Gender differences in self-harm and drinking behaviors among middle school students in Beijing, China

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Abstract

Background: Self-harm and drinking were both serious problems in adolescents and many studies presented evidence of their association. However, gender difference in this association was seldom deeply discussed. Our study was aimed to evaluate the prevalence of self-harm and explore its association with drinking behaviors by gender and investigate the extent to which the gender differences exist in the association between self-harm and drinking.

Methods: A total of 32362 students in grades 7 to 12 were anonymously surveyed using two-stage, stratified probability proportion sampling in Beijing, China. Self-harm, drinking behaviors and other basic information were obtained from anonymous questionnaire. Demographic variables and indicators of self-harm as well as drinking behaviors were analyzed with chi-square test and Gamma test between genders and the gender difference in this association was analyzed by log-binomial regression.

Results: The total prevalence of self-harm was 13.7% with no significant gender difference (B=0.352, P=0.553). The prevalence of self-harm decreased with age in girls (G=-0.163, P<0.001). Self-harm was associated with drinking behaviors in both boys and girls. The Log-binomial regression demonstrated that girls in 15-19 years were at lower risk of self-harm than girls in 10-14 years while no age difference in boys. The higher OR for self-harm was found among girls with early drinking experiences compared with boys (1.863 vs 2.565). Girls who ever drunk (1.636 vs 2.211), were currently drinking (2.122 vs 3.400) and binge drinking (3.924 vs 6.357) had greater risk for self-harm than boys. Gender differences in self-harm were found at the following reasons of drinking, *feeling down* (4.402 vs 5.742), *customary chronic drinking* (3.945 vs 5.460), *feeling delighted* (1.806 vs 2.615), *drinking with peers* (1.797 vs 2.693).

Conclusion: Self-harm has significant positive association with drinking among middle school students and girls with drinking behaviors were at higher risk of suffering self-harm. Identifying adolescents' drinking behaviors is of vital importance to self-harm prevention and special attention should be focused on younger girls.

Background

Self-harm is defined as a person's harming of his or her own body on purpose such as self-injury and self-poisoning, irrespective of motive or the extent of suicidal intent[1-5]. Self-harm causes a great health expenditure and loss for health care resource[6]. It is associated with numerous somatic diseases[7], in particular, with mental or psychiatric diseases such as depression and anxiety[2, 8]. Within the lifecourse, self-harm is more prevalent when it comes to puberty[9]. Globally, the prevalence of self-harm ranged from 3.1% to 15.5 % among adolescents aged between 12 to 21 years[1,5,10-15], while in China, the prevalence reached 27.6% and some subtypes of self-harm could be even at 32.0%[2, 16].

An 'iceberg model' is often raised to describe the situation of suicide, so is the self-harm, which is recognized as a '*hidden behavior*': less than 13% of the self-harm episodes led to hospital presentation[1, [illegible] itted self-harm in a cohort study did not refer to mental

health services[8]. Thus, clinical based investigation might underestimate the prevalence of self-harm and conducting self-reported survey could help us find those who have committed self-harm but without hospitalization. Moreover, hidden behavior means that we need more readily observed markers or indicators to help identify self-harm.

Drinking is such an observable behavior. Numerous researches have reported the positive association between self-harm (or self-injury) and drinking (or alcohol abuse)[1, 7, 8, 10, 11, 13, 17-24] . Ness et al. conducted an epidemiological and longitudinal study and found that alcohol was involved in 58.4% of self-harm episodes[24]. Heerde et al. found that the recent alcohol users were at 2.70 times risks to commit self harm[21]. However, most studies focused on the relationship between the current drinking condition of respondents or alcohol-related effect of subjects and self-harm. Other indicators for drinking behavior, like the age of one's first drink and one's main reason for drinking, have been seldom adopted in these studies. Moreover, whether gender disparity exists in the association between self-harm and drinking needs further study. Although limited studies showing gender difference in the relationship between self-harm and drinking demonstrated that the effect of current drinking status was stronger among girls[22], as mentioned above, other important indicators for alcohol use in adolescents such as the age of one's first drink and one's main reason for drinking were not discussed. Other studies identified the early onset of alcohol use but did not discuss the gender difference in the relationship between self-harm and early drinking experience[18, 21]. Another study even found that alcohol-involved self-harm was more common in men rather than women though its subjects were mainly adults[24]. Therefore, this study aimed to evaluate the prevalence of self-harm and explore its association with drinking behaviors by gender and investigate the extent to which the gender differences existing in the association between self-harm and drinking.

Methods

Design and Sampling

A two-stage, stratified probability proportion sampling was conducted to obtain a representative sample for the middle school students in Beijing, China. The first stage of the sampling was to extract schools which were classified based on socioeconomic development levels of the districts or counties where those middle schools were located and based on whether the school was a *key middle school* (refer to a middle with good records of past educational accomplishment, which had priority in the assignment of teachers, equipment, and funds and the privilege of recruiting the best students[25]) or not. The levels of the socioeconomic development were classified as *upper,moderate* and *lower* according to the local economic development. In the beginning, all middle schools in Beijing formed as the first-order sampling framework. A probability proportion sampling was conducted to extract schools stratified by school type, which was done respectively in the three categories of socioeconomic development. The second stage of the sampling was to extract students in the selected schools. A random sampling by grade was conducted by using class as the sampling unit and all students in the sampled class participated in the

survey (Figure 1). The investigation was conducted from April to May, 2014. Each participant in this survey was required to complete a self-reported anonymous questionnaire with absence of their teachers.

Measures

The questionnaire was derived from the 2003 Youth Risk Behavior Surveillance survey in the United States[26], which was a widely accepted questionnaire with robust reliability and validity[27-29].

Self-harm

The frequency of self-harm behaviors was asked in the questionnaire as *"In the past 12 months, have you ever deliberately committed self-harm (such as burning oneself with butt, cutting oneself and hitting the wall with one's head et al.)"*. Many scales or researches for estimating self-harm adopted similar questions to determine whether the participant had the experience of self-harm[8, 11, 30], and its reliability and validity were already examined to be qualified[31]. The choices for this question include *never*, *once*, *twice or three times* and *four times or more*.

Drink behaviors

Three variables of drinking behaviors were adopted to look into the association between different aspects of drinking behaviors and self-harm. The age of one's first drinking was asked by "*How old were you when you had your first drink of alcohol other than a few sips?*" Having one's first drink before 13 years old was considered as early drinking experience[28]. The main reason for drinking was also asked. The condition of drinking behaviors was defined as: lifetime (at least one previous drink), current (at least one alcoholic drinks in the past 30 days) and binge drinking (at least five alcoholic drinks per occasion in one day during the past 30 days)[26, 32]. These definitions were used in the previous studies[21, 33]. A recoding process referring to Heerde et al.'s research[21] was utilized to simplify four variables that described drinking conditions for participants into one variable with four categories defined as *no alcohol use*, *non-recent alcohol use* (lifetime use but no use in the past month), *recent(past month)alcohol use* (but no binge use), and *binge drinking*. The initial questions for the four categories were as follows, "*Have you ever had your first drink other than a few sips?*"; "*In the past 30 days, on how many days did you have at least one drink containing alcohol?*" and "*During the past 30 days, on how many days did you have ≥ 5 drinks of alcohol in row?*"

Controlling variables

Four basic demographic variables were controlled in the analysis for the association between self-harm and drinking behaviors, which included gender, age and urban or suburban areas as well as school type (*key schools* or *not)*.

Statistical analysis

A total of 33,694 middle school students completed their questionnaires (16819 girls). 1,332 participants were excluded due to information missing, logic error and or unqualified age. The missing data was randomly distributed in gender, age and setting (Figure 2)

A descriptive analysis was conducted to present the general information of the sample and the association between self-harm and drinking behaviors. Gamma test was used to compare the difference between subgroups. All the demographic variables significantly associated with self-harm would be considered as co-variables in the log-binomial regression. The log-binomial regression was conducted to test the difference of the association between self-harm and drinking behaviors and reasons by gender. The variables significantly associated with self-harm in the univariate analysis were included in the model as co-variables. Three models for different drinking behaviors and seven models for drinking reasons were established respectively due to the multicollinearity. All analyses were executed by gender. The gender disparity in the association between self-harm and drinking behaviors were evaluated by adding one interaction term of drinking behaviors and gender at a time in each model. Significance level was accepted at $P < 0.05$, two-tailed. All data were analyzed using SPSS20.0 for Windows (SPSS Inc., Chicago, IL, USA) or Stata 15 SE (Stata Corp LLC).

Results

The prevalence of self-harm by gender

The total prevalence of self-harm was 13.7%. Among all surveyed students, 7.1% reported that they had self-harmed more than once. No significant difference was found in the prevalence of self-harm between genders (P=0.553). Totally, the prevalence of self-harm decreased with age in girls (G=-0.163, P<0.001) but the prevalence of self-harm in boys seemed to be fluctuating with age though the association in boys was still statistically significant (G=-0.038, P=0.010). The gender differences existed in both earlier and older adolescence, but with different directions, within the adolescents younger than 16, the prevalence of self-harm was higher in girls than boys (=18.388, P<0.001), while the boys showed higher prevalence that girls when they were at older adolescence (=6.870, P=0.009). Girls who were in key schools were less vulnerable to self-harm compared with those in non-key schools (G=0.075, P=0.001) but the prevalence showed no difference between school types among boys (G=0.023, P=0.306). (about here comes the table1)

Univariate analysis of self-harm and drinking behaviors by gender

The boys were more likely to have early drinking experience than girls (41.8% in boys and 31.2% in girls, =392.253, P<0.001) and drinking behaviors were more popular among boys (23.1% of the boys reported recent alcohol use while 13.4% of the girls, =299.677, P<0.001). Drinking behaviors were associated with self-harm in both boys and girls. The frequency of self-harm was higher in early drinkers (Boys: G=0.338, P<0.001; Girls: G=0.507, P<0.001). The more severe the extent of drinking condition was, the more frequency of self-harm was found in both boys (G=0.345, P<0.001) and girls (G=0.475, P<0.001). Among

nge drinkers, the prevalence of self-harm was as high as

21.4% and 39.4% respectively. 24.0% of the girls with binge drinking experience reported multiple self-harm in the past 12 months, this prevalence was much higher than those without binge drinking experience (=572.930, P<0.001).

Gender disparity in the association between self-harm and drinking behaviors

The Log-binomial regression demonstrated that girls in older adolescence (15-19 years) were at lower risk of self-harm than girls in earlier adolescence (10-14 years) but this association was not found in boys (ORs were shown in Table 2). Participants with early drinking experiences had a higher risk for self-harm compared to those who did not (OR=1.854). Higher OR for self-harm was found among girls with early drinking experiences (1.863 vs 2.565). Both genders with any extent of drinking condition would increase the risk for self-harm. Girls who ever drunk (1.636 vs 2.211), were currently drinking (2.122 vs 3.400) and binge drinking (3.924 vs 6.357) had greater risk for self-harm than boys. All the ORs for self-harm mentioned above were shown in Table 2.

As shown in Table 3, *feeling down* was the most dangerous cause of self-harm (OR=4.607), followed by *customary chronic drinking* (OR=4.063), and *asked to drink by others* (OR=2.341). Gender differences in self-harm were found at the following reasons of drinking, *feeling down* (4.402 vs 5.742), *customary chronic drinking* (3.945 vs 5.460), *feeling delighted* (1.806 vs 2.615), *drinking with peers* (1.797 vs 2.693) and *other reasons* (1.588 vs 2.509).

Discussion

We found an obvious gender difference in the prevalence of self-harm in our study, and during the earlier age, the prevalence of self-harm was higher in girls than boys while boys exceed girls in the older age. However, in total sample, the difference tended to disappear. Our findings of earlier puberty was accordance with prior studies, their results across settings, despite the variety of methods used or differences in sampling, consistently find a greater prevalence of self-harm in girls, although both female and male youths are vulnerable[2, 10, 12, 13, 22, 30, 34]. However, our result of boys were partly consistent with Patton et al.'s researches that the later pubertal stage was associated with higher rate of self-harm and boys' pubertal stage was latter than girls'[14]. This pubertal stage difference in age increasing might result in different self-harm prevalence between boys and girls of earlier age or older age. O'Connor et al. found that the most common influence factor of self-harm was being influenced by other people, especially friends[13]. The fluctuation of self-harm prevalence in boys reflected that the boys might be influenced by girls.

A developmental gap between puberty and brain development was assumed to exist as the prefrontal cortex, the part of one's brain regulating cognitive control[35], was undergoing a thinning and structural transformation process during puberty period[36]. This process was related to enhancing the efficiency of the communication between neurons, the stability and precision of the synapses of the prefrontal cortex and was more significant in girls[36]. Because prefrontal cortex was responsible for generating and

maintaining the ability to adopt a cognitive tactics to reframe negative emotional stimuli, it could be speculated that the obvious decreasing rate of self-harm in girls might be based on this special process.

Our results demonstrated that the association between self-harm and drinking behaviors differed between genders. Drinking behaviors in girls seemed to have stronger association with self-harm than boys. Some researches on the metabolism of alcohol manifested that the ability to eliminate intracorporal ethanol was limited in female compared with male. The alcohol dehydrogenase (ADH), which was the enzyme catalyzing the phase I ethanol metabolism reaction, was less active in female than male[37]. Also, the low affinity of gastric χ-ADH of female resulted in the enhanced vulnerability of women to develop alcohol-related disease[38]. Some genotypes of aldehyde dehydrogenase (ALDH) were earlier inactivated among female, which might lead to more serious intolerance of alcohol in female than male[37]. Ness et al. conducted a converse research which was aimed to investigate the prevalence of alcohol abuse in those who had committed self-harm. Among them, more men were involved in alcohol use while alcohol abuse and self-injury were associated significantly in women. Alcohol abuse in female would increase the risk of death by subsequence suicide in female[24]. Berman et al. adopted the Self-Aggression Paradigm, a laboratory analog of non-suicidal deliberate self-harm, to prospect the acute effect of alcohol on the occurrence of self-harm. In this research, men were more readily to exert more self-harm analogical behaviors than women and the extent of self-harm was dose-dependent to the concentration of blood ethanol[17]. The long-term effect of chronic alcohol abuse and the acute effect of alcohol abuse may have separate effect on women and men, which needed further research to determine the different time phase property of the effect that drinking induced to the prevalence of self-harm.

China is a country where drinking is regarded as a kind of traditional culture. People drink when it comes to essential events from traditional festivals to commercial negotiation. For most adolescents, drinking alcohol was sometimes encouraged by their parents for its function of social communication in Chinese culture. Among those who were middle school students, the prevalence of ever using alcohol was 51.1% [33]. Gender difference was still obvious pertaining to drinking behaviors. Boys were 1.78 times more likely to be current drinkers than girls and 1.86 times more likely to have alcohol related problems[39]. Drinking has been always inhibited or at least, not encouraged for girls from cultural perspective. However, drinking is not always the way to handle negative situation among boys. They drink when they are happy, showing respect to others or just strutting their maturity. On the contrary, once women's alcohol abuse become severe, it will be regarded as a risk for children, families or even society's traditional moral problems[40]. A possible explanation for the difference of the association between drinking and self-harm among boys or girls is that occasional heavy drinking is almost normative in men according to the social context factors. Thus, the girls who drank are likely to be those who have difficulty in adapting to their environments and more readily to have sociopsychological problems.

Early drinking experience was popular among our subjects in our research, which was consistent with another longitudinal study focusing on the effect of early sipping or tasting. Evidence demonstrated that early sipping or tasting alcohol, even with parental permission, predicted increased frequency and [illegible] sed alcohol-related problems in late adolescence[41]. As our

study presented, more serious drinking behaviors were associated with higher rate of self-harm. This phenomenon was significant in both boys and girls, with girls more significant than boys. Researches demonstrated that anxiety and depression were more prevalent in female and both were associated with alcohol use disorder[42, 43]. In our study, the association between current drinking condition and the rate of self-harm may be dose-dependent. Though we did not find studies for adolescents to prove this relationship, Strine et al. conducted a research for adults and one of their results concluded that the severity of depression would elicit more binge drinking among women but not men[44]. From another perspective, depression was more readily found in women who drank larger quantities per drinking instead of men[45]. Hawton et al. claimed in his review of self-harm in adolescents that anxiety and depression both were risk factors for self-harm[5]. Thus, more serious drinking condition was associated with more prevalent self-harm in both boys and girls while this possible dose-dependent effect was stronger in girls. And this was also the reason why those who drank because of *feeling down*, *habit* were the two groups of people committed the highest prevalence of self-harm.

Our study still had several limitations. Firstly, it was a cross-sectional study which could not determine the causal relationship between drinking and self-harm. Secondly, our study was based on self-reported questionnaire which may be influenced by recall bias and reporting bias. However, the reliability and validity of our questionnaire had been proved and all the processes were under strict control. Thirdly, our study was based on the data collected from school samples, which may not represent those adolescents who were dropped out of school. One global research on adolescents physical activity based on school-going adolescents admitted that collecting data from out-of-school adolescents was quite impossible and this was a problem which needed to be urgently addressed[46]. Fortunately, China's enrolment rate of primary school-age children in 2013 was 99.7%. The junior high school enrolment rate was 98.3% and 91.2% for senior high school[47]. Our sample not only contained those who were from vocational schools but also extracted from Beijing, the capital and the cultural center of China. These all mean that our sample is still representative though no more than 10% of adolescents are not in our sampling frame.

Conclusion

Our study presents that self-harm behavior was significantly positively associated with drinking behaviors among middle school students. Self-harm might be identified by drinking behaviors, especially for girls. Although the prevalence of intemperate drinking behavior was lower in girls, the prevalence of self-harm was higher in those girls with active drinking condition. Moreover, it is important to focus on younger girls, who has the highest prevalence of self-harm. The intervention aimed to drinking behaviors might be also effective in preventing self-harm. Comprehensive action to prevent self-harm by identifying adolescents' drinking behaviors will require engagement and coordinated responses across multiple stakeholders including, but not limited to, schools, families and the community health workers.

Declarations

This survey was approved by Peking University's Medical Research Ethics Committee (IRB00001052-17010) with the consent of the participants and their parents. The privacy of all the participants was rigorously protected.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to data management of Peking University, China, but are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

CL and YS conceived and designed the study. CL carried out the initial analyses and prepared the first draft of the manuscript. SM and YS made language polishing of the manuscript. YS, JZ, DL, XY, SM and NM critically reviewed and revised the manuscript. YS, JD and RL conducted the research and collected the data. All authors read and approved the final manuscript.

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Tables

Table 1 Self-harm prevalence in different demographic groups

		Total	Frequency of self-harm				*G*	*P*
			Never	Once	Twice or three times	Four times or more		
Boys								
Age	12	537	480(89.4)	35(6.5)	12(2.2)	10(1.9)	-0.038	0.010
	13	2405	2060(85.7)	163(6.8)	98(4.1)	84(3.5)		
	14	2698	2277(84.4)	202(7.5)	127(4.7)	92(3.4)		
	15	2212	1904(86.1)	145(6.6)	90(4.1)	73(3.3)		
	16	3348	2896(86.5)	200(6.0)	128(3.8)	124(3.7)		
	17	3246	2857(88.0)	181(5.6)	118(3.6)	90(2.8)		
	18	1466	1280(87.3)	76(5.2)	61(4.2)	49(3.3)		
	19	190	163(85.8)	8(4.2)	9(4.7)	10(5.3)		
Setting	Urban	8100	7005(86.5)	495(6.1)	323(4.0)	277(3.4)	0.002	0.920
	Suburban	8003	6913(86.4)	515(6.4)	320(4.0)	255(3.2)		
School type	Key School	5761	5001(86.8)	352(6.1)	216(3.7)	192(3.3)	0.023	0.306
	Not Key School	10342	8917(86.2)	658(6.4)	427(4.1)	340(3.3)		
	Total	16103	13918(86.4)	1010(6.3)	643(4.0)	532(3.3)		
Girls								
Age	12	691	572(82.8)	62(9.0)	32(4.6)	25(3.6)	-0.163	<0.001
	13	2415	1979(81.9)	213(8.8)	143(5.9)	80(3.3)		
	14	2468	2044(82.8)	192(7.8)	156(6.3)	76(3.1)		
	14	2246	1923(85.6)	167(7.4)	106(4.7)	50(2.2)		
	15	3559	3126(87.8)	231(6.5)	135(3.8)	67(1.9)		
	17	3202	2844(88.8)	182(5.7)	121(3.8)	55(1.7)		
	18	1486	1351(90.9)	65(4.4)	43(2.9)	27(1.8)		
	19	191	176(92.1)	7(3.7)	8(4.2)	0(0.0)		
Setting	Urban	8141	6996(85.9)	557(6.8)	386(4.7)	202(2.5)	-0.024	0.274
	Suburban	8118	7020(86.5)	562(6.9)	358(4.4)	178(2.2)		
School type	Key School	6304	5508(87.4)	381(6.0)	269(4.3)	146(2.3)	0.075	0.001
	Not Key School	9955	8508(85.5)	738(7.4)	475(4.8)	234(2.4)		
Total		16259	14016(86.2)	1119(6.9)	744(4.6)	380(2.3)		

Table 2 Results of Log-binomial regression

Risk Factors	Total AORs	Girls AORs	Boys AORs	Interaction term *p*
Age[a]				
12	0.773(0.504, 1.185)	**2.274(1.362, 3.796)**	**0.761(0.496, 1.167)**	**0.002**
13	1.037(0.721, 1.492)	**2.364(1.444, 3.871)**	**1.025(0.712, 1.474)**	**0.009**
14	1.121(0.781, 1.607)	**2.242(1.369, 3.672)**	**1.111(0.774, 1.593)**	**0.027**
15	0.997(0.692, 1.436)	**1.889(1.150, 3.102)**	**0.990(0.687, 1.425)**	**0.045**
16	0.965(0.673, 1.383)	1.589(0.970, 2.603)	0.959(0.669, 1.374)	0.114
17	0.852(0.593, 1.224)	1.443(0.879, 2.367)	0.849(0.591, 1.218)	0.094
18	0.899(0.618, 1.308)	1.177(0.706, 1.963)	0.896(0.616, 1.304)	0.414
Drink condition[b]				
Non-recent alcohol use	1.680(1.492, 1.892)	**2.211(1.979, 2.471)**	**1.636(1.451, 1.844)**	**0.002**
Recent alcohol use	2.187(1.942, 2.464)	**3.400(3.054, 3.786)**	**2.122(1.882, 2.393)**	**<0.001**
Binge drinking	4.106(3.670, 4.594)	**6.357(5.707, 7.080)**	**3.924(3.498, 4.401)**	**<0.001**
Age of First Drink[c]				
<13	1.854(1.714, 2.006)	**2.565(2.376, 2.770)**	**1.863(1.721, 2.016)**	**<0.001**

[a] Controlling settings and school type, compared with the 19-age-old.

[b] Controlling setting, school type and age, compared with never drink.

[c] Controlling setting, school type and age, compare with ≥13.

Table 3 Results of Log-binomial regression (Reasons for drinking)

Reasons [a]	Total AORs	Girls AORs	Boys AORs	Interaction term *p* values
Feeling down	4.607(4.107, 5.168)	**5.742(5.184, 6.361)**	**4.402(3.916, 4.947)**	**0.008**
Customary chronic	4.063(3.356, 4.919)	**5.460(4.464, 6.677)**	**3.945(3.256, 4.780)**	**0.033**
Asked by others	2.341(1.859, 2.947)	2.799(2.085, 3.756)	2.270(1.803, 2.859)	0.398
No other drinks	2.204(1.723, 2.817)	2.849(2.225, 3.648)	2.163(1.691, 2.766)	0.161
Feeling delighted	1.890(1.603, 2.228)	**2.615(2.183, 3.132)**	**1.806(1.531, 2.131)**	**0.016**
Drinking with peers	1.899(1.711, 2.109)	**2.693(2.433, 2.981)**	**1.797(1.616, 1.998)**	**<0.001**
Curiosity	1.782(1.457, 2.179)	1.733(1.381, 2.174)	1.794(1.467, 2.194)	0.861
Others	1.634(1.320, 2.023)	**2.509(2.110, 2.984)**	**1.588(1.282, 1.967)**	**0.002**

[a] Controlling for age, settings and school type, compared with never drink.

Figures

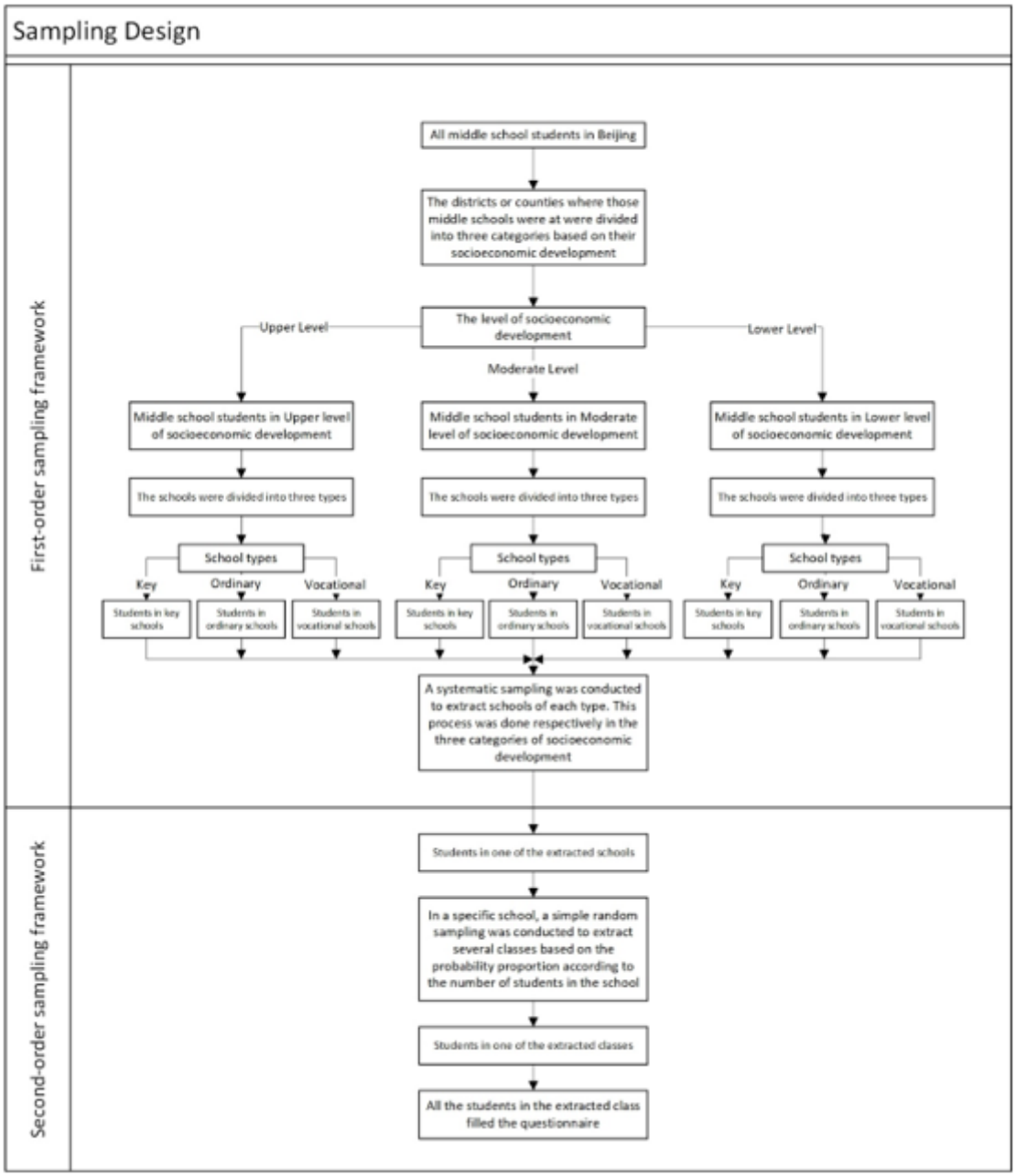

Figure 1

The sampling process of Beijing Youth Health Risk Behaviors Surveillance Survey, 2014

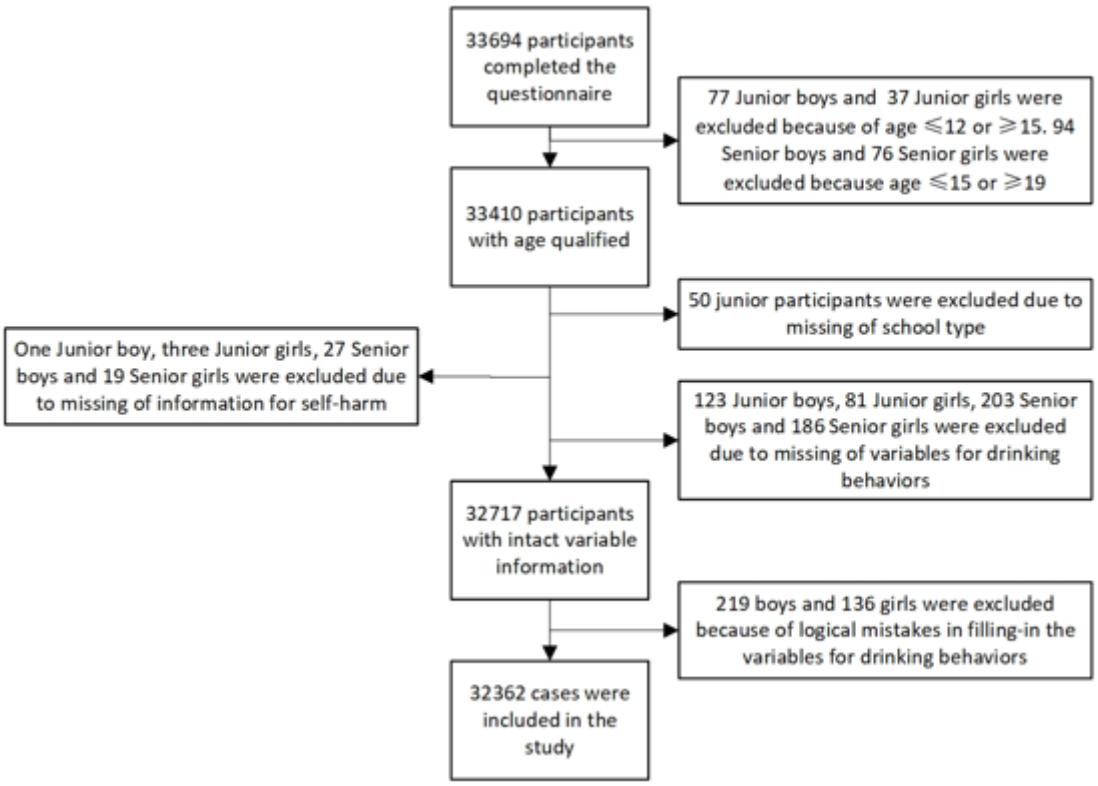

Figure 2

The flowchart of participants including in the analysis

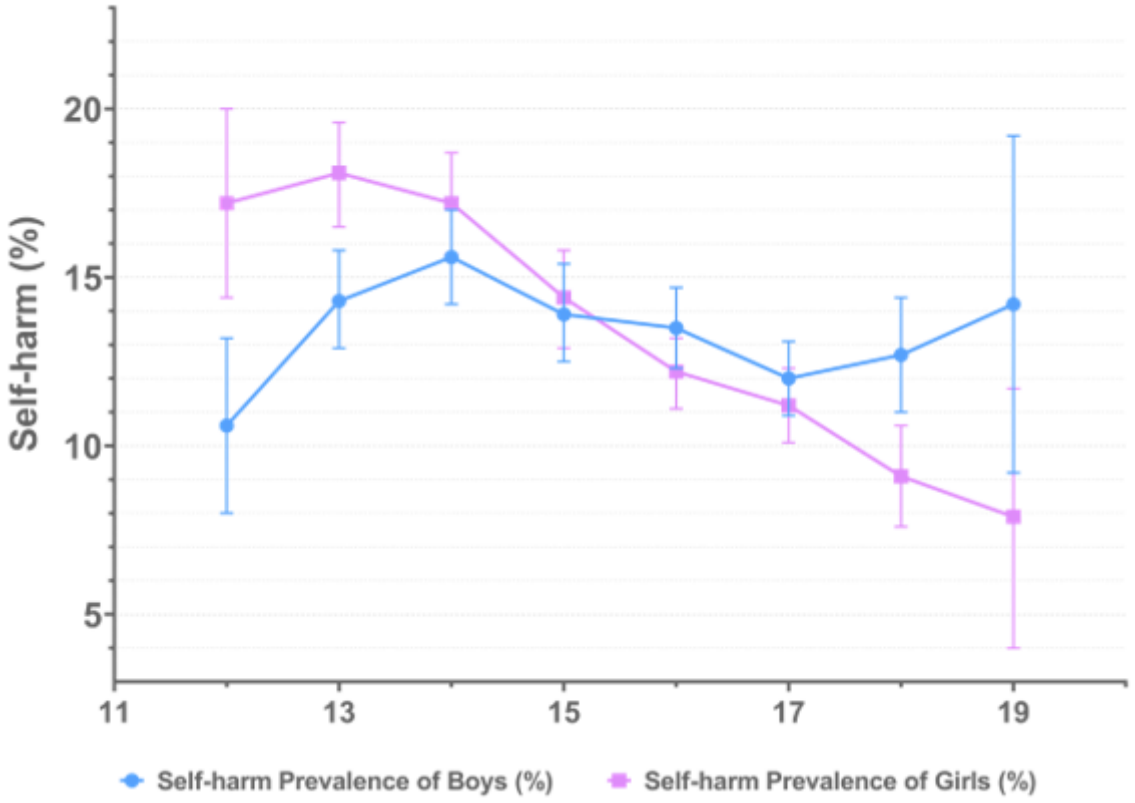

Figure 3

The prevalence of self-harm in different ages.

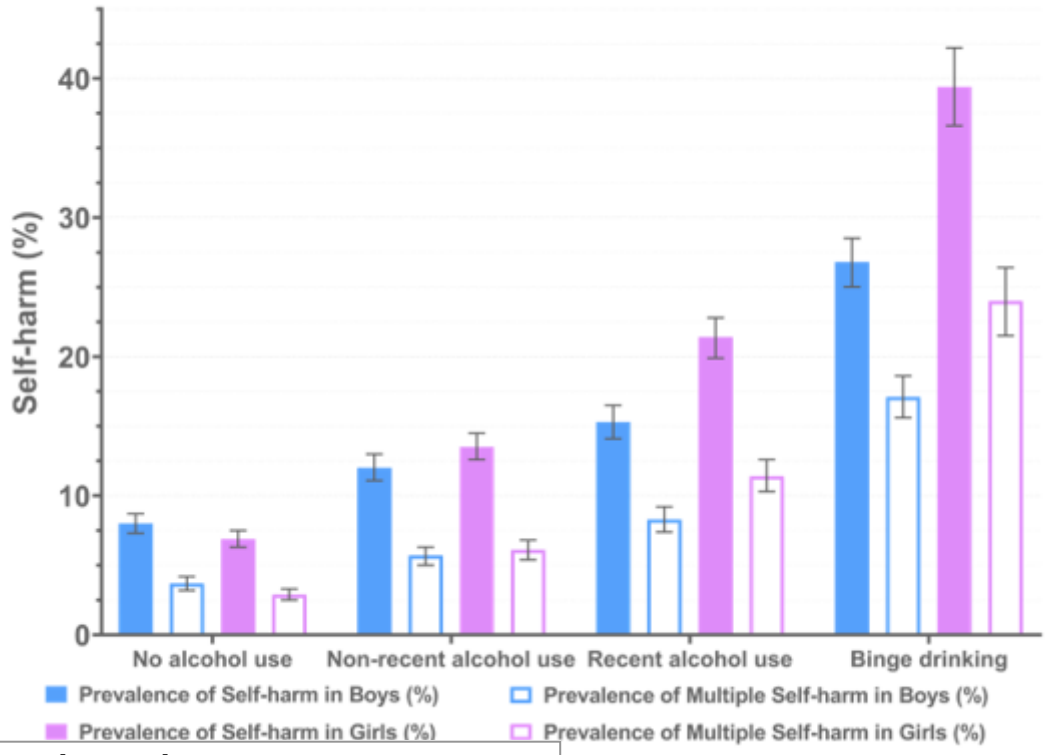

Figure 4

The prevalence of self-harm and multiple self-harm in different groups of drinking condition by gender.