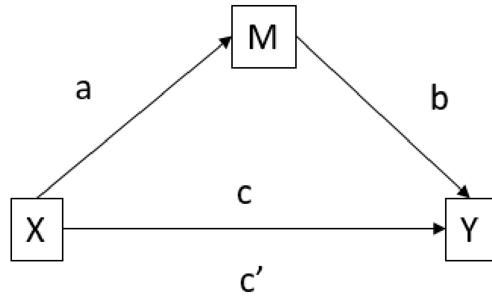
Note. OR=odds ratio. CI=confidence interval. Significant results in bold (95% CI)
[a]Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2022), ©Gouvernement du Québec, Institut de la statistique du Québec.
[b] Adjusted for socio economic status and prior mental health age 10-12. Pooled results reported.

Table 3. Direct and indirect effects of trajectories on mental health problems via loneliness among males and females [a]

	Direct effect	Indirect effect	
Females	OR 95% CI	OR 95% CI	% mediation
Severe anxiety	1.32 (0.83 to 2.10)	**1.16 (1.06 to 1.31)**	35.2%
Severe depression	**1.93 (1.21 to 3.09)**	**1.22 (1.09 to 1.41)**	23.1%
Non suicidal self-injury	**1.56 (1.02 to 2.55)**	**1.10 (1.02 to 1.20)**	16.8%
Suicidal ideation	**1.82 (1.09 to 3.03)**	**1.14 (1.05 to 1.28)**	18.1%
Males			
Severe anxiety	2.10 (0.90 to 4.91)	1.19 (0.98 to 1.52)	
Severe depression	1.53 (0.63 to 3.73)	1.20 (0.98 to 1.58)	
Non suicidal self-injury	1.39 (0.61 to 3.18)	1.15 (0.93 to 1.41)	
Suicidal ideation	1.23 (0.50 to 3.02)	1.19 (0.98 to 1.53)	

Note. OR=odds ratio. CI=confidence interval. Significant results in bold (95% CI). Results adjusted for prior mental health and socio-economic status at 10-12 years old. [a]Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2021), ©Gouvernement du Québec, Institut de la statistique du Québec.

Figure 1. Conceptual model of mediation analyses



Note: X=Exposure (high or low level disordered eating trajectories). M=Mediator (loneliness). Y=Internalizing symptoms (anxiety, depression, non-suicidal self-injury or suicidal thoughts). ab=Indirect effect of X on Y. c=Total effect of X on Y. c’=Direct effect of X on Y.

Table S1. Comparisons of participants and non-participants on key variables measured at 5 months old based on unweighted values

	Females (n=1040)			Males (n=1080)		
	Participants (N=759)	Non-participants (N=281)	*p*	Participants (N=557)	Non-participants (N=523)	*p*
Family characteristics						
Maternal age at birth in years, mean (SD)	26.18 (4.857)	24.96 (5.08)	.001	26.29 (4.79)	25.14 (5.03)	<.001
Maternal depression, mean (SD)	1.31 (1.253)	1.53 (1.36)	.021	1.344 (1.34)	1.53 (1.45)	0.026
Non-intact family (single or blended), No. (%)	141 (18.7%)	67 (24.0%)	.056	95 (19.8%)	103 (17.1%)	0.224
Family socioeconomic status	.11 (1.00)	-.201 (1.02)	<.001	.14 (.94)	-.20 (1.00)	<.001

[a]Data were compiled from the final master file of the Québec Longitudinal Study of Child Development (1998–2021), ©Gouvernement du Québec, Institut de la statistique du Québec.