Co-occurrence subgroups of child sexual abuse, health risk behaviors and their associations among secondary school students in China

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Abstract

Background

Little is known on the co-occurrence and heterogeneity of child sexual abuse (CSA) or health risk behavior (HRB) prevalence nor the associations among the victims.

Objectives

To detect adolescent subgroups reporting CSAs or HRBs, and to examine the association between the subgroups.

Methods

Participants were secondary school students in a national survey in China (N = 8746). Self-reported CSA and HRB experiences were collected through a computer assisted questionnaire. Multigroup latent class analysis (LCA) was used to examine latent subgroups of CSA and HRB. Dual latent class regression analysis was used to examine the association between CSA and HRB classes.

Results

A total of 8746 students participated in our study. The prevalence of having ever experienced any of the reported seven CSA items was 12.9%. The preferred LCA model consisted of a three-class CSA latent variable, i.e. "Low CSAs"(95.7% of the total respondents), "Verbal or exhibitionism CSAs"(3.3%), and "high multiple CSAs" (1.1%); and a three-class HRB latent variable, i.e. "Low HRBs"(70.5%), “externalizing HRBs” (20.7%), and “internalizing HRBs” (8.7%). Students in the
"Verbal or exhibitionism CSAs" or "high multiple CSAs" classes had higher probabilities of being in “externalizing HRBs” or “internalizing HRBs” class. The probabilities were higher in "high multiple CSAs" class (male externalizing OR 4.05, 95%CI 1.71-9.57; internalizing OR 11.77, 95%CI 4.76-29.13; female externalizing OR 4.97, 95%CI 1.99-12.44; internalizing OR 9.87, 95%CI 3.71-26.25) than those in "Verbal or exhibitionism CSA" (male externalizing OR 2.51, 95%CI 1.50-4.20; internalizing OR 3.08, 95%CI 1.48-6.40; female externalizing OR 2.53, 95%CI 1.63-3.95; internalizing OR 6.05, 95%CI 3.73-9.80).

Conclusions

There are different latent class co-occurrence patterns of CSA items or HRB items among the respondents. CSA experiences are in association with HRB experiences and the associations between latent classes are dose-responded. Heterogeneity plays a role in the associations. The results could help identify high-risk subgroups and promote more nuanced interventions addressing adverse experiences and risk behaviors among at-risk adolescents.

Keywords: middle school students, child sexual abuse, health risk behaviors, latent class analysis
Background

Child Sexual Abuse (CSA) means the involvement of a child in sexual activity that he or she does not fully comprehend, is unable to give informed consent to, or for which the child is not developmentally prepared and cannot give consent, or that violates the laws or social taboos of society[1]. CSA has spread throughout countries, continents, and socioeconomic classes in recent decades [2] and attracted increasing attention from the public, the media, and the academia. WHO [3] estimated in 2006 that 150 million girls and boys under the age of 18 have experienced CSA. Some meta-analyses estimated the average global prevalence of CSA to be around 11.8 %, although it varies from 2 % to 62 % among different studies as well as types of CSA[4] [5, 6].

CSA is regarded as a type of Adverse Childhood Experiences and has long been concerned with short-term and long-term negative sequelae [7] [8] [9-14]. Even a single form of abuse can be associated with risk in different mechanisms[15, 16]. CSA is, however, a multi-indicator measurement, which indicates that experiencing CSA often means experiencing more than one form of CSA[17, 18 ] i.e. multiple victimization[19, 20]. Studies have shown that CSA victims are more likely to engage in behaviors that can place them at risk for negative outcomes, which are in general referred to as youth Health Risk Behavior (HRB) [21] [22]. Among the victimized teenagers, some do not show health or mental damage after experiencing one or more forms of CSA, while some show problems such as alcoholism, drug abuse, anxiety, violence or suicidal attempts [23, 24]. Different forms of abuse items may overlap and interact with each other, and the combination of different forms may modify specific social and psychological consequences[20] [25] [26]. Without considering the
nature of co-occurrence, the estimation of the association between CSA and HRB may be biased[27].

The lack of research on multi-victimization hinders our understanding of the impact of multiple CSA victimization[28]. Insights into different patterns of adolescents at risk could help service providers and decision makers identify groups of individuals that need help[29-31].

China has the largest youth population in the world, with more than 200 million students in primary and secondary schools, accounting for 20% of the national population in total. CSA has attracted public attention in China, while researches in this field are still insufficient, with scarcely any on multiple victimization. Existing Chinese researches on the association between child victimization and health behaviors often focused on single form of the adolescent adverse experiences from small samples or limited study sites[32-34]. It is thought that the cultures and traditions of Asian societies may lead to different CSA patterns and their associations with behaviors, but there is little research on CSA patterns[35] in China. There is need to examine the heterogeneity and patterns of multi-victimization in teens to help optimize prevention and intervention programs on a national scale.

Methods

Study aims:

This study aimed to investigate the prevalence and latent co-occurrence patterns of items of CSA or HRB, and to test the hypothesis that the latent subtypes of CSA are associated with HRB sub-types.
Survey design, site and population:

This was a cross-sectional school-based study. The data for the analysis came from a national reproductive and health survey of high school students in China. Given China's population diversity, multistage sampling was applied to recruit study participants. Seven provinces/autonomous regions (Shandong, Guangxi, Hebei, Heilongjiang, Sichuan, Shaanxi, Inner Mongolia) representing geographic or social variation were selected. Then, one city/town with a moderate level of economic development was selected in each province/autonomous region. In each city/town, one urban area and one rural area were selected, after which one junior secondary school and one senior secondary school were selected in each area. Two classes in each grade (including all three grades in junior secondary school and all three grades in senior secondary school) were invited to participate in the survey using cluster random sampling.

Survey implementation and data collection:

This survey was conducted between year 2014 and 2015. Data collection was through a questionnaire with a computer-assisted self-interviewing (CASI) approach. The content of the questionnaire related to this analysis included a set of designed questions on experiences of CSA items, experiences of HRB items, and some covariates. During the survey day, each student took a separate seat in the school's computer room and completed the electronic questionnaire. The questionnaire was anonymous, and the subjects could not obtain information of others even using the same computer afterwards. Field investigators assisted the students by monitoring or providing explanations when necessary to avoid ambiguity, however, they could not see or interfere with the respondent's answers.
If any respondent feel uncomfortable with any question, he or she can skip part or all of the content.

The data generated after the investigation were uniformly stored and processed by the researchers after deprivacy.

Ethics:

The research has been reviewed and approved by the local ethics committee. Before the survey was conducted, the purpose and implementation of the study were explained to the students, teaching staff, and parents whose children were on the invitation list in the parents meeting of the sample classes. Anonymity and confidentiality were guaranteed and the rights to refuse or terminate participation in the investigation were understood. Students and parents who were willing to accept the invitation in our study were asked and signed a written consent form.

Measures:

Child sexual abuse (CSA)

CSA refers to reluctant sexually related experiences encountered by the participated students aged 10-18 years. Sexual abuse experiences from peers were excluded. Due to the length of the investigation, we modified the ISPCAN Child Abuse Screening Tool (ICAST-R) and some existing Chinese CSA scales to obtain a set of seven-item two-category items (yes / no) self-reported CSA scale. The Cronbach's alpha is 0.65 (Table 1).

Health risk behaviors (HRB)
This study includes several risk behaviors that cover different behavioral dimensions. These questions were transformed into a set of two-category items (yes / no) (Table 1).
Table 1. Definitions of CSA and HRB items

| Child sexual abuse items (CSAs) | Response |
|---------------------------------|----------|
| **CSA1** | Have you ever had been told dirty jokes or shown pornographic pictures, publications or supplies, etc? |
| | 0=No, 1=Yes |
| **CSA2** | Have you ever had seen someone exposing his/her genitals or masturbating in front of you? |
| | 0=No, 1=Yes |
| **CSA3** | Have someone ever touched your privates/breasts or forcing you to touch his/her privates/breasts? |
| | 0=No, 1=Yes |
| **CSA4** | Have someone ever touched rubbed his/her genitals on you? |
| | 0=No, 1=Yes |
| **CSA5** | Have someone ever touched your genitals or forcing you to make contact with his/her genitals by mouth? |
| | 0=No, 1=Yes |
| **CSA6** | Have someone ever touched attempted to have sex with you? |
| | 0=No, 1=Yes |
| **CSA7** | Have someone ever touched forced to have sex with you? |
| | 0=No, 1=Yes |

| Health risk behaviors items (HRBs) | Response |
|-----------------------------------|----------|
| **HRB01** | Have you ever had sexually intimate behaviors such as hugging, kissing, touching breasts, genitals, thighs, or having intercourse? |
| | 0=No, 1=Yes |
| **HRB02** | Have you ever smoking (including even smoked just a cigarette or two)? |
| | 0=No, 1=Yes |
| **HRB03** | Have you ever had a habit of drinking alcohol (refers to drinking alcohol at least once a month, including beer, liquor, wine, etc.)? |
| | 0=No, 1=Yes |
| **HRB04** | Have you ever been depressed, feeling despair, or extremely anxious for over two weeks or more? |
| | 0=No, 1=Yes |
| **HRB05** | Have you ever seriously considered committing suicide? |
| | 0=No, 1=Yes |
| **HRB06** | Have you ever committed suicide? |
| | 0=No, 1=Yes |
| **HRB07** | Have you gambled in the past year(not including activities such as playing mahjong or poker with friends or relatives for entertainment purposes and for winning a small amount of money or jackpot)? |
| | 0=No, 1=Yes |
| **HRB08** | Have you fought with acquaintances / classmates / strangers in the past year? |
| | 0=No, 1=Yes |
| **HRB09** | Have you skipped classes during the last year? |
| | 0=No, 1=Yes |
| **HRB10** | Have you ever run away from home? |
| | 0=No, 1=Yes |

**Covariates**

Covariates included in this analysis were variables associated with sociodemographic background, variables associated with school life, variables associated with family function, and variables associated with the respondents’ free time lifestyle (Table 2).

**Power calculation**
Based on the sample size framework, about fifty students were planned to investigate of each sex and each age group from each site and the expected sample size was 8400. All students attended to school in the sample classes on the survey day were invited to our survey. Finally, we yielded a total sample of 8746 students. In this study, the associations between CSAs and HRBs were analyzed. According to the literature[31], the OR between CSAs and HRBs, such as depression, suicide attempt and substance abuse, etc., was between 1.2 and 2.9. Considering 2 as the estimated OR value, we conducted the power estimation based on the total sample size of 8746 cases, and then the statistical power(1-β) could reach 82.7%.

Analytic Approach

A descriptive statistical analysis was conducted to examine the prevalence of CSA items and HRB items. Categorical data were reported in count and percentage (%). Then a multi-group latent class analysis (LCA) was adopted to detect profiles of CSA and profiles of HRB across genders to explain the relation between several categorical manifest variables (indicators) by one or more underlying latent categories (classes). Model fit statistics such as the Bayesian information criterion (BIC), the Akaike information criterion (AIC), and the interpretability were considered when evaluating model fit. Once the preferred LCA models were conducted, we got two latent categorical variables (CSA profile and HRB profile). We determined the most likely latent class membership using the highest posterior class probability for each individual. To explore the association of CSA profile and HRB profile, dual LCA regression stratified by gender was used to explore the association of the two latent categorical variables. Covariates can be incorporated in the dual LCA regression model using a logistic link function. Missing data were replaced using full information maximum likelihood (FIML)
estimation, which is the default in Mplus. Sawtooth Software was used to classify data from the questionnaire. Data was checked and cleaned site by site, and then merged and exported into Stata format via Stata version 15.1. Descriptive analysis was conducted in R version 3.6.1. Latent class analysis and the dual LCA regression were completed using Mplus version 7.4[36].

Results

Participant Demographics:

Ages of the participants ranged from 12 to 18 years, with a mean of 15.37 ± 1.95. The number of male students participated in the survey was 4339(49.6%), and that of female students was 4407(50.4%). (Table 2)
Table 2. Participant Demographic Characteristics

|                      | Full Sample | Male (%) | Female (%) |
|----------------------|-------------|----------|------------|
| **Area**             |             |          |            |
| Urban                | 4305 (49.2) | 2168 (50.0) | 2137 (48.5) |
| Rural                | 4441 (50.8) | 2171 (50.0) | 2270 (51.5) |
| **Grade**            |             |          |            |
| Seventh grade        | 2246 (25.7) | 1191 (27.4) | 1055 (23.9) |
| Eighth grade         | 1147 (13.1) | 625 (14.4) | 522 (11.8) |
| Ninth grade          | 1021 (11.7) | 517 (11.9) | 504 (11.4) |
| Tenth grade          | 2431 (27.8) | 1133 (26.1) | 1298 (29.5) |
| Eleventh grade       | 1092 (12.5) | 483 (11.1) | 609 (13.8) |
| Twelfth grade        | 809 (9.2)   | 390 (9.0) | 419 (9.5) |
| **Age**              |             |          |            |
| 12 y                 | 350 (4.0)   | 153 (3.5) | 197 (4.5) |
| 13 y                 | 1756 (20.1) | 895 (20.6) | 861 (19.5) |
| 14 y                 | 1207 (13.8) | 687 (15.8) | 520 (11.8) |
| 15 y                 | 1101 (12.6) | 562 (13.0) | 539 (12.2) |
| 16 y                 | 1418 (16.2) | 655 (15.1) | 763 (17.3) |
| 17 y                 | 1574 (18.0) | 732 (16.9) | 842 (19.1) |
| 18 y                 | 1340 (15.3) | 655 (15.1) | 685 (15.5) |
| **Whether to live on campus** |         |          |            |
| No                   | 4404 (50.4) | 2349 (54.1) | 2055 (46.6) |
| Yes                  | 4342 (49.6) | 1990 (45.9) | 2352 (53.4) |
| **Academic performance** |       |          |            |
| Good                 | 3605 (41.2) | 1705 (39.3) | 1900 (43.1) |
| Fair                 | 3602 (41.2) | 1686 (38.9) | 1916 (43.5) |
| Poor                 | 1539 (17.6) | 948 (21.8) | 591 (13.4) |
| **Peer relationship** |          |          |            |
| Good                 | 5255 (60.1) | 2610 (60.2) | 2645 (60.0) |
| Fair                 | 3266 (37.3) | 1605 (37.0) | 1661 (37.7) |
| Poor                 | 225 ( 2.6) | 124 ( 2.9) | 101 ( 2.3) |
| **Sibling number**   |             |          |            |
| None                 | 4350 (49.7) | 2436 (56.1) | 1914 (43.4) |
| One                  | 3165 (36.2) | 1385 (31.9) | 1780 (40.4) |
| 2 or more            | 1231 (14.1) | 518 (11.9) | 713 (16.2) |
| **Marital status of parents** |         |          |            |
| Normal / married     | 7782 (89.6) | 3866 (89.9) | 3916 (89.3) |
| Divorced / separation| 670 ( 7.7) | 326 ( 7.6) | 344 ( 7.8) |
| Death of one or both parents | 233 ( 2.7) | 110 ( 2.6) | 123 ( 2.8) |
| **Parents’ relationship** |        |          |            |
| Harmonious           | 5189 (66.7) | 2564 (66.3) | 2625 (67.0) |
| Not harmonious       | 2593 (33.3) | 1302 (33.7) | 1291 (33.0) |
| **Father’s education** |          |          |            |
| Elementary and below | 1298 (15.7) | 603 (14.8) | 695 (16.6) |
| Junior high school   | 4276 (51.9) | 2050 (50.5) | 2226 (53.2) |
| High school / Vocational school | 2002 (24.3) | 1038 (25.5) | 964 (23.0) |
| College and above    | 670 ( 8.1) | 372 ( 9.2) | 298 ( 7.1) |
| **Relationship with father** |      |          |            |
| Good                 | 5117 (58.5) | 2517 (58.0) | 2600 (59.0) |
| Fair                 | 2283 (26.1) | 1153 (26.6) | 1130 (25.6) |
| Poor                 | 1346 (15.4) | 669 (15.4) | 677 (15.4) |
| **Severity of father** |          |          |            |
| Strict               | 1199 (13.7) | 626 (14.4) | 573 (13.0) |
Prevalence of CSA and HRB items:

The prevalence of the CSA indicators is shown in the upper half of Table 3. In general, a total of 1131 respondents reported to have had at least one CSA experience, with an overall proportion of 12.9%.

Among all respondents, 527 (6.0%) had experienced non-physical contact CSA, while 357 (4.1%) had experienced physical-contact CSA and 247(2.8%) had experienced attempted intercourse or forced intercourse. Between the genders, non-physical contact CSA and physical-contact CSA were more commonly experienced while attempted intercourse or forced intercourse were less seen in males.

The prevalence of the HRB indicators are shown in the lower part of Table 3. There were 39.4% that had at least one risk behavior. For males, there was a higher prevalence of "sex-related behavior", "smoking", "drinking alcohol", "gambling", "skipping classes ", "fighting" and "running away from home". For females, there was a higher prevalence of having a suicidal attempt, (female 14.1% vs. male 10.3%) or suicidal behavior (female 3.2% vs. male 1.9%).
Table 3. Prevalence of CSA and HRB by gender and type of abuse (N (%))

|                             | Full Sample (N=8746) | Male (N=4339) | Female (N=4407) |
|-----------------------------|----------------------|---------------|-----------------|
| **Child sexual abuse items (CSAs)** |                      |               |                 |
| Having experienced at least one CSA | 1131 (12.9)         | 613 (14.1)    | 518 (11.8)      |
| Non-physical contact CSA     |                      |               |                 |
| CSA1: Having been told dirty jokes or shown pornographic pictures, publications or supplies, etc. | 382 (4.4) | 234 (5.4) | 148 (3.4) |
| CSA2: Having seen someone exposing his/her genitals or masturbating in front of you | 389 (4.4) | 208 (4.8) | 181 (4.1) |
| Physical-contact CSA         |                      |               |                 |
| CSA3: Having had someone touching your privates/breasts or forcing you to touch his/her privates/breasts | 352 (4.0) | 184 (4.2) | 168 (3.8) |
| CSA4: Having had someone rubbing his/her genitals on you | 166 (1.9) | 100 (2.3) | 66 (1.5) |
| CSA5: Having had someone touching your genitals or forcing you to make contact with his/her genitals by mouth | 102 (1.2) | 64 (1.5) | 38 (0.9) |
| Attempting intercourse/intercourse | 247 (2.8)         | 106 (2.4)    | 141 (3.2)      |
| CSA6: Having had someone attempting to have sex with you | 211 (2.4) | 88 (2.0) | 123 (2.8) |
| CSA7: Having had someone forcing to have sex with you | 85 (1.0) | 39 (0.9) | 46 (1.0) |
| **Health risk behaviors items (HRBs)** |                      |               |                 |
| Having had at least one risk behavior | 3450 (39.4)       | 1149 (26.5)  | 2301 (52.2)    |
| HRB01: Sex-related behavior | 658 (7.5)          | 486 (11.2)   | 172 (3.9)      |
| HRB02: CSA: Smoking | 1877 (21.5)       | 1491 (34.4)  | 386 (8.8)      |
| HRB03: Drinking alcohol | 1893 (21.6)       | 1289 (29.7)  | 604 (13.7)     |
| HRB04: Depression and anxiety | 1952 (22.3)     | 985 (22.7)   | 967 (21.9)     |
| HRB05: Suicidal attempt | 1069 (12.2)       | 448 (10.3)   | 621 (14.1)     |
| HRB06: Suicidal behavior | 223 (2.5)          | 84 (1.9)     | 139 (3.2)      |
| HRB07: Gambling | 532 (6.1)          | 394 (9.1)    | 138 (3.1)      |
| HRB08: Skipping classes | 964 (11.0)        | 619 (14.3)   | 345 (7.8)      |
| HRB09: Fighting | 743 (8.5)          | 437 (10.1)   | 306 (6.9)      |
| HRB10: Running away from home | 2300 (26.3)   | 1698 (39.1)  | 602 (13.7)     |

**LCA model selection:**

Table 4 shows the fit statistics of the latent class analysis models for CSAs and HRBs. To select a suitable latent class model for the seven CSA items, multi-group LCA models were estimated from
two to nine latent classes. As can be seen in Table 4, the three-class solution CSA latent class had the lowest BIC value (25544.357), and the lowest AIC value (25214.351). As for HRB, the three-class solution has the lowest BIC (71091.7). Although the AIC value at this point was not the smallest, there was an obvious turning point to show a steep drop before the point and a slow descent after the point. Meanwhile, the three-class model has a clear, meaningful interpretation. The probabilities of classification error of both models were fairly accepted (CSA 0.0369, HRB 0.1314). Therefore, this analysis considered the three-classification model as the most suitable latent class model for CSAs and HRBs.

Table 4. Parameters for LCA model selection

| Class     | AIC       | BIC       | aBIC      | Entropy | Classification Error |
|-----------|-----------|-----------|-----------|---------|----------------------|
| CSA models |           |           |           |         |                      |
| 2-class model | 25244.969 | 26129.973 | 25449.022 | 0.981   | 0.0089               |
| 3-class model | 25214.351 | 25544.357 | 25420.402 | 0.907   | 0.0369               |
| 4-class model | 25217.654 | 25563.405 | 25451.566 | 0.96    | 0.0516               |
| 5-class model | 25230.403 | 25642.235 | 25506.741 | 0.955   | 0.0611               |
| 6-class model | 25237.068 | 25745.078 | 25581.271 | 0.905   | 0.0664               |
| 7-class model | 25280.811 | 25867.275 | 25646.413 | 0.907   | 0.0915               |
| 8-class model | 25271.005 | 25980.084 | 25748.634 | 0.872   | 0.1034               |
| 9-class model | 25332.067 | 26226.312 | 25797.306 | 0.88    | 0.2096               |
| HRB models  |           |           |           |         |                      |
| 2-class model | 70809.482 | 71255.292 | 71055.089 | 0.842   | 0.0903               |
| 3-class model | 70497.285 | 71091.699 | 70824.761 | 0.837   | 0.1033               |
| 4-class model | 70410.626 | 71153.643 | 70819.971 | 0.791   | 0.1314               |
| 5-class model | 70320.915 | 71212.535 | 70812.129 | 0.776   | 0.1518               |
| 6-class model | 70333.206 | 71373.43  | 70906.289 | 0.746   | 0.2151               |
| 7-class model | 70305.65  | 71494.477 | 70960.602 | 0.735   | 0.2453               |
| 8-class model | 70296.554 | 71633.984 | 71033.375 | 0.749   | 0.2854               |
| 9-class model | 71587.223 | 71884.43  | 71750.962 | 0.75    | 0.2319               |

Latent Class Profiles:
As shown in Fig 1, the three profiles of CSAs were characterized by the following conditional probabilities: In "high multiple CSAs", there was a high probability of positive response on each CSA item. In "Verbal or exhibitionism CSA", a higher probability of positive response was seen on the item "Having been told dirty jokes or shown pornographic pictures, publications or supplies. while lower probability on items such as “Having had someone rubbing his/her genitals on you”, “Having had someone touching your genitals or forcing you to make contact with his/her genitals by mouth”, “Having had someone attempting to have sex with you” and “Having had someone forcing to have sex with you”. In "Low CSAs", there was a low probability of positive response on each topic. Among them, the "Low CSAs" accounted for the largest proportion (boys 96.1%, girls 95.2%). A smaller proportion of respondents was classified as the "Verbal or exhibitionism CSA"(boys 2.6%, girls 3.9%). The number of respondents in the "high multiple CSAs" is the smallest. The proportion of "high multiple CSAs" in boys is higher than that in girls (1.3% vs. 0.9%).

As shown in Fig 2, the three profiles of HRBs were characterized by the following probabilities: The "Low HRBs", which accounted for the largest proportion (70.5 %) in the population, had the lowest probability of positive response on each HRB item. A smaller proportion (20.7%) of the population belonged to “externalizing HRBs” which showed a higher probability of positive response on topics such as "fondling ", "smoking", "drinking alcohol", "gambling", "skipping classes" and "fighting", while a lower probability of positive response on "depression, despair, or extreme anxiety", "suicidal attempt", and "suicidal behavior". The lowest proportion in the population of this latent class was taken up by “internalizing HRBs”(8.7%), which had a higher probability of positive responses on topics such as "depression, despair, or extreme anxiety", "suicidal attempt" and "suicidal behavior".
while a lower probability of positive responses on the remaining topics. Compared between genders, girls were more prominent in internalization behaviors, while boys presented a two-peak distribution of both internalization and externalization of the latent conditional probabilities.

Fig 1. Profile probabilities of CSA latent class analysis
Association Analysis:

In Table 5, results of the dual LCA regression model among boys showed that: considering "Low HRBs" as the baseline, there was a significant association between “externalizing HRBs” and "Verbal or exhibitionism CSA" (OR 2.51, 95% CI 1.50-4.20), and a significant association between the “externalizing HRBs” and "high multiple CSAs" (OR 4.05, 95% CI 1.71-9.57). There was also a significant association between “Internalizing behaviors " and "Verbal or exhibitionism CSA" (OR 3.08, 95% CI 1.48-6.40); and a significant association between the " Internalizing behaviors " and "high multiple CSAs" (OR11.77, 95% CI 4.76-29.13). The association of "Verbal or exhibitionism CSA" and "high multiple CSAs" in girls was of greater strength, which almost doubled that in boys.
(male OR 3.08, 95% CI 1.48-6.40 vs female OR 6.05, 95% CI 3.73-9.80). After adjusted by variables such as school, family, and personal lifestyle, the above associations still existed, and their directions remained the same, with little difference in strength.

Table 5. Association between CSA classes and HRB classes

| CSA Latent classes | Proportion | HRB Latent Classes | Crude Association | Adjusted Association * |
|--------------------|------------|--------------------|-------------------|------------------------|
|                    | Total | Low HRBs | Externalizing HRBs | Internalizing HRBs | Externalizing HRBs | Internalizing HRBs | Externalizing HRBs | Internalizing HRBs |
| Male               |       |          |                  |                  |                      |                    |                  |                      |
| Low CSAs           | 4170  | 2912     | 969              | 289              | REF                  | REF                | REF               | REF                  |
| Verbal or exhibition CsAs | 114 (2.6) | 50 (1.7) | 49 (4.7) | 15 (4.6) | 2.95 [1.97-4.40] | 3.02 [1.68-5.45] | 2.51 [1.50-4.20] | 3.08 [1.48-6.40] |
| High multiple CSAs | 55 (1.3) | 11 (0.4) | 23 (2.2) | 21 (6.5) | 6.28 [3.05-12.94] | 19.24 [9.18-40.29] | 4.05 [1.71-9.57] | 11.77 [4.76-29.13] |
| Total              | 4339  | 2973     | 1041             | 325              |                      |                    |                  |                      |
| Female             |       |          |                  |                  |                      |                    |                  |                      |
| Low CSAs           | 4196  | 3118     | 700              | 378              | REF                  | REF                | REF               | REF                  |
| Verbal or exhibition CsAs | 171 (3.9) | 67 (2.1) | 57 (7.4) | 47 (10.7) | 3.79 [2.64-5.45] | 5.79 [3.93-8.53] | 2.53 [1.63-3.95] | 6.05 [3.73-9.80] |
| High multiple CSAs | 40 (0.9) | 9 (0.3)  | 16 (2.1) | 15 (3.4) | 7.92 [3.48-17.99] | 13.75 [5.98-31.63] | 4.97 [1.99-12.44] | 9.87 [3.71-26.25] |
| Total              | 4407  | 3194     | 773              | 440              |                      |                    |                  |                      |

* Adjusted Association: Adjusted for variables associated with school, family function, and respondents' individual free time lifestyle

Discussion

Traditional studies recommended CSA to be classified into four types, namely (1) non-contact, (2) genital touching, (3) attempted vaginal or anal insertion, and (4) vaginal or anal penetration. Empirical opinions showed that CSA involving types (2), (3), and (4) are more likely to have significant negative consequences. Other studies suggested to group CSA into two types, one being body-contact CSA and the other being non-contact CSA. However, in real life, victims often encounter more than one type of CSA [37]. Traditional classification methods set empirical cut-off values for classification,
dividing children into mutually exclusive categories. One advantage of these methods is that the classification is easy to create and compare. The disadvantage is that they required priori assumptions about the adverse impact, and often took into account only one type of the most serious sexual abuse experience that an individual had experienced. They cannot extract how and to what extent various types of abuse coexist in the target population. Thus, some other studies tried cluster analysis to explore more reasonable CSA classification. For example, a study conducted on 303 teenagers in Denmark resulted in a model of four latent classes, namely, multiple CSA latent class, high language/low contact latent class, high sexual contact latent class and nonvictim latent class[38].

The results of our study are consistent with the literatures highlighting subgroups of CSA by latent class analysis rather than the traditional empirical approach. Compared with the categories obtained according to the traditional classification, the latent class of CSA obtained in our study has taken into account both heterogeneity and co-occurrence. Based on the conditional probability and local independence, this study obtained a three-class latent variable to characterize the latent categorical profiles behind CSA experience as "Low CSAs", "Verbal or exhibitionism CSA", and "High Multiple CSAs". The results of our study and the Danish study found similar latent class subgroups of CSA victims, characterized by high language/low contact latent class, high multiple CSA class and low CSA latent class, which reflected that the LCA method is helpful and stable in detecting latent CSA subgroups. In another study trying using LCA, a sample of 657 young people recruited from high schools and colleges was examined to identify latent class of sexually abusive perpetrators[39]. In this analysis, latent classes of kissing/caressing, attempting sexual intercourse, and completed sexual intercourse were established based on CSA items, which were then found to be related to the abusive
behaviors of verbal coercion, material seduction, and violent coercion of the perpetrators. It can be seen that LCA can help to find homogeneous subgroups and the association between the groups and some certain distal variables.

Our study also fits a three-category latent class variable according to the heterogeneity of HRBs. The result is consistent with the results of some other researches. Zlotnick[40] believed that some characteristics of complex posttraumatic stress disorder (PTSD) should coexist with internalized indicators (for example, ineffectiveness, shame, depression / despair, social withdrawal, and physical discomfort), while other characteristics should be more related to externalization indicators (for example, self-destructive behavior, impulsive actions, and hostility). Miller's research[41] indicated internalization and externalization show higher scores on complex PTSD rather than simple PTSD in a series of scales measuring the core concept of PTSD. These findings highlight the heterogeneous of patients with complex adverse experiences. The practice of the LCA method in these researches suggests that the latent category method can better take into account the consistency within group and the difference between groups. The attempts of these studies using the LCA method suggest that the LCA method has great potential in the field of exploring adolescent behavior co-occurrence and heterogeneity.

Studies have suggested that the effects of CSA are cumulative. Exposure to high levels or multiple forms of CSA experiences may have more harmful and more reversible effects[20]. In our study, the results of association analysis showed that, compared to the students classified as "Low HRBs", those classified as "externalizing HRBs" were associated with a high probability of "Verbal or
exhibitionism CSA”, and a similar association was evident among those in “internalizing HRBs”. Meanwhile, compared with "Low CSAs", those in "high multiple CSAs", have the strongest association with both “externalizing HRBs” and “internalizing HRBs”. All these associated directions were positive and statistically significant, which are consistent with the research hypothesis. Existing studies suggest that children with CSA experiences show higher risk of engaging in health-risk behaviors, such as drinking, smoking, gambling, suicidal idea and suicidal attempts [42] [43] [44] [45], or being less ambitious, having fewer friends, and having lower self-esteem [8] [46], and then their lives may have been traumatically disrupted by these behaviors[10-14, 47]. Compared with those who have received low or no abuse, multiple victimization are associated with an increased risk of externalization problems[48] or internalizing problems[49] [50-53]. Our results not only confirmed the relation between CSA and risk behaviors, but also showed a dose-response association between the amount of ACE and behavioral and health issues, which were consistent with some of the few current studies, which means multiple victims are more likely to have behavioral or psychological problems. Sexual assault or forced penetrated abuse is more likely to associate with more negative long-term consequences[54-56] compared with non-forced or non-penetrated sexual abuse. More severe forms of sexual abuse are more destructive because they reinforce feelings of helplessness, powerlessness and self-blame[57]. Our study supports previous studies that multiple CSA experiences may lead to a decrease in the overall perception of one's health [58] and an increase in negative health behaviors[59].

Previous studies showed that boys and girls who experienced CSA may have similar physical and mental health sequelae[60-62]. Our study showed that some of the association strength differed
between genders. The associations were nearly twice as strong in girls as it was in boys (male OR= 3.08, 95%CI 1.48–6.40 vs female OR= 6.05, 95%CI 3.73–9.80). The results suggest that boys and girls may differ in how they respond to negative events[63] [64]. Females tend to internalize stress into shyness, shame, guilt, sadness, and self-hostility[65], while males are more likely to respond with externalizing behaviors such as problematic alcohol use or committing violent acts[66]. However, there are controversies in existing studies on the impact of gender on the associations of CSA and HRB. Coohey[67] suggested that sexually abused boys were more likely than girls to have an internalizing behavior problem using a clinical sample, while Maikovich-Fong[49, 60] claimed that sex did not moderate the relation between abuse characteristics and youth emotional and behavioral problems. These findings highlight the importance of gender in the field of CSA research.

**Limitations:**

The CSA experience measured in this study was embedded in a large national study. Due to the limitation of the investigation duration, the simplified scale adapted based on existing CSA measurements was not a generally accepted scale. It is difficult to avoid the impact of measurement bias and recall bias using self-report to collect data, which limit future comparisons between our results and other studies using different measurements. Application of LCA enables us to identify and categorize the target population into heterogeneity subgroups. The misclassification assigned to each latent class is reasonable and the probabilities of classification error were fairly accepted. However, uncertainty [68] in model class membership still exists. The results should be cautiously interpreted. Rare prevalence of CSA experiences, underestimation and potential misclassification may cause smaller sample cells and may reduce the statistical power. Our analysis was based on a limited
number of covariates, thus revealing a broader range of confounding factors that may also influence the association between CSA and HRB is in need. Further considerations should be tested in cooperating broader potential mediators, moderators and their possible impacts on adolescent adverse experiences or behaviors.

Conclusions:

Notwithstanding the limitations, our study contributes to the scarce literature on exploring co-occurrence subgroups of Chinese school teens reporting sexual abuse and examines the association between CSA and HRB patterns. The co-occurrence and heterogeneity of target population plays a role in the association of both CSA and HRB. Findings also suggest that HRB issues are related to both female and male youth who are more involved in sexual abuse experiences. The results could help improve understandings of the co-occurrence phenomenon, providing new evidence and research directions for association between CSA and HRB, and help identify high risk subgroups and promote the design and effectiveness of interventions.

Suggestions for future studies:

This study aims to explore the potential mechanism and to provide new clues and research directions for the association between CSA and HRB. Future research should examine differences between subgroups with specific risk factors that have the potential to mediate or moderate the association, which could help develop more nuanced interventions addressing adverse experiences and risk behaviors among at-risk adolescents.
Declarations

• Abbreviations

CSA: Child sexual abuse

HRB: Health-Risk Behaviors

OR: Odds Ratio

CI: Confidence Interval

LCA: Latent Class Analysis

ISPCAN: International Society for Prevention of Child Abuse and Neglect

AIC: Akaike Information Criterion

BIC: Bayesian Information Criterion

aBIC: Adjusted Bayesian Information Criterion

• Ethics approval and consent to participate

This study was reviewed and approved by the institutional review board of Shanghai Institute of Planned Parenthood Research (reference number: 2012-01). All survey participants and their parents read and agreed to a written informed consent document prior to completing the survey and are given the right to skip any part of the survey or question. All methods were carried out in accordance with the ethical principles of the Declaration of Helsinki 1964.

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analysis of data, and interpreting the results or in writing the manuscript or in the decision to submit
the manuscript for publication. The content of this publication is only the responsibility of the authors.

- **Consent for publication**

Not applicable.

- **Availability of data and materials**

The datasets used and/or analyzed during the current study are available from the corresponding
author on reasonable request.

- **Competing interests**

The authors declare that they have no competing interests.

- **Authors' contributions**

WZ, CL, XT, SZ, and SL conceptualized and designed the study; XZ, YM, QL, SL, and SZ collected
and cleaned the data; YZ carried out statistical analysis and drafted the manuscript; YZ and QL
interpreted the results; CL, WZ, and XT contributed to discussion; and all authors read and approved
the final manuscript.

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**Figures**

**Figure 1**

Profile probabilities of CSA latent class analysis
Figure 2

Profile probability of HRB latent class analysis