J Child Fam Stud (2017) 26:1380–1387
DOI 10.1007/s10826-017-0659-y

ORIGINAL PAPER

# Association between Child Abuse and Health Risk Behaviors among Chinese College Students

**Yi-lin Chen[1] · Xing Liu[1] · Yao Huang[1] · Hong-jie Yu[1] · Shuai Yuan[1] · Yong-ling Ye[1] · Qing-xiao Li[2] · Qi-qiang He[1,3]**

Published online: 7 February 2017


**Abstract** Little is known about the link between child abuse and health risk behaviors among Chinese college students. This cross-sectional study examined the prevalence of child abuse and its relations with individual and clusters of health risk behaviors among Chinese college students. A total of 507 students participated in this survey. The prevalence of child abuse from the highest to the lowest was emotional neglect (53.9%), physical neglect (49.0%), emotional abuse (21.8%), physical abuse (18.3%), and sexual abuse (18.1%), respectively. Males were more likely to report child abuse than females ($p < 0.01$). For males, emotional abuse was associated with internet addiction [OR = 2.28; 95%CI (1.00, 5.20)] and suicidal behavior [OR = 12.47, 95%CI (2.61, 59.54)]; while sexual abuse was associated with internet addiction [OR = 2.30, 95%CI (1.14, 4.66)]. For females, emotional abuse was significantly associated with increased risks for self-harm behavior [OR = 15.03, 95%CI (3.59, 63.07)] and suicidal behavior [OR = 5.16, 95%CI (1.63, 16.40)]. Physical abuse was related to risks for internet addiction [OR = 2.50, 95% CI (1.03, 6.04)] significantly. Two-step cluster analysis showed that participants in clusters with more health risk behaviors reported higher scores of child abuse. These findings suggest that child abuse was associated with both individual and clustering of health risk behaviors among Chinese college students.

**Keywords** Child abuse · Health risk behaviors · College students

## Introduction

Child abuse is a major public health issue worldwide. The main types of child abuse include sexual abuse, physical abuse, emotional abuse, physical neglect, and emotional neglect (Bernstein et al. 2003). A recent meta-analysis of 55 studies from 24 countries showed that the prevalence of child sexual abuse ranged from 8 to 31% for girls and 3 to 17% for boys (Barth et al. 2013). Two other comprehensive meta-analyses showed that the prevalence of physical abuse, physical neglect, and emotional neglect were 17.7, 16.3, and 18.4%, respectively (Stoltenborgh et al. 2013a, b).

Adverse childhood experiences such as abuse can cause changes in brain structure and function and stress–responsive neurobiological systems, which in turn can lead to negative health outcomes and behaviors (Anda et al. 2006). Existing research shows that child abuse has long-term negative behavioral and psychological consequences on adolescent and adulthood. Kristman-Valente et al. found that child abuse (physical and sexual abuse) before aged 18 years was risk factors of adolescent smoking, which predicted smoking frequency in adulthood (Kristman-Valente et al. 2013). Two other studies showed that physical and sexual abuse history before aged 18 years among non-Asian women were significantly associated with sexual risk behaviors between 18 and 40 years old (Littleton et al. 2007; Roemmele and Messman-Moore 2011). A meta-

Yi-lin Chen and Xing Liu contributed equally to this work.

✉ Qi-qiang He
heqiqiang@gmail.com

[1] School of Public Health, Wuhan University, Wuhan, P. R. China

[2] Department of Applied Economics, University of Minnesota, Minneapolis, MN 55455, USA

[3] Global Health Institute, Wuhan University, Wuhan, P. R. China

analysis of 22 studies among Chinese subjects found child physical abuse before and at the age of 18 years was significantly associated with mental disorders (Lp et al. 2016). Another study on child sexual abuse among Chinese female adolescents aged between 17 and 19 years found that sexual abuse was associated with higher rates of mental health and behavioral problems, including depression, suicidal thinking and planning, alcohol use, smoking and having sexual intercourse (Chen et al. 2006). However, a key limitation of these studies is that only a few have assessed the impact of other types of child abuse, including emotional abuse, emotional neglect, and physical neglect. One study showed that exposures to emotional abuse and emotional neglect in childhood could affect brain development, and were important predictors of depression and suicidal ideation in both males and females (Anda et al. 2006). Furthermore, most previous studies only examined the impact of child abuse on individual health risk behavior. However, health risk behaviors may co-occur instead of acting independently (Busch et al. 2013; de Bruijn and van den Putte 2009), Therefore, there is a need to explore the relationships between various types of child abuse with clusters of health risk behaviors.

Existing research has shown that college students are at a critical transitional period when they could easily establish health risk behaviors (i.e., cigarette smoking, binge drinking, self-harm behavior, suicidal behavior, risky sexual behavior, and internet addiction) (Steptoe et al. 2002; Yang et al. 2016; Ye et al. 2015; Xu and Chen 2016), and these behaviors may have adverse health consequences in their later lives, including increased risks for chronic disease and cognitive impairment (Pelletier et al. 2016; Thayanukulvat and Harding 2015). Furthermore, the timing of abuse and the accumulation of adverse childhood experiences will impact later health status (Felitti et al. 1998). Given that studies among Chinese college students are limited, we, therefore, examined the relationship between child abuse and clusters of health risk behaviors among Chinese college students. Since males and females reported differing levels of adverse experiences and risk behaviors (Kristman-Valente et al. 2013), we explored whether the relations would be different based on gender.

## Method

### Participants

Year 1 college students were recruited via a multistage sampling method from Wuhan, China. Of the 600 approached students, 547 students (240 males and 307 females) aged between 18 and 24 years old ($M = 20.3$, $SD = 1.1$) were included in this study.

### Procedure

This cross-sectional study was approved by the Medical Research Ethics Committee of Wuhan University. At the first stage of the sampling, three colleges were selected randomly in Wuhan city. Second, one school in year 1 was selected from each college using a simple random sampling method. Third, two classes from each school were invited to participate in the study. Participants with a written informed consent completed a self-administered, confidential questionnaire in a classroom setting in the absence of teachers. The research staffs collected the questionnaires immediately after completion.

### Measures

#### *Demographic variables*

Relevant basic demographic variables included participants' age, gender, height, weight, school, and maternal education level [low (≤6 years), medium (7–12 years), or high (≥13 years)] (Canan et al. 2014; Yang et al. 2016).

#### *Health risk behaviors*

This survey investigated six health risk behaviors: internet addiction, self-harm behavior, suicidal behavior, current smoking, binge drinking, and risky sexual behavior. Items were adapted from Youth Behavior Survey Questionnaire (YRBS) developed by the CDC in the USA (Brener et al. 2002) and Young's Internet Addiction Test (Young 2009). The questionnaires have been translated into Chinese and showed good validation in previous studies (Cao and Zhang 2010; Chen et al. 2004).

*Internet addiction* The Young's Internet Addiction Test was utilized to assess internet addiction. The scale consisted of 20 items with 5 response choices for each item scored from 1 to 5 (e.g., do you stay online longer than originally intendedly?). Participants with a total score higher than 50 were identified as "internet addiction" (Young 2009). The Cronbach's α coefficient was 0.91 in the Chinese version (Cao and Zhang 2010).

*Self-harm behavior* Participants were asked to report the frequency of hurting themselves deliberately (How often did you hurt yourself deliberately during the past 12 months, for example, by cutting yourself?) There were two response categories: "none" and "once or more". The respondents who reported any self-harm behaviors were considered as having self-harm behavior (Stallard et al. 2013).

*Suicidal behavior* Respondents were asked whether they had ever thought about or attempted at killing themselves in the past 12 months. If yes, they were classified as "suicidal behavior group" (Wan et al. 2012).

*Current smoking* The behavior of current smoking was assessed by asking the number of days the respondents smoked a cigarette during the past 30 days. Respondents who reported smoking on one or more days in the previous 30 days were considered as "current smoking" (Fettes and Aarons 2011).

*Binge drinking* Participants were asked to report number of days having five or more drinks in a row in the past 30 days. The response options included "none", "1–2 days", "3–5 days", "6–9 days", "10–19 days", and "≥20 days". For data analysis purpose, the responses were coded as "none = 0" and "once or more = 1" (Patrick et al. 2013). Those who reported any days were classified as binge drinking.

*Risky sexual behavior* Risky sexual behavior was assessed by two items. Respondents were first asked to report whether they had any sexual intercourse in the past 30 days. Then, they were asked by a following question that if there was a condom use (e.g., Have you had sex with a condom?). If the answer was "yes" for the first question and "no" for the latter one, they were considered as "having risky sexual behavior" (Yang et al. 2016).

*Child abuse*

Experiences of child abuse occurred before aged 18 years were measured by using *Childhood Trauma Questionnaire—Short Form (CTQ-SF)*, a well-validated retrospective self-report inventory (Bernstein et al. 2003). In this 28-item questionnaire, five dimensions of child abuse and neglect were identified including emotional abuse, physical abuse, sexual abuse, emotional neglect, and physical neglect. Strong internal consistency and test-rested reliability have been demonstrated with both English CTQ-SF (Bernstein and Fink 1994) and Chinese version (Zhao et al. 2005) for all subscales. Each item was rated on a 5-point Likert scale ranging from 1 ("never true") to 5 ("very often true") and item scores were summed to quantify the severity of child abuse ranging from 25 to 100. The Cut-off scores identifying respondents from low to severe exposure for each subscale were: emotional abuse ≥ 9, physical abuse ≥ 8, sexual abuse ≥ 6, emotional neglect ≥ 10, and physical neglect ≥ 8 (Li et al. 2014). These cut-off scores have showed good validation in Chinese samples.

## Data Analyses

SPSS statistical package (version 19.0; SPSS Inc, Chicago, IL, USA) was used to conduct data analysis. Of a total 600 participants, we excluded 93 questionnaires due to their age younger than 18 years old or with substantial missing data (>10% of all data). Otherwise, the missing data were handled in two ways: the missing value was recoded as a dummy variable for categorical variables; and for continuous variable, it was replaced by the mean value. First, the frequency distribution of demographic characteristics and child abuse pattern were described by using bivariate analyses. Chi-square test (for categorical variables) and t-test (for continuous variables) were performed to examine gender difference. Second, after preliminary analysis, we found significant difference between male and female participants. In the following analysis, data analyses were conducted in males and females respectively. Multivariate logistic regression analyses were conducted to explore the relationships between five types of child abuse and individual health risk behaviors, after adjusting for demographic variables (age, body mass index (BMI), school, and maternal education). All five child abuse variables were included in a single model to predict each health risk behavior. The odds ratios (OR) and 95% confidence intervals (CIs) were calculated in each regression model. Third, a two-step cluster analysis was conducted to identify groups of participants with similar health risk behaviors. The associations between child abuse and health risk behavior clusters were examined by using multivariate covariance analyses. Last, we conducted logistic regression analysis to explore the relationship between number of categories of child abuse and the clusters of health risk behaviors. The numbers of categories of child abuse experiences were included in a single model to predict if participants were in the unhealthy cluster identified in the last step.

## Results

The basic characteristics of the respondents are presented in Table 1. Of a total of 547 participants, 240 (43.9%) were males with an average age of 20.6 (SD = 1.2) and 307 (56.1%) females with an average age of 20.1 (SD = 1.1). Compared with female students, male students had a higher BMI (21.3 vs. 19.5, $p < 0.001$). No significant difference was observed in terms of maternal education between males and females. The highest and lowest child abuse symptoms reported in the study were emotional abuse (53.9%) and sexual abuse (18.1%), respectively. Male participants were more likely to report five types of child abuse than females ($p < 0.01$). Internet addiction was the most frequent health risky behavior among males (42.5%) and females (32.6%).

**Table 1** Basic characteristics of 547 participants by sex

| | Total ($n = 547$) | Males ($n = 240$) | Females ($n = 307$) | Statistics |
|---|---|---|---|---|
| Age (years)[a] | 20.3 (1.1) | 20.6 (1.1) | 20.1 (1.1) | 5.125** |
| BMI (kg/m$^2$)[a] | 20.3 (2.4) | 21.3 (2.7) | 19.5 (1.6) | 9.099** |
| Maternal education, *n* (%)[b] | | | | |
| Low (≤6 years) | 134 (24.5) | 64 (26.7) | 70 (22.8) | 1.149 |
| Medium (7–12 years) | 338 (61.8) | 145 (60.4) | 193 (62.9) | |
| High (≥13 years) | 75 (13.7) | 31 (12.9) | 44 (14.3) | |
| Categorized child abuse, *n* (%)[b] | | | | |
| Emotional abuse | 119 (21.8) | 69 (28.7) | 50 (16.3) | 12.292** |
| Physical abuse | 100 (18.3) | 67 (27.9) | 33 (10.7) | 26.573** |
| Sexual abuse | 99 (18.1) | 73 (30.4) | 26 (8.5) | 43.772** |
| Emotional neglect | 295 (53.9) | 159 (66.2) | 136 (44.3) | 26.121** |
| Physical neglect | 268 (49.0) | 149 (62.1) | 119 (38.8) | 29.315** |
| Health risk behaviors, *n* (%)[b] | | | | |
| Internet addiction | 202 (36.9) | 102 (42.5) | 100 (32.6) | 5.699* |
| Self-harm behavior | 33 (6.0) | 17 (7.1) | 16 (5.2) | 0.832 |
| Suicidal behavior | 37 (6.8) | 16 (6.7) | 21 (6.8) | 0.006 |
| Current smoking | 52 (9.5) | 51 (21.2) | 1 (0.3) | 68.553** |
| Binge drinking | 78 (14.3) | 60 (25.0) | 18 (5.9) | 40.347** |
| Risky sexual behavior | 45 (8.2) | 33 (13.8) | 12 (3.9) | 17.279** |

*Notes*: Values are presented as mean (SD) or number (percentage)

*BMI* body mass index

*$p < 0.05$; **$p < 0.01$

[a] *p*-value for t-test

[b] *p*-value for Chi-square test

The least frequent health risky behavior reported in this study was self-harm behavior in males (6.0%) and current smoking in females (0.3%), respectively. Male participants were significantly more likely to involve in internet addiction, current smoking, binge drinking, and risky sexual behavior than females ($p < 0.01$).

As shown in Tables 2 and 3, male students who were abused emotionally in childhood had significantly increased risks for both internet addiction [OR = 2.28, 95%CI (1.00, 5.20)] and suicidal behavior [OR = 12.47, 95%CI (2.61, 59.54)] in college. Childhood sexual abuse was significantly associated with higher rates of internet addiction [OR = 2.30, 95%CI (1.14, 4.66)]. In female students, emotional abuse was linked with increased risks for self-harm behavior [OR = 15.03, 95%CI (3.59, 63.07)] and suicidal behavior [OR = 5.16, 95%CI (1.63, 16.40)] in college, while physical abuse was associated with higher rates of internet addiction [OR = 2.50, 95%CI (1.03, 6.04)].

Characteristics of two different health risk behavior clusters are shown in Table 4. Male students in the unhealthy cluster showed significantly higher rates of five health risk behaviors (except for internet addiction) than those in the healthy cluster, and they were also more likely to have higher scores on three types of child abuse (emotional abuse, sexual abuse, and physical neglect) than the healthy cluster. Compared with those in the healthy cluster, female participants in the unhealthy cluster showed significantly higher rates of five health risk behaviors (except for current smoking) and significantly higher scores for five types of child abuse.

Table 5 shows the prevalence of co-occurrence of child abuse and its association with health risk behavior clusters. Male students who experienced three or more types of child abuse were three to five times more likely to engage in the unhealthy cluster than those without child abuse experiences. Female students with three or more types of child abuse experiences were about three to seventeen times more likely to end up in the unhealthy cluster.

## Discussion

The current study is unique in that it reports the relation between child abuse and health risk behaviors clusters among Chinese college students. We show significantly positive associations between child abuse and health risk behaviors both individually and in cluster. Specifically, emotional abuse was associated with increased risks of

**Table 2** Association between child abuse and individual health risk behaviors among 240 male participants

| Variables | Internet addiction OR (95% CI) | Self-harm behavior OR (95% CI) | Suicidal behavior OR (95% CI) | Current smoking OR (95% CI) | Binge drinking OR (95% CI) | Risky sexual behavior OR (95% CI) |
|---|---|---|---|---|---|---|
| Emotional abuse | 2.28 (1.00–5.20)* | 3.12 (0.72–13.50) | 12.47 (2.61–59.54)* | 1.27 (0.45–3.54) | 1.09 (0.44–2.70) | 1.75 (0.60–5.11) |
| Physical abuse | 0.79 (0.33–1.90) | 1.77 (0.39–7.98) | 1.00 (0.22–4.49) | 0.56 (0.19–1.66) | 0.99 (0.40–2.48) | 0.75 (0.24–2.34) |
| Sexual abuse | 2.30 (1.14–4.66)* | 1.15 (0.29–4.58) | 0.73 (0.19–2.85) | 2.25 (0.99–5.11) | 1.24 (0.58–2.66) | 1.45 (0.57–3.73) |
| Emotional neglect | 1.81 (0.83–3.96) | 1.01 (0.23–4.47) | 0.89 (0.19–4.22) | 2.10 (0.83–5.30) | 0.69 (0.30–1.57) | 0.92 (0.32–2.68) |
| Physical neglect | 0.93 (0.42–2.09) | 1.83 (0.33–10.14) | 0.72 (0.14–3.74) | 0.51 (0.20–1.29) | 1.68 (0.70–4.10) | 1.29 (0.42–4.00) |

Adjusted for age, BMI, school, and maternal education

*OR* odds ratio, *CI* confidence interval

*$p < 0.05$

**Table 3** Association between child abuse and individual health risk behaviors among 307 female participants

| Variables | Internet addiction OR (95% CI) | Self-harm behavior OR (95% CI) | Suicidal behavior OR (95% CI) | Current smoking OR (95% CI) | Binge drinking OR (95% CI) | Risky sexual behavior OR (95% CI) |
|---|---|---|---|---|---|---|
| Emotional abuse | 1.15 (0.54–2.46) | 15.03 (3.59–63.07)** | 5.16 (1.63–16.40)* | – | 1.99 (0.51–7.78) | 1.20 (0.19–7.63) |
| Physical abuse | 2.50 (1.03–6.04)* | 3.29 (0.61–17.68) | 1.14 (0.29–4.42) | – | 1.81 (0.34–9.74) | 0.86 (0.08–9.77) |
| Sexual abuse | 1.01 (0.37–2.79) | 0.28 (0.04–2.05) | 1.52 (0.38–6.13) | – | 1.85 (0.29–11.62) | 1.57 (0.13–19.43) |
| Emotional neglect | 1.65 (0.90–3.01) | 1.18 (0.28–5.00) | 1.04 (0.30–3.55) | – | 0.80 (0.23–2.78) | 0.81 (0.18–3.55) |
| Physical neglect | 0.91 (0.49–1.69) | 0.68 (0.15–3.15) | 3.91 (1.09–14.06) | – | 0.62 (0.17–2.36) | 0.69 (0.14–3.36) |

Adjusted for age, BMI, school, and maternal education

*OR* odds ratio, *CI* confidence interval

*$p < 0.05$; **$p < 0.01$

internet addiction and suicidal behavior in males; for females, they were more likely to report suicidal and self-harm behavior with a history of emotional abuse. The association between sexual abuse and increased risks of internet addiction in males was not observed in females, while females who reported physical abuse were more likely to be involved in internet addiction. These findings contribute to a further understanding of child abuse and its impact on health behaviors among young adults.

Overall the prevalence of child abuse in this study is consistent with several previous studies conducted in mainland China, but higher than those in Hong Kong and Taiwan. For instance, the prevalence of sexual abuse in our study is similar to the study among 683 adolescents in mainland China by Lin et al. (2011), but is higher than 5.15% reported in another study in Taipei (Zhu et al. 2015) and 6% among 2147 Hong Kong college students (Tang 2002). Compared to international studies, the results are mixed. Lower prevalence of emotional abuse and higher prevalence of physical neglect were observed in our study when in comparison with the pooled estimates among Vietnamese college students (Tran et al. 2015), while emotional and physical neglect rates in the current study were higher than those in another international research (Stoltenborgh et al. 2013a, b). Several factors may contribute to the inconsistent findings: First, the understanding of child abuse may be different under diverse cultural backgrounds in different regions. Although mainland China, Hong Kong, and Taiwan are all influenced by traditional Confucian culture which emphasizes the virginity of female before marriage and parental authority, the extent of adherence to Confucius culture is discrepant due to different social systems and cultural values developed in the last few decades. Second, different research methodologies may lead to the inconsistence in these results, such as sampling method, scale, and cut-off points. Therefore, further studies are needed to explore the factors leading to these discrepancies across studies.

The current study shows that males reported significantly higher prevalence of child abuse than females. Gender difference in child abuse has also been observed in previous studies (Kristman-Valente et al. 2013; Lin et al. 2011). Several plausible reasons may explain for this phenomenon. First, gender stereotyping still exists in many Chinese families, and it requires that boys should play more important social roles and support families in the future

**Table 4** Characteristics of health risk behavior clusters among 547 Chinese college students

| | Males ($n = 240$) | | | Females ($n = 307$) | | |
|---|---|---|---|---|---|---|
| | Healthy cluster ($n = 136$) | Unhealthy cluster ($n = 104$) | Statistics | Healthy cluster ($n = 181$) | Unhealthy cluster ($n = 126$) | Statistics |
| *Health risk behavior, n (%)*[c] | | | | | | |
| Internet addiction | 59 (43.4) | 43 (41.3) | 0.100 | 0 | 100 (79.4) | 213.047** |
| Self-harm behavior | 0 | 17 (16.3) | 23.925** | 0 | 16 (12.7) | 24.248** |
| Suicidal behavior | 0 | 16 (15.4) | 22.418** | 0 | 21 (16.7) | 32.382** |
| Current smoking | 0 | 51 (49.0) | 84.689** | 0 | 1 (0.8) | 1.441 |
| Binge drinking | 0 | 60 (57.5) | 104.615** | 0 | 18 (14.3) | 27.468** |
| Risky sexual behavior | 0 | 33 (31.7) | 50.033** | 0 | 12 (9.5) | 17.939** |
| *Child abuse score*[a,b] | | | | | | |
| Emotional abuse | 6.9 (0.2) | 7.8 (0.3) | 2.322* | 6.3 (0.2) | 7.6 (0.2) | 4.584** |
| Physical abuse | 6.6 (0.2) | 7.3 (0.3) | 1.943 | 5.5 (0.2) | 6.3 (0.2) | 3.403** |
| Sexual abuse | 6.3 (0.3) | 7.4 (0.3) | 2.644** | 5.3 (0.1) | 5.9 (0.2) | 2.718** |
| Emotional neglect | 12.7 (0.5) | 13.2 (0.6) | 0.289 | 9.2 (0.3) | 10.6 (0.4) | 2.216* |
| Physical neglect | 9.2 (0.3) | 9.8 (0.3) | 0.741 | 7.2 (0.2) | 8.2 (0.3) | 2.601** |

*Notes*: Values are presented as mean (SD) or number (percentage) or mean (SE)

*BMI* body mass index

*$p < 0.05$; **$p < 0.01$

[a] Adjusted for age, BMI, school, and maternal education

[b] *p*-value for t-test

[c] *p*-value for Chi-square test

**Table 5** Association between number of categories of child abuse and health risk behavior clusters among 547 participants

| | Males ($n$=240) | | Females ($n$=307) | |
|---|---|---|---|---|
| | *n* (%) | OR (95% CI) | *n* (%) | OR (95% CI) |
| Number of categories[a] | | | | |
| 0 | 47 (19.6) | – | 128 (41.7) | – |
| 1 | 38 (15.8) | 1.92 (0.76–4.85) | 70 (22.8) | 1.27 (0.68–2.36) |
| 2 | 73 (30.4) | 1.90 (0.84–4.29) | 67 (21.8) | 1.54 (0.81–2.93) |
| 3 | 31 (12.9) | 3.24 (1.20–8.76)* | 16 (5.2) | 3.52 (1.15–10.73)* |
| 4 | 15 (6.2) | 4.86 (1.37–17.22)* | 18 (5.9) | 3.49 (1.23–9.92)* |
| 5 | 36 (15.0) | 2.91 (1.12–7.55)* | 8 (2.6) | 16.83 (1.03–146.75)* |

Adjusted for age, BMI, school, and maternal education

*OR* odds ratio, *CI* confidence interval

*$p<0.05$

[a] Categories refer to child abuse experiences

(Niu et al. 2014). Therefore, parents tend to use more severe punishment on boys than girls. Second, Chinese traditional culture which emphasizes the virginity and virtue of females may lead to lower sexual abuse and other types of abuse in females than in males (Luo et al. 2008). Last, females may have underreported child abuse because they were afraid of being judged or laughed at. Even social stigma towards risky sexual behavior still exists in China, and risky sexual behaviors of male students are considered normal, it is different for girls (Lin et al. 2011).

Although several studies have examined the prevalence of child abuse, only a few have explored the relationship between child abuse and multiple health risky behaviors among college students. Kristman-Valente et al. found that physical abuse and sexual abuse were associated with increased risk of smoking in adolescence (Kristman-Valente

et al. 2013). Another study conducted among 683 adolescents in rural China found that sexual abuse was associated with higher level of engagement in smoking, binge drinking, suicidal attempt and ideation (Lin et al. 2011). The current study corroborates previous findings showing that emotional abuse, physical abuse, and sexual abuse were significantly related to greater risks of several health risk behaviors among college students. In addition, we found a positive association between child abuse and the clusters of health risk behaviors in college students. This association was even stronger among students with three or more types of child abuse experiences. Our finding was consistent with Felitti et al.'s study, where a strong graded relationship was found between the number of categories of childhood exposures and risk behaviors among 13494 adults in the USA (Felitti et al. 1998). This could contribute greatly to understanding of cumulative risks of child abuse and prevention strategies regarding health risk behaviors.

There are several limitations in the present study. First, childhood trauma questionnaire measured child abuse retrospectively; therefore, under-reporting due to recalling bias or social pressure should not be overlooked. However, the latter one might have been reduced because the questionnaires were completed independently. Second, because the study was cross-sectional in design, causality between child abuse and health risk behaviors could not be established at the moment. Third, since respondents did not report precise timing of abuse, it is not possible to assess the impact of different timing of abuse on risk behaviors. Fourth, the dichotomous categorization of the risk behaviors might limit variability and combine someone who did the behavior once ever with someone who does the behavior daily.. Finally, our results might not be generalizable to Chinese young adults because the participants were only recruited from Wuhan city, China.

**Author's Contributions** H.Q.Q.: designed and executed the study, assisted with the data analyses, and wrote the paper. C.Y.L.: collaborated with the design, analyzed the data and writing of the study. L. X.: collaborated with the design, analyzed the data and writing of the study. H.Y.: analyzed the data and wrote part of the results. Y.H.J.: analyzed the data and wrote part of the results. Y.S.: collaborated with the design and writing of the study. Y.Y.L.: collaborated with the design and writing of the study. L.Q.X.: collaborated in the writing and editing of the final manuscript.

**Compliance with Ethical Standards**

**Conflict of Interest** The authors declare that they have no competing interest.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

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