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Adolescent psychotic experiences before and during the COVID-19 pandemic: a prospective cohort study

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Background: Understanding the etiology of psychosis is essential to the development of preventive interventions. The COVID-19 pandemic provides a rare natural experiment that can expand our understanding of the role of social factors in the trajectories and etiology of psychosis across adolescence, particularly in Tokyo where the prevalence of actual COVID-19 infection remained low. We hypothesized that the likelihood of self-reporting psychotic experiences (PEs) would increase following the onset of the COVID-19 pandemic. **Methods:** The Tokyo Teen Cohort (TTC) is a prospective cohort study of adolescents in the general population of the Tokyo metropolitan area, followed from age 10 to 16 years. We used multi-level linear regression models to test the associations between the phase of the COVID-19 pandemic and self-reported PEs. **Results:** Among 1935 adolescents included in the analysis, a rapid increase in PEs occurred at the onset of the COVID-19 pandemic, following approximately 6 years of steady decline across prior waves. This association was more pronounced for boys compared to girls. This increase became more pronounced as the pandemic moved into later phases, defined based on contemporaneous sociopolitical changes in Tokyo (i.e. changes to school closure, social distancing guidelines, and the state of emergency status). **Conclusions:** The steady decline in PEs across adolescence was halted and reversed concurrent with the COVID-19 pandemic onset, despite very low rates of COVID-19 infection. This implicates COVID-19 related socioenvironmental factors as contributory etiological factors in the development of PEs in this adolescent cohort. **Keywords:** coronavirus; COVID-19; epidemiology; gender; pandemic; psychosis.

Introduction

Psychotic experiences (PEs) are hallucination- and delusion-like symptoms that serve as population-level indicators of psychosis vulnerability and have been linked to a broad range of genetic, neurobiological, psychological, substance-related, infection-related, and societal etiologic factors (Linscott & van Os, 2013). The COVID-19 pandemic provides a rare natural experiment in which some of these factors rapidly changed on a societal level (e.g. social isolation, exposure to victimization, and COVID-19 infection itself) and some did not (e.g. ethnic density, individual-level genetics). COVID-19 social distancing measures and other restrictions have directly resulted in social isolation (Bennett, Surkan, Moulton, Fombonne, & Melchior, 2020; Narita, Stickley, & DeVylder, 2020), and have increased and are linked to mental health symptoms during the COVID-19 pandemic (Loades et al., 2020).

There is also evidence that infectious diseases in themselves may increase subsequent risk for psychosis (Kulaga & Miller, 2021), and there have been numerous case reports of the new onset of PEs following infection with COVID-19 (Chaudhary et al., 2022), as well as case reports of incident PEs attributed to pandemic-related anxiety or quarantine [without evidence of infection (Finatti, Pigato, Pavan, Toffanin, & Favaro, 2020; Huarcaya-Victoria, Herrera, & Castillo, 2020)]. One large population-level study of college students found independent associations between COVID-19 anxiety, financial distress, and infection and PEs (Oh, Goehring, et al., 2021; Oh, Schiffman, et al., 2021), highlighting the difficulty in untangling biological versus psychosocial explanations.

The okyo Teen Cohort (TTC), an ongoing longitudinal study that has followed 3,171 youth in metropolitan Tokyo since age 10. While the COVID-19 pandemic was an unanticipated global

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phenomenon, it fortuitously occurred midway through Wave 4 (16-year-old) data collection. The TTC data set, therefore, is in the opportune position to identify changes in risk for psychosis related to the COVID-19 pandemic at the approximate peak age of developmental psychosis vulnerability. Further, given the very low rate of actual COVID-19 infection in Tokyo during the first year of the pandemic, any change in the patterns of self-reported psychosis corresponding with the onset of the pandemic is likely to be primarily driven by psychosocial changes rather than infection itself. This study therefore tests the hypothesis that the likelihood of youth reporting PEs increased following the onset of the COVID-19 pandemic, which would be interpreted as evidence for a socially caused shift in psychosis trajectories at the population level.

Methods

Participants and procedure

Data were collected as part of an ongoing population-based prospective cohort study of adolescent health and development, conducted in Tokyo (TTC; Ando et al., 2019). Adolescents born in between September 1, 2002, and August 31, 2004, were randomly selected based on the Basic Resident Register of the Tokyo metropolitan area (Setagaya, Mitaka, and Chofu). Invitation letters were sent to the parents of the adolescents around their tenth birthday. Data were collected when the participants in the TTC were aged around 10 (age 10 survey: T1), 12 (age 12 survey: T2), 14 (age 14 survey: T3), and 16 (age 16 survey: T4; four-time points). At T1, 3171 adolescent-parent pairs participated; of these, 3,007 pairs participated at T2 (follow-up rate: 94.8%), 2,667 participated at T3 (follow-up rate: 84.1%), and 2,616 participated at T4 (follow-up rate 82.5%). A trained interviewer administered self-report questionnaires to both children and parents at their homes and conducted semi-structured interviews with the parents. The survey was completed over two visits in each wave.

Ethical considerations

The TTC study protocol was approved by the Institutional Review Boards of the Tokyo Metropolitan Institute of Medical Science (#12-35), SOKENDAI (the Graduate University for Advanced Studies, #2012002), and the University of Tokyo (#10057). Written informed consent was obtained from all parents of the participating adolescents, and informed assent was obtained from all adolescents, prior to participation.

Study period related to the COVID-19 pandemic

The survey at T4 was conducted before and during the COVID-19 pandemic, from February 2019 to September 2021 (Figure 1). Japanese government implemented school closures to prevent the spread of the COVID-19 on March 2, 2020, and subsequently declared the first nationwide state of emergency on 7 April. During the first state of emergency period, residents were requested to avoid unnecessary outings and practice physical distancing. The school closures lasted for most schools in Tokyo until May 30, 2020, while the state of emergency ended on May 25, 2020. Although no further school closure had been implemented, the second state of emergency was declared on January 7, 2021 due to the increase in the number of patients with COVID-19; the subsequent states of emergency were intermittently declared until the fourth declaration ended on September 30, 2021.

Variables

Elapsed time from the COVID-19 pandemic. The elapsed time (in year) from the start of the epidemic in Japan (March 2020) was calculated based on the date that each participant took the survey.

Indicator for the COVID-19 pandemic. An indicator for the COVID-19 pandemic was defined based on the date of the survey as follows: 'pre-pandemic survey' (scored as 0, before March 2020); and 'during-pandemic survey' (scored as 1, March 2020 or later). In addition, to examine whether the impact of the pandemic on PEs in adolescents differ in different phases of the pandemic period, another indicator for the COVID-19 pandemic was defined by dividing 'during-pandemic survey' into three survey periods (used as categorical variables): 'early-pandemic survey' (March to May 2020, corresponding with the school closure period); 'mid-pandemic survey' (June to December 2020, corresponding with school re-open and easier social distancing measures); and 'late-pandemic survey' (January to September 2021, corresponding with the reintroduction of the state of emergency declaration).

Psychotic experiences. PEs were assessed using a series of items derived from the schizophrenia section of the Diagnostic Interview Schedule for Children (DISC-C; Costello, Edelbrock, & Costello, 1985), with an added question on visual hallucinations. DISC-C items focus specifically on hallucination- and delusion-like experiences and symptoms, which are frequently reported at sub-clinical levels in the absence of a diagnosable psychotic disorder. The actual items were as follows (five items): 'Have you ever heard voices that other people cannot hear?' (auditory hallucinations); 'Have other people ever read your thoughts?' (thought broadcasting); 'Have you ever had messages sent especially to you through the television or radio?' (special messages); 'Have you ever thought that people are following you or spying on you?' (persecutory thoughts); 'Have you ever seen things that other people could not see?' (visual hallucinations). Each item was scored on a three-point scale: no (0); maybe (0.5); and yes, definitely (1). Summing each of the items produced an overall score (ranged from 0 to 5), which was then treated as a continuous variable for statistical analyses, as done in prior published reports on PE from the TTC data (Kiyono et al., 2022). The assessments were conducted through adolescent self-report.

Demographic and substance use variables. The following demographic variables were assessed at each wave: sex, age (in years), and recreational drug use including cannabis (only at T3 and T4).

Statistical analysis

The participants were included in the following statistical analyses, when they had valid responses for PE both at T4 and at least one of the three previous waves (i.e. T1–T3). We first compiled each demographic variable and PE score of all the included participants by timing of the survey at T4, and examined potential biases by comparing those who took the survey at T4 before pandemic with those during the pandemic (Table 1). We also examined potential biases from attrition by comparing those included in the analyses with those excluded (Table S1).

We then examined the potential impact of the COVID-19 pandemic (Exposure) on PE (Outcome) by analyzing within-

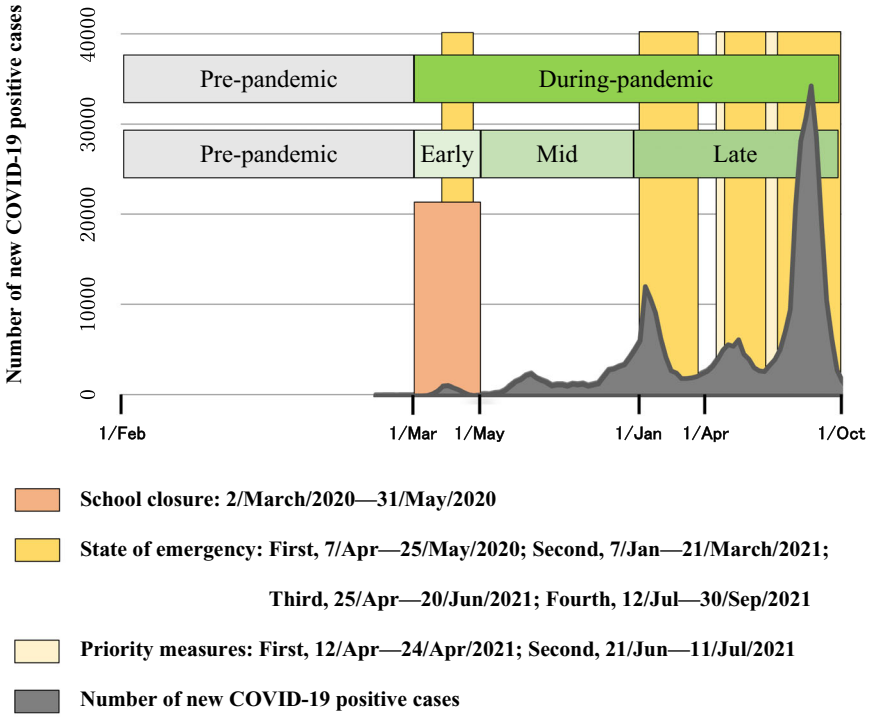

Figure 1 The COVID-19 context in Tokyo. The study phase and periods of 'school closure,' 'state of emergency,' and 'priority measures' are shown with the number of new COVID-19 positive cases. Data of the number of new COVID-19 positive cases in Tokyo was obtained from https://data.stopcovid19.metro.tokyo.lg.jp/130001_tokyo_covid19_patients_per_report_date.csv. Data of the periods of 'school closure,' 'state of emergency,' and 'priority measures' were obtained from https://www.seisakukikaku.metro.tokyo.lg.jp/en/cross-efforts/2022/11/images/enh3.pdf

person change in PE scores and its association with the COVID-19 pandemic using multilevel linear regression model. Because TTC survey had been conducted before (T1–T3, and the first half of T4) and during (the last half of T4) the COVID-19 pandemic, we are in a unique situation to test the impact of the pandemic on PEs. In Model 0, a linear slope factor of elapsed time from the COVID-19 pandemic was included, because previous studies have observed declining trend in PE symptoms over time (Staines et al., 2022). In Model 1, an indicator for the COVID-19 pandemic (i.e. the 'pre-pandemic survey' or the 'during-pandemic survey') was added to examine the impact of the COVID-19 pandemic on PEs. In Model 2, an interaction term between sex and the indicator for the COVID-19 pandemic was added to test whether the impact of the COVID-19 pandemic on PEs differed by sex. In this Model 2, an interaction term between sex and elapsed time was also included, to test whether the trajectories of PE scores differ by sex (Staines et al., 2022). All models included a term for the random slope of elapsed time in addition to random intercept of each participant, as well as adjustment for chronological age at T4. Furthermore, to investigate whether the impact of the COVID-19 pandemic on PEs differed by phase of the COVID-19 pandemic, we repeated the analyses using a categorical indicator of pandemic phase with four categories (i.e. 'pre-pandemic survey', 'early-pandemic survey', 'mid-pandemic survey', and 'late-pandemic survey'). Multilevel linear regression model is based on maximum likelihood estimation, and robust for missing data in outcomes under the assumption of missing at random (Bell & Fairclough, 2014). Significance level was set at $\alpha = 0.05$ with 2-sided hypothesis test. All analyses were conducted using R version 4.3.0 with lmerTest package.

Results

Among the 1935 participants [girls, $n = 922$ (47.6%)] included in the current study, 951 (49.1%) participants took the T4 survey before the pandemic, and the 984 (50.9%) participants took the T4 survey during the pandemic (Table 1). Compared to the former, those taking the survey during the pandemic were slightly older at T4 (mean age 16.6 vs. 16.9 years, $p < .001$). As indicated in the Table 1 and Figure 2, their raw mean PE scores were highest at T1 and declined persistently towards T4. These raw mean scores were not significantly different at each wave. Reflecting broader national trends in Japan, no participants used recreational drugs, including cannabis, at T3 or T4. Furthermore, we examined potential biases from attrition by comparing those included in the analyses with those excluded (Table S1). There were several differences between them (e.g. age at T4), although their PE scores were not significantly different at each wave.

Table 2 shows the results of the multilevel linear regression models which analyze the within-person change in mean PE scores across T1 to T4 and its association with the COVID-19 pandemic. Model 0, which included elapsed time and chronological age at T4, shows that PE scores decreased with time. Model 1, which further included an indicator of the COVID-19 pandemic, shows that in 'during-pandemic survey' period, significant increase was observed in PE scores (unstandardized coefficients (B): 0.147, 95% confidence interval (CI): 0.094–0.201), compared to the score predicted by 'pre-pandemic survey' period. This result indicated that

Table 1 Characteristics of study participants included in the current study by the timing of age 16 survey (before or during the pandemic)

	Total sample (N = 1,935)				
	At T4, samples taking the survey				
	before the pandemic (n = 951, 49.1%)		during the pandemic (n = 984, 50.9%)		
	n	(%), mean (*SD*)	n	(%), mean (*SD*)	p-value[a]
Age at T4	951	16.6 (0.3)	984	16.9 (0.3)	<.001
Sex					
Boy	502	(52.8)	511	(51.9)	.74
Girl	449	(47.2)	473	(48.1)	
Recreational drug use including cannabis at T3					
No	840	(100.0)	809	(100.0)	–
Yes	0	(0.0)	0	(0.0)	
Recreational drug use including cannabis at T4					
No	899	(100.0)	940	(100.0)	–
Yes	0	(0.0)	0	(0.0)	
PE score at T1	913	0.91 (0.92)	956	0.86 (0.91)	.20
PE score at T2	859	0.59 (0.85)	841	0.59 (0.84)	.91
PE score at T3	851	0.36 (0.67)	818	0.37 (0.73)	.78
PE score at T4	951	0.21 (0.52)	984	0.23 (0.59)	.38

PE: psychotic experience; T1: age 10 survey; T2: age 12 survey; T3: age 14 survey; T4: age 16 survey.
[a]p-values were derived from t-test for continuous variables and from the chi-square test for dichotomous variables.

the pandemic had a significant negative impact on adolescents' PEs. In Model 2, significant interactions between sex and impact of the pandemic (in addition to elapsed time) were observed. According to the results of additional analyses (stratified by sex, Model 1 in Table S2), for boys, in the 'during-pandemic survey' period, significant increase was observed in PE scores (B: 0.200, 95% CI: 0.125–0.275), compared to the score predicted by the 'pre-pandemic survey' period. For girls, such an increase was also significant but smaller (B: 0.076, 95% CI: 0.000–0.152). This sex difference for the negative impact of the pandemic on PE scores was illustrated by Figure 2.

Table 3 shows differences of the impact of the COVID-19 pandemic on adolescents' PEs in different phases of the pandemic period. Model 1 shows that the negative impacts of the pandemic were significant in the 'mid-pandemic survey' and 'late-pandemic survey' periods (B: 0.145, 95% CI: 0.085–0.205; B: 0.216, 95% CI: 0.110–0.321, respectively), but not in the 'early-pandemic survey' period (corresponding with the school closure period in Japan). In Model 2, significant interactions between sex and impact of the pandemic were observed in the 'early-pandemic survey' and 'late-pandemic survey' periods, but not in the 'mid-pandemic survey' period. According to the results of additional analyses (stratified by sex, Model 1 in Table S3), for boys, in the all during-pandemic survey periods, significant increases were observed in PE scores ('early-pandemic survey', B: 0.199, 95% CI: 0.055–0.343; 'mid-pandemic survey', B: 0.169, 95% CI: 0.086–0.252; 'late-pandemic survey', B: 0.356, 95% CI: 0.206–0.505), compared to the score predicted by 'pre-pandemic survey' period. On the other hand, for girls, such a significant increase was observed only in 'mid-pandemic survey period' (B: 0.111, 95% CI: 0.023–0.197).

Discussion

Main findings

In this longitudinal cohort study, we found that self-reported PE gradually declined across adolescence, from age 10 to 16, but that this steady decline abruptly reversed direction following the onset of the COVID-19 pandemic. Further, tests of moderation by gender revealed that this trend reversal was significantly more pronounced for boys compared to girls. The early stage of the COVID-19 pandemic in Tokyo was characterized by abrupt and widespread social change, including school closures and social distancing measures, but notably, a very low rate of actual COVID-19 infection, particularly among youth. Further, while substance use may have been broadly impacted by the pandemic in many countries, the exceedingly low rates of marijuana use in Japan (lifetime prevalence of 0% among 15–19 years (National Center of Neurology and Psychiatry, 2021) effectively rule this out as a factor in the current data. Finally, our use of prospective data is consistent with a clear direction of temporality in which social change (i.e. the pandemic and its effects) immediately precedes the increase in PEs. Therefore, the trend identified in these data is highly consistent with a social causation model, in that the social changes that accompanied the COVID-19 pandemic provide the most parsimonious explanation for the

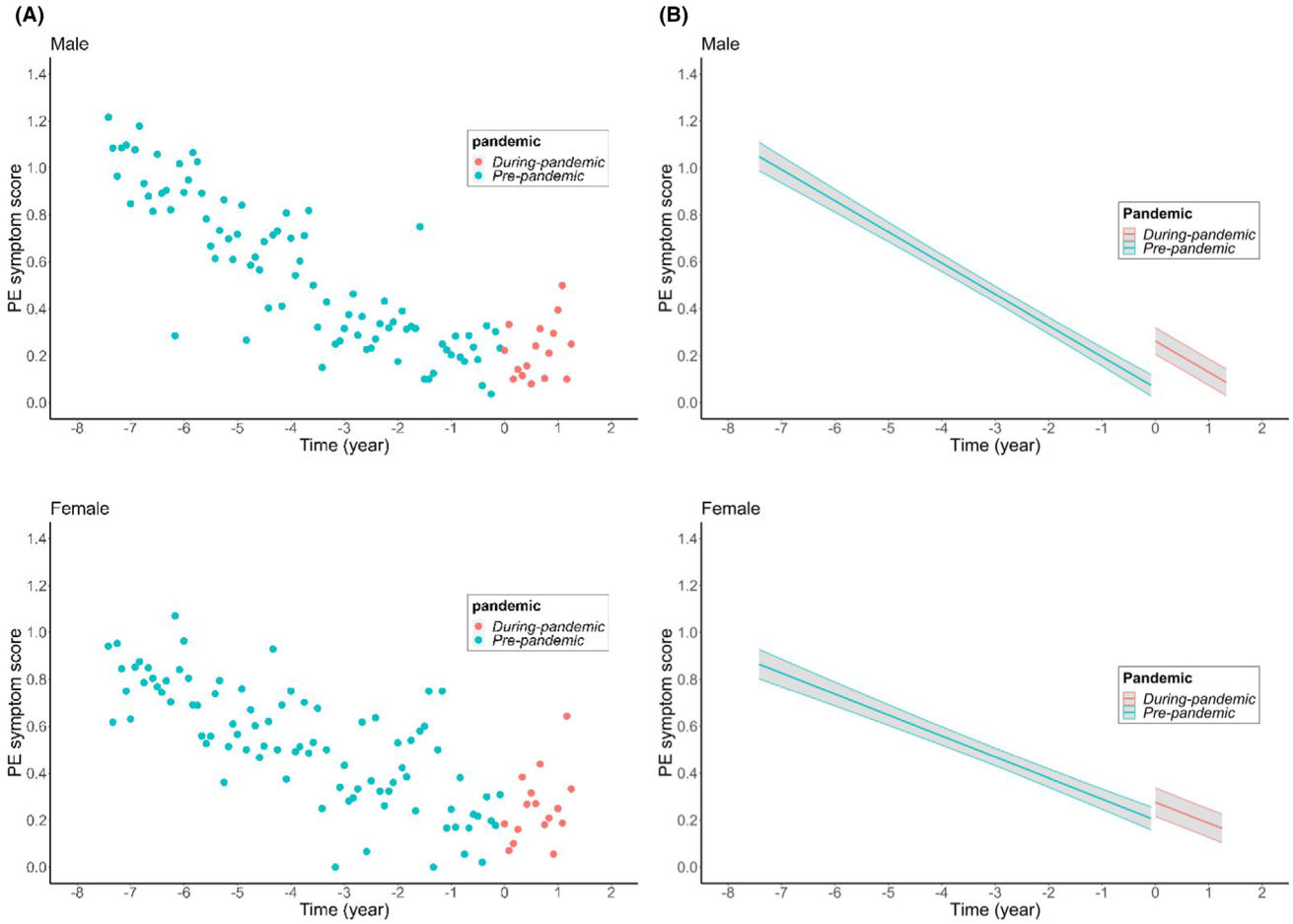

Figure 2 The mean score of psychotic experiences among adolescents surveyed pre and during the COVID-19 pandemic. (A) The raw mean score of psychotic experiences (PEs). Each plot shows raw mean score of PEs in adolescents who took the survey at the time shown in the Figure (the number of boys, median: 38, inter quartile range: 21–54; the number of girls, median: 34, inter quartile range: 21–47). Each adolescent took the survey 2–4 times. (B) The mean score of PEs predicted by multilevel linear regression analysis. In this analysis, we assumed that a slope of predicted lines across 'pre-pandemic survey' period is the same as that of 'during-pandemic survey' period, and that a difference between the two predicted lines shows the effects of the COVID-19 pandemic

abrupt reversal of trends in PE trajectories identified in these data.

Potential mechanisms

The COVID-19 pandemic spurred changes in social exposures for youth in Japan, most directly through social distancing measures and school closures (Tokyo Metropolitan Government, 2020). This may have directly contributed towards greater objective social isolation and subjective feelings of loneliness (Loades et al., 2020), although, notably, longitudinal analyses of earlier waves of TTC suggested that PEs precede rather than follow increases in loneliness (Endo et al., 2022). There is also evidence that rates of child maltreatment increased during the COVID-19 pandemic (Rodriguez, Lee, Ward, & Pu, 2021) which has been linked to PE risk in prior longitudinal research (Bell, Foulds, Horwood, Mulder, & Boden, 2019), although it is not presently clear how trends in child maltreatment were affected by the pandemic in Japan. The COVID-19 pandemic may also have affected expectations for the future among adolescents (e.g. future college and employment prospects), and given notable gender divides in Japan (e.g. Japan ranks 116 among 146 countries included in the global gender gap index and lowest in East Asia, at 19 out of 19 countries, according to the World Economic Forum, 2022), negative effects of the pandemic on youth expectations for their own future could have disproportionately affected the mental well-being of adolescent boys compared to girls. There is also evidence that adolescent boys and girls differ in the nature of their interpersonal relationships and conceptualization of friendship; it is possible that boys' friendships, previously shown to be more characterized by shared social activities rather than those of adolescent girls (Poulin & Chan, 2010), may have been more impacted by COVID-19 related social distancing measures. On the other hand, gender difference in the effects of the pandemic was not significant in the mid-pandemic period. In this period, schoolwork-related stress/pressure, which are the major factors of mental health problems (Steare, Gutierrez Munoz, Sullivan, & Lewis, 2023), may be more prevalent compared to

Table 2 The effects of the COVID-19 pandemic on psychotic experiences

Variable	Model 0: Time included	Model 1: Pandemic indicator included	Model 2: Sex-interaction included
	Unstandardized estimates (95% confidence interval)		
Intercept	0.184 (0.158, 0.211)***	0.126 (0.092, 0.160)***	0.062 (0.015, 0.108)**
Time (in year)[a]	−0.101 (−0.108, −0.094)***	−0.113 (−0.121, −0.105)***	−0.133 (−0.144, −0.122)***
Age at T4[b]	0.100 (0.028, 0.172)**	0.062 (−0.011, 0.136)†	0.062 (−0.011, 0.135)†
During-pandemic survey[c] (Reference: pre-pandemic survey)		0.147 (0.094, 0.201)***	0.202 (0.128, 0.275)***
Sex (Reference = male)			0.136 (0.069, 0.204)***
Sex & Time interaction			0.043 (0.028, 0.059***
Sex & During-pandemic interaction			−0.116 (−0.221, −0.011)*
Random effect		Variance and correlation	
Residual	0.348	0.347	0.346
Intercept	0.100	0.098	0.097
Slope	0.007	0.007	0.007
Intercept–slope correlation	−0.14	−0.15	−0.18

T1: age 10 survey; T2: age 12 survey; T3: age 14 survey; T4: age 16 survey.
[a]Centered at the start time of the COVID-19 pandemic in Japan.
[b]Centered at grand mean.
[c]Scored as 0, before the pandemic (T1–T3 and first half of the T4), and scored as 1, during the pandemic (last half of the T4).
†$p < .1$; *$p < .05$; **$p < .01$; ***$p < .001$.

Table 3 The effects of the COVID-19 on psychotic experiences, at early-, mid-, and late- stages of the pandemic

Variable	Model 1: Pandemic indicator included	Model 2: Sex-interaction included
	Unstandardized estimates (95% confidence interval)	
Intercept	0.125 (0.091, 0.159)***	0.060 (0.013, 0.107)*
Time (in year)[a]	−0.113 (−0.121, −0.105)***	−0.134 (−0.144, −0.123)***
Age at wave 16[b]	0.056 (−0.018, 0.129)	0.055 (−0.019, 0.129)
Pre-pandemic	(Reference)	(Reference)
Early-pandemic survey (2020.3–5)[c]	0.095 (−0.010, 0.200)†	0.214 (0.070, 0.357)**
Mid-pandemic survey (2020.6–12)[c]	0.145 (0.085, 0.205)***	0.166 (0.084, 0.249)***
Late-pandemic survey (2021.1–9)[c]	0.216 (0.110, 0.321)***	0.350 (0.200, 0.499)***
Sex (Reference = boy)		0.137 (0.069, 0.204)***
Sex and slope interaction		0.043 (0.028, 0.059)***
Sex and pre-pandemic interaction		(Reference)
Sex and early-pandemic interaction		−0.252 (−0.460, −0.043)*
Sex and mid-pandemic interaction		−0.044 (−0.164, 0.075)
Sex and late-pandemic interaction		−0.273 (−0.478, −0.068)**
Random effect	Variance and correlation	
Residual	0.347	0.346
Intercept	0.097	0.097
Slope	0.007	0.007
Intercept–slope correlation	−0.16	−0.19

T1: age 10 survey; T2: age 12 survey; T3: age 14 survey; T4: age 16 survey.
[a]Centered at the start time of the pandemic in Japan.
[b]Centered at grand mean.
[c]Scored as 0, before the pandemic (T1–T3 and first half of the T4), and scored as 1, during each shown period (otherwise 0).
†$p < .1$; *$p < .05$; **$p < .01$; ***$p < .001$.

other periods, because school works were increased in this period to compensate for decreasing amount of works due to school closure, with 60% decrease in summer vacation (Tokyo Metropolitan Board of Education, 2020). Considering that schoolwork-related stress/pressure was originally more prevalent in girls compared to boys (OECD, 2017), these stress/pressure may affect especially girls in the mid-pandemic period. Notably, a recent umbrella review of risk and protective factors for psychosis

found the strongest evidence for factors that may not have been immediately affected by the pandemic, such as migration and ethnic density, trait anhedonia, olfactory abilities, and premorbid IQ (Radua et al., 2018). However, it is highly likely that many of these factors (both those affected and unaffected by the pandemic) operate through similar mechanisms, possibly inducing feelings of social defeat (Schalbroeck, 2023; Selten, van der Ven, Rutten, & Cantor-Graae, 2013) or the distress of marginalization (Anglin et al., 2021). Further research should identify broader gender differences in the social effects of the COVID-19 pandemic in Japan, which may provide clues explaining the gender differences in psychosis trends identified here.

Limitations

There are several potential limitations to this study. First, because this wave of the study was initiated prior to the availability of testing for COVID-19 (or even widespread awareness of its existence), we did not directly assess COVID-19 infection and therefore cannot rule out a direct biological pathway from COVID-19 infection to PEs, although it is an unlikely explanation considering the low rate of infection among this age group in Japan at this time. TTC also faces issues of attrition, common to most long-term prospective cohort studies, leading to some loss in sample over time. Although there were minor demographic differences between those included in the analyses and those excluded, the difference is small (e.g. 0.2 years age difference at T4) and their PE scores were not significantly different at each wave (Table S1); the attrition might not lead to much bias on the results. We also did not have data available to test a wide range of potential mediating mechanisms that may have explained the pandemic-related changes observed herein. Finally, self-report measures of PEs may be subject to various reporting biases (e.g. social desirability, recall bias), but it is not clear whether any potential biases would result in the pandemic-related uptick in PEs found in our data.

Conclusions

While socially caused risk for psychosis is now well established from a wide range of epidemiological studies, these studies typically face substantial issues of confounding by genetic factors (Maxwell, Coleman, Breen, & Vassos, 2021; Newbury et al., 2022), substance use (van Os et al., 2021), or issues of unclear temporality. The natural experiment provided by the COVID-19 pandemic and examined in this study reveals strong support for a socially caused increase in PEs that cannot be readily explained by these common confounding factors, particularly given the low rate of COVID-19 infection among youth in Japan during the studied phase of the pandemic. Future epidemiological studies should attempt to better understand the mechanisms that may have explained this increase, including potential psychosocial mediators and the effect modification by gender, and future intervention work should expand the focus on mental health in the ongoing public health response to COVID-19 and any future pandemics.

Supporting information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Table S1. Comparison of characteristics of the participants included in the analyses with those excluded in the Tokyo Teen Cohort (TTC).

Table S2. The effects of the COVID-19 pandemic on psychotic experiences by sex.

Table S3. The effects of the COVID-19 on psychotic experiences, at early-, mid-, and late- stages of the pandemic by sex.

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Data availability statement

Data can be made available from the Tokyo Teen Cohort Data Operating Committee for all interested researchers upon requests sent to the committee. The initial contact for the request should be addressed to Dr. Atsushi Nishida [nishida-at@igakuken.or.jp].

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Key points

- The occurrence of self-reported subclinical psychotic experiences (PEs) is believed to decline across childhood and adolescence.
- Social context has been shown to alter the risk for psychosis and, therefore, may alter this trajectory.
- The COVID-19 pandemic was characterized by drastic social change in Japan despite a low incidence of infection.
- In the Tokyo Teen Cohort (TTC), we found that the frequency of reported PEs increased following the onset of the COVID-19 pandemic. Social isolation and related factors may have contributed to this increase.
- These findings highlight the potential mental health costs of pandemic-related social distancing measures for adolescents, and suggest that interventions to reduce social isolation may offer protective effects for psychosis.

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