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Gender differences in the prevalence and impact factors of adolescent dissociative symptoms during the coronavirus disease 2019 pandemic

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The purpose of this study was to explore the differences between the prevalence and impact factors of adolescent dissociative symptoms (ADSs) by using sex-stratification during the coronavirus disease 2019 (COVID-19) pandemic. A school-based, two-center cross-sectional study was conducted in Hangzhou City, China, between January 1, 2021 and April 30, 2022. The sample included 1,916 adolescents aged 13–18 years that were randomly selected using a multiphase, stratified, cluster sampling technique. A two-stage assessment procedure was used to find out the ADSs. We used a multivariate logistic regression analysis to assess the impact factors of ADSs during the COVID-19 pandemic. The adolescent dissociative scores ($t=4.88$, $P<0.001$) and positive ADSs rate (Chi-square = 15.76, $P<0.001$) in males were higher than in females. Gender-stratified, stepwise multiple logistic regression analysis revealed that the conflict relationship of teacher-student [adjusted odds ratio (AOR) 1.06, 95% confidence interval (CI) 1.01–1.10], family expressiveness (AOR 0.87, 95% CI 0.78–0.98), family conflict (AOR 1.15, 95% CI 1.05–1.27), family organization (AOR 0.88, 95% CI 0.78–0.99), and family cohesion (AOR 0.87, 95% CI 0.77–0.99) were linked to ADSs only in males, while individual psychological states of somatic complaint (AOR 1.04, 95% CI 1.00–1.08) and paranoid ideation (AOR 1.09, 95% CI 1.01–1.19) were associated with female ADSs only. The ADSs seemed to be prevalent in Hangzhou City, studied during the COVID-19 pandemic. Gender differences in the prevalence and impact factors of dissociative symptoms seem to be significant among adolescents. Thus, gender-specific intervention programs against ADSs should be considered as reducing this risk.

Abbreviations

COVID-19	Coronavirus disease 2019
TSRs	Traumatic stress reactions
ADD	Adolescent dissociative disorder
DSs	Dissociative symptoms
DSM-5	Diagnostic and statistical manual of mental disorders 5th edition
ADSs	Adolescent dissociative symptoms
DD	Dissociative disorder
CI	Confidence intervals
SHSS	School health surveillance system
A-DES	Adolescent dissociative experience scale
SCID-D	Structured clinical interview for DSM-5- dissociative disorders
CASA	Chinese adaptation scale for adolescents
STRS	Student–teacher relationship scale
STRS-CV	Student–teacher relationship scale-Chinese version
CPRI	Chinese version of the peer relationship inventory

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FES-CV	Chinese version of family environment scale
SCL-90-CV	Chinese version of symptom checklist-90
MCMC	Markov chain monte carlo
MI	Multiple imputation
SD	Standard deviation
AOR	Adjusted odds ratio

Adolescence is a critical period of mental development and greater vulnerability that involves many profound biopsychosocial transformations^{1,2}. Unlike infection control measures from other countries, China imposed the 'dynamic zero-COVID policy' measure to reduce the coronavirus disease 2019 (COVID-19) transmission as of now. Thus, coping with the COVID-19 pandemic and complying with restrictive measures might be easier to produce psychological harms in adolescents than in other age groups³. Recent evidence from several countries (i.e., Canada, China, the United Kingdom, Turkey, and USA) indicated that the COVID-19 pandemic caused negative impacts on adolescents' mental health³⁻⁷. The COVID-19 pandemic has a tremendous impact on adolescents' mental development, as described above. Recent research suggested that traumatic stress reactions (TSRs) during the COVID-19 pandemic are prevalent^{8,9}. Notably, the trauma-induced dissociative symptoms (DSs) of non-integration were prone to occur in traumatized children and adolescents¹⁰⁻¹². Data from several studies also found that there was a high proportion of patients among adolescents' psychiatry with significant DSs after early childhood traumatization^{10,13-15}. Neurobiological studies indicated that active, early and effective identification and treatment interventions on early stressful adolescent experiences were very important for the prevention and treatment of adolescent dissociative disorder (ADD)¹⁶. Hence, DSs is an early sign before the onset of ADD in children and adolescents.

In recent studies, there was increasing recognition that the mental harm reduction of COVID-19 pandemic caused the consideration of potential impact factors¹⁷. There is an urgent need for scientifically proven and improved potentially modifiable impact factors associated with ADD during the COVID-19 pandemic. Some studies suggested that a modifiable impact factors associated with ADD, such as DSs, should be raised^{18,19}. According to the Diagnostic and Statistical Manual of Mental Disorders 5th edition (DSM-5), DSs refer to abnormal integration of thoughts, feelings, and experiences (e.g., disengagement, memory disturbances, derealization, and identity alteration) in the stream of consciousness and memory²⁰. DSs result from preexisting personality traits that are defined by high DSs scores²¹. As DSs research accumulates, researchers have reported a strong association between a history of sexual abuse and adolescent DSs (ADSs)²². ADSs are more prevalent in girls than in boys. ADSs tend to worsen with increasing age and become more similar to adult presentations¹⁰. Extensive research has shown that ADSs may precede the onset of the disorder and could be a risk factor for the development of bipolar disorder²³. ADSs are frequently associated with a worse prognosis and more frequent mood swings²⁴. Although professional interest in ADSs has increased in the past two decades, the assessment and intervention of ADSs is still relatively unfamiliar to clinicians or researchers.

Previous studies have suggested that ADSs could induce several adverse outcomes, including ADD, non-suicidal self-injury, alcohol use disorder, and antisocial personality disorder^{10,19-24}. These studies support a link between DSs and adverse outcomes, and provide evidence for the effects of the early signs of dissociative disorder (DD) overtime. But we still found little reports attributed to the mediation effects of ADSs. For example, though the relevance between DSs and adverse outcomes has been well reported^{10,18}, no specific prevalence nor risk estimates are available pertaining to ADSs. Previous studies over the last decade have provided important information on the treatment of DSs^{25,26}. Such approaches, however, have failed to address the evaluation and intervention of ADSs. According to our review of the literature, little research has been performed based on the gender-specific risk assessment of ADSs^{24,25,27-29}. So far, there are few studies that have investigated gender characteristics in the prevalence and impact factors of ADSs during the COVID-19 pandemic. Early identification and effective intervention may reduce the impact of ADSs and prevent the occurrence of several adverse outcomes and the persistence of DD into adulthood^{19,24,27-29}. This suggested that we might first attempt to identify those adolescents who were at risk of developing DSs at an early stage (e.g., age 13-18 years). Given the studies published to date, developmental patterns of the gender difference in ADSs have been largely neglected^{12,15,16,18,19,27-29}. Of particular concern are unclear pertaining to gender characteristics in ADSs during the COVID-19 pandemic. In order to make up the above mentioned deficiencies, the present study will examine the gender characteristics in ADSs from dissociative scores, the prevalence, and impact factors (i.e., social-demographic, social, family, school, and psychological factors) during the COVID-19.

To effectively reduce ADSs risk and prevalence rates, the potential impact factors of sex-specific ADSs should be investigated using large-scale community and epidemiologic studies during the COVID-19 pandemic, further developing effective interventions against ADD and other mental disorders. We assumed that, if it was possible to determine the environmental variables that were related to ADSs, environmental factors might mediate the association between gender and ADSs. Thus, we performed a two-center, cross-sectional study to discuss gender differences based on the prevalence and impact factors of ADSs across Hangzhou City during the COVID-19 pandemic.

Materials and methods

Sample size calculation. To calculate the sample size, we used the following formula³⁰:

$$N = \frac{Z^2 \times (1 - P)P}{\delta^2} \times deff$$

where N = sample size; Z = Z statistic for confidence level; P = expected prevalence rate; δ = allowable error. We used the design effect $deff$ to calculate the sample size due to multistage sampling methods in the present study.

In this study, the sample size was calculated to meet the following conditions: (1) the preliminary estimate of ADSs prevalence was 23.6% in the pre-survey study; (2) the allowable error was taken to ensure accuracy by using 3%; (3) for a 95% confidence level, which was conventional, the Z -value was 1.96; (4) the investigators present their results with 95% confidence intervals (CI) and $deff = 2$. In this study, the sample size was calculated as 1,539. The calculation of sample size needed to consider students who were lost in the follow-up survey, student rejection rate, sampling error, and stratification factors. The final sample size was satisfied in our study as 2,160.

Study methods. This study was a school-based, cross-sectional study, in which six schools were recruited in Hangzhou City from January 1, 2021 to April 30, 2022. We used a random number table, and a stratified cluster sampling method to select participants. A sample of 360 students aged 13–18 years at each of the enrolled schools were randomly selected from two School Health Surveillance System (SHSS) centers (including Jiande County Center and Fuyang District Center in Hangzhou City). To be included, participants had to be adolescents aged 13–18 years, and could converse in Chinese. Participants were excluded if they had a history of psychosis or neurocognitive deficits or received a secondary mental health service. Figure 1 provides further details of this study.

In the present study, ADSs was estimated at a two-stage appraisal procedure. In the first stage, ADSs were screened by the Adolescent Dissociative Experience Scale (A-DES)³¹. In the second stage, subjects whose responses to the A-DES suggested they might have ADSs were further evaluated by three psychiatrists to get a final diagnosis. The investigators included uniformly trained psychiatrists, medical students, and school health care personnel. About 60 trained investigators performed 2 questionnaires to participants that were estimated as having ADSs. The investigators administered face-to-face evaluations and investigations in each school. In addition, 3 trained investigators were present in each school in order to guarantee the quality of our research process.

Measures and procedures. *ADSs measurement.* We used a two-stage identification procedure to appraise ADSs. In the first stage, ADSs were screened for using the A-DES, which contained 30 items³¹. Items in the A-DES included experiences of dissociative amnesia (items 2, 5, 8, 12, 15, 22, 27), depersonalization/derealization (items 3, 6, 9, 11, 13, 17, 20, 21, 25, 26, 29, 30), absorption/imaginative involvement (items 1, 7, 10, 18, 24, 28), and passive influence (items 4, 14, 16, 19, 23). The items are rated by the adolescent on an 11-point Likert scale ranging from 0 = 'never' to 10 = 'always', with no midpoint scores³¹. We used the mean of all item scores to calculate the total A-DES score (score range, 1–10 points) for the original instrument, with higher scores showing greater severity³¹. The present study used a mean score of 3 or above on the A-DES to signify pathological dissociation³².

Participants whose responses to the A-DES suggested that they might have ADSs (i.e. a medium or high dissociation scores ≥ 3)³², which were further estimated by three psychiatrists (such as three chief physicians) to get a final diagnosis as follows. First, they carefully reviewed the diagnostic criteria of ADD and related studies on DSs due to ensuring the diagnostic consistency and accuracy of the three psychiatrists. Next, the psychiatrists used the Structured Clinical Interview for DSM-5- Dissociative Disorders (SCID-D) and the Chinese Classification of Mental Disorders to diagnose all patients with ADSs, DD and other mental or personality disorders. Then, to ensure the appraisal consistency of the different psychiatrists, they used a mutual evaluation form; thus, ADSs were only confirmed when DSs were consistently diagnosed by all three psychiatrists.

During this assessment, psychiatrists took primary responsibility for the diagnosis and differential diagnosis of ADSs. The ADSs was considered if a subject had a) a medium or high dissociation scores (≥ 3); b) the exclusion of organic diseases, or other mental or personality disorders; c) no history of neurological/psychiatric illness; and d) no intelligence deficit (i.e. an intelligence quotient > 70)³³.

The reliability of the questionnaire was tested in the pre-survey study. The responses were analyzed using Cronbach's alpha. Cronbach's alpha for all 30 items was 0.97 in the current study.

Social adjustment status measurement. We used the Chinese Adaptation Scale for Adolescents (CASA) to assess the social adjustment status of adolescents^{34,35}. The CASA comprises three factors: emotional adaptation (6 items), social adaptation (6 items), and study and life adaptation (5 items)³⁵. This CASA was a 4-point Likert scale for a total score of 17–68 points. The answer response format is a 1–4 scale, anchored at the ends with 1 = 'not at all' and 4 = 'exactly'. Higher scores indicate better social adjustment abilities in the CASA. Previous studies from our group showed that the CASA has high reliability and validity, with a Cronbach coefficient of 0.88³⁴. The internal consistency was 0.90 in the present sample.

School environment status measurement. *Teacher-student relationship.* We used the Student-Teacher Relationship Scale (STRS) to evaluate the relationship between teachers and students³⁶. The STRS is a 28-item self-report instrument, which includes four domains: intimacy, conflict, support, and satisfaction³⁶. The STRS rates the extent to which they agreed with each statement using a 5-point Likert scale (1 = 'Definitely does not apply'; 2 = 'Does not really apply'; 3 = 'Neutral, not sure'; 4 = 'Applies somewhat'; and 5 = 'Definitely applies'). This STRS uses a total score of 28–140 points to assess the student-teacher relationship. The three dimensions of intimacy, support and satisfaction for the STRS reflect a positive teacher-student relationship, which higher scores indicate better teacher-student relationship. The dimension of conflict reflects a negative teacher-student relationship, in which higher scores indicate worse teacher-student relationship in the STRS. Our previous study suggested that the Chinese version of the STRS (STRS-CV) has good internal consistency and acceptable test-retest reliability (with a Cronbach coefficient of 0.87)³⁴. The internal consistency was 0.83 in the present sample.

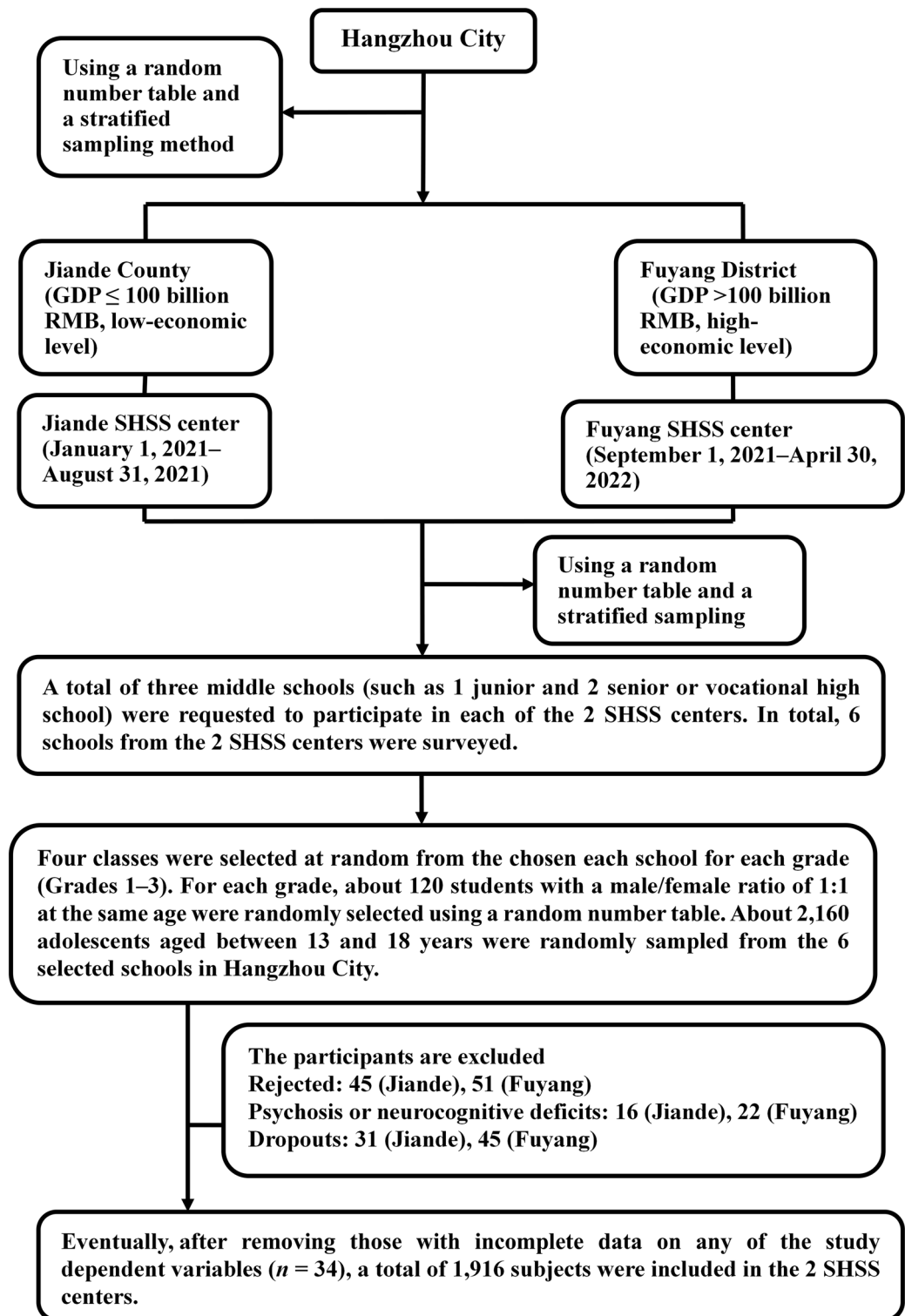


Figure 1. Workflow in this study. *GDP* gross domestic product, *SHSS* School Health Surveillance System.

Peer relationship. We used the Chinese version of the Peer Relationship Inventory (CPRI) to estimate adolescents' peer relationships³⁷. The CPRI is a 20-item self-report instrument, which measures three analytically derived dimensions of peer relations: social maturity, aggression, and independence³⁷. The participants were asked to rate on a 5-point Likert scale (1 = 'Not at all matches'; 2 = 'Mild match'; 3 = 'Moderate match'; 4 = 'Most matches'; and 5 = 'Perfect match'). The peer relationship was estimated by using a total CPRI score (score range, 20–100 points) for the original scale, with higher scores showing better peer relationship³⁷. In our prior studies,

the scale has high reliability and validity, with a Cronbach coefficient of 0.90³⁴. The internal consistency was 0.94 in the present sample.

Family environment status measurement. We used the Chinese Version of Family Environment Scale (FES-CV) to assess relationships, personal growth, and system maintenance in one's family environment³⁸. The FES-CV is a 90-item self-report instrument³⁸, which includes three dimensions measured by 10 subscales that include relationship dimension [cohesion (score range, 0–9 points), expressiveness (score range, 0–9 points), and conflict (score range, 0–9 points) subscales], personal growth dimension [independence (score range, 0–9 points), achievement orientation (score range, 0–9 points), intellectual-cultural orientation (score range, 0–9 points), active-recreational orientation (score range, 0–9 points), and moral-religious emphasis (score range, 0–10 points) subscales], and system maintenance dimensions [organization (score range, 0–8 points) and control (score range, 0–9 points) subscales]. The adolescents were asked to rate on dual-choice (1 = 'yes' and 0 = 'no') questionnaire with ten scales that assessed different characteristics of families. Higher scores in the subscales of cohesion, expressiveness, independence, achievement orientation, intellectual-cultural orientation, active-recreational orientation, moral-religious emphasis, and organization indicated better family relationship. Higher scores in the subscales of conflict and control signified worse family relationship. Prior studies indicated that ten subscales of the FES-CV showed moderate to excellent internal consistency (ranging from 0.63–0.75) and acceptable test–retest reliability at 0.55–0.92^{34,38}. The internal consistency of this scale was 0.89 in the present sample.

Mental health status measurement. We used the Chinese version of Symptom Check List-90 (SCL-90-CV) to estimate the mental health status of adolescents³⁹. The SCL-90-CV is a 90-item self-report instrument, which includes ten subscales (i.e., objective-comprehensive, somatic complaint, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation, psychoticism, and diet/sleeping) that respond to an individual's specific aspect of the symptomatic situation³⁹. The total score of SCL-90-CV ranges from 90 to 450. Each item on the scale is measured on a 5-point Likert scale, with 1–5 representing the severity of the symptoms as follows: (1 = 'Not at all'; 2 = 'A little bit'; 3 = 'Moderately'; 4 = 'Quite a bit'; and 5 = 'Extremely'). The items relevant to each subscale are averaged to give a subscale score (score range, 1–5 points). Based on the scores of each subscale, it is possible to initially determine which subscales represent problematic psychological symptoms according to their experience in recent weeks³⁹. Thus, a higher score reflected more serious psychological symptoms. Related research demonstrated that the SCL-90-CV had good internal consistency and acceptable reliability⁴⁰. In the present sample, the internal consistency was 0.94.

Statistical analysis. All data was double entered and verified by using EpiData 3.1 software. The analyses of all data were carried out with R (R Core Team (2021) version 4.1.2. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Beijing, China; <https://www.R-project.org>), with the aid of the 'forestmodel' package. Markov chain Monte Carlo (MCMC) method of multiple imputation (MI) was used to handle missing data⁴¹. We used a MCMC approach to perform 200 imputations of each variable based on the MI procedure in R software ('mice' package). We evaluated the initial estimates for MCMC through the expectation–maximization algorithm.

We used the Kolmogorov–Smirnov test to assess the normality of quantitative variables. We calculated the frequencies and percentages of categorical variables. Continuous variables were presented as the mean \pm standard deviation (SD).

Univariate analyses were used to separately analyze all the variables that were potentially associated with ADSs. We included in multiple regression models at a significance level of 0.10. The independent *t*-test was used to analyze continuous variables with a normal distribution. Pearson's chi-squared test was used for categorical variables.

We used multivariate logistic regression models to evaluate whether the variables, including demographics, environmental factors, and psychological factors, were associated with male or female ADSs. A stepwise procedure was used to select further the variables related to ADSs at a significance level of $P > 0.05$ for removal and a significance level of $P \leq 0.05$ for reentry. We performed the hypothesis testing to indicate statistical significance by using a two-sided test with an alpha value of 0.05.

Ethics approval and consent to participate. The studies involving human participants were reviewed and approved by the ethics committee of Hangzhou Center for Disease Control and Prevention. Written informed consent to participate in this study was provided by the participants or their legal guardian/next of kin. In addition, all methods were carried out in accordance with relevant guidelines and regulations.

Results

Baseline characteristics of the subjects. The response rate was 88.70% (1,916/2,160) in the cross-sectional study. In total, 1,916 subjects completed this survey, and 96 subjects refused to take part in the study, representing a refusal rate of 4.44% (96/2,160) at six schools in Hangzhou City. In addition, we excluded 38 participants because of psychosis or neurocognitive deficits and 76 participants because of dropouts. After removing questionnaires with incomplete data on any of the study dependent variables ($n = 34$, accounting for 1.57%), 1,916 subjects were included in subsequent analyses. Among 1,916 subjects, 924 (48.23%) were males and 992 (51.87%) were females. The average age of participants was 15.52 years (SD 1.67). Among them, the participants were 1,320 (68.89%) in rural areas, and 596 (31.11%) in urban areas.

Variables	Total	ADSs	Deff	χ^2 (Phi coefficient)	P-value*	Dissociative scores	Deff	t (Cohen's d-statistic)	P-value*
Gender									
Male	924	260 (58.69)	1	15.76 (-0.08)	<0.001	2.77 ± 2.36	1,914	4.88 (0.20)	<0.001
Female	992	183 (41.31)				2.29 ± 1.91			
Age (years)									
13–15	936	204 (46.05)	1	1.13 (0.02)	0.288	2.51 ± 2.19	1,914	-0.22 (0.10)	0.823
16–18	980	239 (53.95)				2.53 ± 2.12			
Residence area									
Rural	1,320	322 (72.69)	1	2.45 (-0.03)	0.118	2.60 ± 2.17	1,914	2.47 (0.11)	0.014
Urban	596	121 (27.31)				2.34 ± 2.11			

Table 1. Baseline characteristics of subjects ($N = 1,916$). Data are presented as No. (%) or mean ± standard deviation. ADSs Adolescent dissociative symptoms. *Data in bold are statistically significant ($P < 0.10$).

Differences in terms of the adolescent dissociative scores and prevalence of ADSs. The overall positive ADSs rate was 23.12% (95% CI 21.25–25.08%) (443/1,916) at 18.45% (95% CI 16.03–20.86%) (183/992) for females and 28.14% (25.26–31.16%) (260/924) for males in Hangzhou City. The adolescent dissociative scores ($t = 4.88$, $P < 0.001$) and positive ADSs rate (Chi-square = 15.76, $P < 0.001$) in males were higher than in females. The adolescents from rural areas had higher adolescent dissociative scores ($t = 2.47$, $P = 0.014$) compared to adolescents from urban areas (Table 1). The prevalence rate of male ADSs was higher in rural areas than in urban areas (Chi-square = 4.13, $P = 0.042$). However, there was no significant difference in the prevalence of female ADSs between rural and urban areas ($P > 0.05$). We also found that age did not significantly relate to the adolescent dissociative score or positive ADSs rate in adolescents ($P > 0.05$) (Table 1).

Gender differences in terms of the impact factors of ADSs. Table 2 summarizes the results of the univariate analyses of the association between potential covariates and ADSs. About 23 of the 31 tested covariates were significantly associated with male ADSs ($P < 0.10$). The significant covariates were (a) demographic characteristics, including residence area; (b) environment impact factors including social adjustment status (i.e., emotional adaptation, social adaptation, and study and life adaptation), school environment factors (i.e., the conflict relationship of teacher-student and interpersonal harmony relationship of peer), and family environment factors (i.e., expressiveness, conflict, intellectual-cultural orientation, active-recreational orientation, moral-religious emphasis, organization, and cohesion); (c) psychological factors, including 10 factors scores of SCL-90. The remaining 8 covariates, including age, age group, the positive relationship of teacher-student, the social emotion relationship of peer, the interpersonal interaction relationship of peer, family independence, family achievement orientation, and family control, did not significantly relate to male ADSs risk ($P \geq 0.10$) (Table 2). Whilst 25 of the 31 tested covariates were significantly associated with female ADSs ($P < 0.10$). The significant covariates were (a) demographic characteristics (i.e., age); (b) environment impact factors including social adjustment status (i.e., emotional adaptation, social adaptation, and study and life adaptation), school environment factors (i.e., the positive and conflict relationships of teacher-student, and peer relationships with social emotion, interpersonal interaction, and interpersonal harmony), and family environment factors (i.e., expressiveness, conflict, intellectual-cultural orientation, moral-religious emphasis, organization, and cohesion); (c) psychological factors, including 10 factors scores of SCL-90. The remaining 6 covariates (including age, residence area, family independence, family achievement orientation, family active-recreational orientation, and family control) did not significantly relate to female ADSs risk ($P \geq 0.10$) (Table 2).

To further explore the potential gender differences in the association between ADSs and impact factors, we performed gender-stratified, multivariate logistic regression analyses. Analyses showed that the conflict relationship of teacher-student [adjusted odds ratio (AOR) 1.06, 95% CI 1.01–1.10], family expressiveness (AOR 0.87, 95% CI 0.78–0.98), family conflict (AOR 1.15, 95% CI 1.05–1.27), family organization (AOR 0.88, 95% CI 0.78–0.99), and family cohesion (AOR 0.87, 95% CI 0.77–0.99) were linked to ADSs only in males, while somatic complaint (AOR 1.04, 95% CI 1.00–1.08) and paranoid ideation scores (AOR 1.09, 95% CI 1.01–1.19) were significantly associated with female ADSs only (Table 3).

Discussion

Unfortunately, there have been limited reports to date designed to evaluate the dissociative score, the prevalence and impact factors of ADSs during the COVID-19 pandemic. In the present study, we performed a two-center cross-sectional study with stratification by gender to explore dissociative scores, the prevalence, and impact factors of ADSs during the COVID-19 pandemic. Our results might provide more reliable evidence in developing prevention and intervention measures of ADSs and guiding mental health executives' decision-making (e.g., formulate the effective surveillance, assessment and intervention programmes for ADSs). We anticipate that these findings will be useful in reducing the risk of ADSs and the design of clinical interventions for preventing ADSs. In addition, this study will provide a scientific basis for the gender-specific prevention and treatment of ADSs in pandemics.

Variables	Males (n=924)*			Females (n=992)*		
	No	Adjusted OR (95% CI)	P-value	No	Adjusted OR (95% CI)	P-value
Sociodemographic characteristics						
Age (years)	924	1.07 (0.98–1.16)	0.154	992	1.09 (0.99–1.20)	0.080
Age group (years)						
16–18 (Senior high school students)	471	1.20 (0.90–1.60)	0.216	509	1.12 (0.81–1.54)	0.502
13–15 (Junior high school students)	453	Reference		483	Reference	
Residence area						
Rural	625	1.55 (1.12–2.13)	0.008	695	1.03 (0.72–1.46)	0.888
Urban	299	Reference		297	Reference	
Environment factors						
Social adjustment status						
Emotional adaptation	924	0.90 (0.87–0.94)	< 0.001	992	0.86 (0.82–0.91)	< 0.001
Social adaptation	924	0.92 (0.89–0.96)	< 0.001	992	0.83 (0.79–0.88)	< 0.001
Study and life adaptation	924	0.95 (0.91–0.99)	0.015	992	0.86 (0.82–0.91)	< 0.001
School environment factors						
Teacher-student relationship						
Positive relationship	924	1.00 (0.98–1.02)	0.862	992	0.98 (0.96–1.00)	0.065
Conflict relationship	924	1.11 (1.07–1.16)	< 0.001	992	1.10 (1.04–1.15)	< 0.001
Peer relationship						
Social emotion	924	0.99 (0.96–1.02)	0.424	992	0.96 (0.92–1.01)	0.086
Interpersonal interaction	924	0.97 (0.94–1.01)	0.131	992	0.91 (0.87–0.95)	< 0.001
Interpersonal harmony	924	0.97 (0.95–0.99)	0.017	992	0.93 (0.90–0.96)	< 0.001
Family environment factors						
Expressiveness	924	0.82 (0.70–0.90)	< 0.001	992	0.78 (0.71–0.86)	< 0.001
Conflict	924	1.28 (1.19–1.38)	< 0.001	992	1.26 (1.17–1.36)	< 0.001
Independence	924	1.01 (0.92–1.11)	0.759	992	0.96 (0.86–1.07)	0.477
Achievement orientation	924	0.95 (0.87–1.04)	0.311	992	1.06 (0.96–1.17)	0.240
Intellectual-cultural orientation	924	0.94 (0.87–1.01)	0.090	992	0.90 (0.83–0.97)	0.008
Active-recreational orientation	924	0.90 (0.84–0.96)	0.003	992	0.96 (0.89–1.04)	0.315
Moral-religious emphasis	924	0.85 (0.77–0.94)	0.001	992	0.91 (0.82–1.01)	0.078
Organization	924	0.76 (0.69–0.83)	< 0.001	992	0.76 (0.69–0.84)	< 0.001
Control	924	1.06 (0.98–1.14)	0.147	992	0.99 (0.91–1.07)	0.768
Cohesion	924	0.82 (0.76–0.89)	< 0.001	992	0.81 (0.75–0.87)	< 0.001
Psychological factors						
Symptom Check List-90 scores						
Obsessive-compulsive	924	1.09 (1.07–1.11)	< 0.001	992	1.14 (1.12–1.17)	< 0.001
Somatic complaint	924	1.12 (1.09–1.14)	< 0.001	992	1.13 (1.11–1.16)	< 0.001
Interpersonal sensitivity	924	1.11 (1.08–1.13)	< 0.001	992	1.16 (1.13–1.19)	< 0.001
Depression	924	1.08 (1.07–1.10)	< 0.001	992	1.11 (1.09–1.13)	< 0.001
Anxiety	924	1.13 (1.10–1.16)	< 0.001	992	1.16 (1.13–1.18)	< 0.001
Hostility	924	1.19 (1.15–1.23)	< 0.001	992	1.23 (1.19–1.28)	< 0.001
Phobic anxiety	924	1.16 (1.13–1.20)	< 0.001	992	1.18 (1.14–1.21)	< 0.001
Paranoid ideation	924	1.20 (1.16–1.24)	< 0.001	992	1.28 (1.23–1.33)	< 0.001
Psychoticism	924	1.13 (1.10–1.16)	< 0.001	992	1.17 (1.14–1.20)	< 0.001
Diet/sleeping	924	1.18 (1.14–1.21)	< 0.001	992	1.23 (1.19–1.27)	< 0.001

Table 2. Univariate logistic regression analyses were stratified for the association between impact factors and ADSs by gender during the coronavirus disease 2019 pandemic ($N = 1,916$). ADSs Adolescent dissociative symptoms, OR Odds ratio, CI Confidence interval. *Data in bold are statistically significant ($P < 0.10$).

Gender differences in the prevalence of ADSs. To the best of the authors' knowledge, few similar studies have been previously conducted on a large scale of ADSs in China during the COVID-19 pandemic. Prior studies have noted that the intervention in risk factors was important from depression tendency to depression or other adverse outcomes^{42,43}. However, very little was found in the literature on the question of ADSs intervention. The current study found that DSs seemed to be prevalent among adolescents during the COVID-19 pandemic. Compared with a prior study⁴⁴, which reported a prevalence of 7% of post-traumatic stress symptoms a month after the COVID-19 epidemic. This DSs prevalence seems to have an even greater impact on adoles-

Variables	Males (n = 924)*			Females (n = 992)*		
	No	Adjusted OR (95% CI)	P-value	No	Adjusted OR (95% CI)	P-value
Sociodemographic characteristics						
Age (years)	924	NA	NA	992	1.07 (0.94–1.21)	0.055
Residence area						
Rural	625	1.43 (1.00–2.08)	0.055	695	NA	NA
Urban	299	Reference		297	Reference	
Environment factors						
Social adjustment status						
Emotional adaptation	924	0.95 (0.90–1.02)	0.140	992	1.01 (0.92–1.10)	0.876
Social adaptation	924	1.00 (0.93–1.08)	0.987	992	0.92 (0.83–1.02)	1.00
Study and life adaptation	924	1.04 (0.97–1.12)	0.218	992	1.00 (0.92–1.09)	0.963
School environment factors						
Teacher-student relationship						
Positive relationship	924	NA	NA	992	1.01 (0.98–1.05)	0.383
Conflict relationship	924	1.06 (1.01–1.10)	0.016	992	1.00 (0.94–1.07)	0.933
Peer relationship						
Social emotion	924	NA	NA	992	1.07 (0.99–1.15)	0.077
Interpersonal interaction	924	NA	NA	992	0.94 (0.87–1.02)	0.134
Interpersonal harmony	924	1.02 (0.98–1.06)	0.278	992	1.01 (0.95–1.08)	0.782
Family environment factors						
Expressiveness	924	0.87 (0.78–0.98)	0.020	992	0.95 (0.83–1.09)	0.454
Conflict	924	1.15 (1.05–1.27)	0.004	992	1.01 (0.91–1.12)	0.852
Intellectual-cultural orientation	924	1.01 (0.91–1.12)	0.900	992	1.01 (0.90–1.13)	0.850
Active-recreational orientation	924	1.01 (0.91–1.11)	0.923	992	NA	NA
Moral-religious emphasis	924	0.96 (0.86–1.09)	0.549	992	1.00 (0.88–1.15)	0.967
Organization	924	0.88 (0.78–0.99)	0.036	992	0.93 (0.81–1.07)	0.312
Cohesion	924	0.87 (0.77–0.99)	0.032	992	1.04 (0.92–1.19)	0.517
Psychological factors						
Symptom Check List-90 scores						
Obsessive-compulsive	924	0.97 (0.93–1.02)	0.219	992	1.01 (0.96–1.06)	0.832
Somatic complaint	924	1.01 (0.97–1.06)	0.540	992	1.04 (1.00–1.08)	0.041
Interpersonal sensitivity	924	0.97 (0.91–1.03)	0.306	992	0.99 (0.93–1.05)	0.750
Depression	924	1.01 (0.97–1.06)	0.557	992	1.01 (0.97–1.06)	0.493
Anxiety	924	1.06 (0.99–1.14)	0.086	992	1.00 (0.94–1.07)	0.935
Hostility	924	1.02 (0.95–1.09)	0.608	992	1.04 (0.97–1.11)	0.310
Phobic anxiety	924	1.02 (0.96–1.09)	0.511	992	1.00 (0.95–1.06)	0.964
Paranoid ideation	924	1.08 (0.99–1.18)	0.086	992	1.09 (1.01–1.19)	0.035
Psychoticism	924	0.97 (0.91–1.04)	0.435	992	1.01 (0.95–1.08)	0.709
Diet/sleeping	924	1.05 (0.99–1.12)	0.126	992	1.02 (0.96–1.09)	0.538

Table 3. Multivariate logistic regression analyses were stratified for the association between impact factors and ADSs by gender during the coronavirus disease 2019 pandemic ($N = 1,916$). ADSs Adolescent dissociative symptoms, OR Odds ratio, CI Confidence interval, NA Not available. *Data in bold are statistically significant ($P \leq 0.05$).

cents. The levels observed in this investigation are also far beyond those observed by Kihlstrom et al. in the total population⁴⁵. The yields in this investigation were also higher compared to our earlier similarity observations^{34,46}.

Clearly, attention needs to be focused on the prevalence rate of ADSs, which is higher than expected. A possible explanation for this might be that the global pandemic of COVID-19 is creating distress and exacerbating psychological health problems in adolescents during this study period. Recent studies have revealed that trauma-related disorders (i.e., Post-traumatic stress disorder, autism spectrum disorder, and DD) were particularly prevalent during the COVID-19 pandemic^{47,48}. Thus, the strong association between trauma-related symptoms (e.g., ADSs) and environmental factors was indirectly confirmed. The ADSs may be a serious public health problem in the future of China. According to these data, we can infer that an effective intervention strategy is urgently needed and further exploring the mechanism underlying is urgently required for reducing the prevalence of ADSs.

Another important finding was that the prevalence of ADSs was higher in males than in females. Our study has suggested that environmental factors, such as school factors (i.e., the conflict relationship of teacher-student) and family factors (i.e., family expressiveness, family conflict, family organization, and family cohesion), seemed to affect more male ADSs than female ADSs. Currently, COVID-19 has caused a global pandemic. The higher

prevalence of males might be affected by the environmental factor of COVID-19 pandemic. Another reason may be that long-term infection control measures for COVID-19 seem to be easier to trigger TSRs among male adolescents⁴⁹. This finding was contrary to previous similarity studies which have suggested that the prevalence of males was lower than females for depression tendencies, hysterical tendencies, and somatization tendencies^{34,46,50}. In fact, as Rania et al.⁵¹ argued, males seemed to have worsened this dimension by perceiving more loneliness due to infection control measures during COVID-19. The present study raised the possibility that it would be beneficial to reduce the ADSs prevalence by using the gender-specific intervention.

This finding was unexpected and suggested that the prevalence of ADSs was higher in rural areas than in urban areas among males. However, this difference was not found in female ADSs. It is difficult to explain this result, but it might be related to psychological characteristics of male adolescents. Prior studies indicated that the mental health of male adolescents was more likely to be affected by environmental factors⁴⁶. The superposition of poor environmental conditions and COVID-19 pandemic seems to aggravate the mental health problems of male adolescents in rural areas. This finding, while preliminary, suggests that there is an urgent need to reduce male ADSs in rural adolescents.

Gender differences in the impact factors of ADSs. In our study, the conflict relationships of teacher-student, family expressiveness, family conflict, family organization, and family cohesion contributed to male ADSs only. Simultaneously, somatic complaint and paranoid ideation scores were only associated with female ADSs. These results provided further support for the hypothesis that environmental factors (i.e., school and family environments) seemed to affect more male ADSs than female ADSs; correspondingly, the impact on individual psychological factors seemed to be more female ADSs than male ADSs during the COVID-19 pandemic. It is difficult to explain these findings, but it might be related to the difference in personality traits between females and males⁵². Female adolescents may suffer more re-experiencing, negative alterations than males in cognitions and mood, and hyperarousal symptoms⁵³. Findings indicated, as has also been observed in USA and China^{54,55}, that women were more emotionally vulnerable to the effects of COVID-19 context than men. Within these personality traits, some studies suggested that male adolescents had higher levels of extraversion than females, while females presented higher values in conscientiousness and neuroticism^{56,57}. Indeed, there was also a gender difference in stress-coping among adolescents, where females have shown greater stress and lower stress-coping abilities than males⁵⁷, thus supporting our findings.

Prior studies suggested that male adolescents might be more psychologically mature compared with female adolescents in the same age category⁵⁸. Male adolescents can get good mental health through their personality traits and mutually beneficial interpersonal relationships to reduce the impact on mental factors for the risk of ADSs⁵⁹. In addition, female adolescents are relatively more vulnerable to changes in psychological quality than male adolescents, and they are more easily influenced by individual psychological factors⁵⁹. Thus, girls with poor psychology maturity are easier to increase the risk of ADSs during COVID-19. Several reports have shown that the traits of masculinity or femininity could have affects beyond the psychological maturity of males and females^{60,61}. For this reason, they produce perceived gender differences, which includes differences in terms of social relationships, personal resources, coping strategies, stressors, and vulnerabilities^{60–62}. Evidence supported the psychological well-being benefited the mental development of females more than males⁶³. These findings might help us provide gender-specific intervention strategies for ADSs. For instance, to decrease the risk of ADSs, interventions in environmental factors are urgently needed for male ADSs, and the interventions of mental health are urgently needed for female ADSs. Mental therapy, and the prevention interventions in family and school risk factors, are key to addressing adolescents at a high risk of ADSs.

Notably, our study suggested that family factors (such as expressiveness, conflict, organization, and cohesion) were key factors that affect the risk of male ADSs. This finding was consistent with that of Modestin et al.⁶⁴ who indicated that environmental factors contributed to dissociative experiences in young non-patients. The data showed that home isolation had increased the perception of loneliness more in men than in women during the COVID-19 pandemic⁵¹. Considering the current epidemic situation, COVID-19 may further aggravate the loneliness of male adolescents. Prior studies have noted the importance of a positive family climate, which might provide safe surroundings for high-risk adolescents^{34,64,65}. Stable family circumstances could promote positive mental health, optimize learning and living, and prevent health-related events^{34,65}. Previous research has established that family conflict had unique and direct associations with adolescent mental health⁶⁶. We compared our findings with previous conclusions^{34,46,65}. On the one hand, these results seemed to be consistent with our earlier studies which found somatization tendencies were significantly associated with family conflict among adolescents⁴⁶. On the other hand, interestingly, there were some notable differences that should be highlighted. For example, we found that family achievement orientation was significantly linked to hysterical tendencies only in male adolescents³⁴. Whilst family cohesion was significantly associated with female hysterical tendencies only³⁴. The present results were significant in at least two major respects. First, family interventions were key to reducing the risk of male ADSs. Second, education and mental health professionals should perform distinctive intervention and prevention for adolescent psychological problems during COVID-19.

Several lines of evidence suggested that psychological problems were associated with the course of paranoid ideation or somatic complaint in adolescents^{67,68}. These findings further supported the idea of our study. In the present study, female ADSs were predicted by somatization and paranoia symptoms using a categorical regression analysis. This also matched the clinical observations of dissociative symptoms in adolescence reported by Mutluer et al.⁶⁹. In summary, we should focus on the mental health of females in monitoring ADSs. Interestingly, the present data suggested that male adolescents had higher scores on ADSs during the COVID-19 pandemic than females. Contrary to the results of Zhang et al.¹⁹, where females showed higher levels of ADSs scores than males. However, these differences could be attributed to the difference in the sociocultural context (China–Europe), as

well as the context of the COVID-19. These data should be brought to the attention of political decision-makers: we also need to focus on the general adolescent population during the COVID-19 pandemic.

Currently, we still do not have a standard approach to measuring ADSs at a fundamental level. The screening of ADSs is somewhat subjective. Thus, the reliability of studies depends mainly on the availability of good-quality data. In this study, we used a two-stage appraisal procedure to identify ADSs based on both subjective and objective evaluation methods; this reduced subjectivity in our screening of ADSs and correspondingly improved the internal validity of the study. Additionally, to enhance the response rate and minimize possible selection bias, we used a multiphase, stratified, cluster sampling method and randomly drew a large sample from a school-based population.

The multifactorial analysis of factors related to the ADSs risk during COVID-19 may be a useful tool to measure the associated TSRs among adolescents to explain and prevent the mental outcomes of COVID-19 pandemic. The use and assessment of questionnaires may provide significant information to prevent and control the mental disorders with COVID-19 pandemic in a short period. Knowledge of this related information could be used by various epidemic response institutions to perform multidisciplinary interventions to reduce this risk and, thus, adolescents' TSRs in the face of the COVID-19.

Limitations. Several limitations should be noted. First, we used the self-reported survey methods, which might decrease the validity of report because of reporting bias or recall bias. However, we used the confidential nature of the questionnaire to effectively reduce under-reporting in our study. Second, some outcomes might be misclassified due to no "gold standard" measurement method of ADSs. Thus, we might underestimate the associations between ADSs and impact factors during the COVID-19 pandemic. However, to reduce this underestimation, we used to integrate both subjective and objective methods to measure ADSs. Third, we only included on-campus adolescents; off-campus adolescents were not sampled in our studies. Thus, these findings may not be extrapolated to all adolescent populations. Notwithstanding these limitations, the study suggests that early intervention with prevention is urgently needed for adolescent psychological problems during COVID-19.

Conclusions

This study has identified that ADSs seem to be prevalent (23.12%) in adolescents across Hangzhou City studied during the COVID-19 pandemic. The prevalence of male ADSs was significantly higher compared with female ADSs. The research has also shown that gender differences in terms of the impact factors of ADSs are very significant. The environmental factors (i.e., school and family environments) seem to affect more male ADSs than female ADSs; correspondingly, the impact on individual psychological factors (i.e., paranoid ideation and somatic complaints) seems to be more female ADSs than male ADSs during the COVID-19 pandemic.

Overall, the present study assessed the gender characteristics of ADSs during the COVID-19 pandemic based on dissociative scores, the prevalence, and the impact factors of social-demographic, environment, and psychology. These findings provided a scientific foundation for the sex-specific prevention and intervention of ADSs in pandemics. This study strengthens the idea that we urgently need gender-specific prevention and intervention to reduce the prevalence and risk of ADSs, preventing further ADD or other adverse outcomes during COVID-19. To reduce the risk of male ADSs, we should focus on the prevention and intervention of environmental factors (such as teacher-student relationships and family factors). To decrease the risk of female ADSs, we should promote the mental well-being of female adolescents through more effective mental health promotion intervention programs. The present study has been one of the first attempts to scrutinize the prevalence and impact factors of ADSs during the COVID-19 pandemic. This will lay the groundwork for future research. Despite its exploratory nature, this study offers some insight into early prevention and intervention of ADD. Finally, we need to use large-scale experimental research to identify how to improve adolescents' psychological quality and change environmental risk factors. In addition, further research needs to examine more closely the links between ADSs and ADD or other adverse outcomes.

Data availability

The datasets generated and/or analysed during the current study are not publicly available due to confidentiality issues, but are available from the corresponding author on reasonable request. Q.L.C (chenghzcdc@sina.com) should be contacted if someone wants to request the data from this study.

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Author contributions

Q.L.C. and G.Z. designed the study. Q.L.C. and J.F.C. conducted the statistical analyses and wrote the first draft of the manuscript. Q.L.C, G.Z, Y.Y.D, L.X., and L.W. carried out the field research. All authors contributed to the article and approved the submitted version.

Competing interests

The authors declare no competing interests.

Additional information

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