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Sexual minority status and suicidal behavior among Chinese adolescents: Findings from a nationally representative sample

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Abstract

Objectives: Suicide problems among sexual minority adolescents have raised worldwide concern in recent decades, and previous Western studies have demonstrated that sexual minority status is associated with adolescent suicidality. However, whether this association exists in Chinese adolescents remains unknown. This study aimed to estimate the prevalence of suicidality and examine the association between sexual minority status and suicidal behavior among Chinese adolescents.
Design: Cross-sectional survey.
Setting: A total of 506 high schools in seven provinces of China.
Participants: A total of 150,822 students in grades 7-12 completed the questionnaires, and 123,459 students who reported being aware of their sexual orientation were included.
Main outcome measures: Suicidal ideation, suicide attempts and sexual attraction.
Results: Sexual minority adolescents reported higher rates of both suicidal ideation (35.22%) and suicide attempts (10.21%) than their heterosexual peers. The prevalence of suicidal ideation was more frequently reported in same-sex attraction females (30.40%) and both-sex attraction females (42.28%) than same-sex attraction males (21.59%) and both-sex attraction males (34.69%), respectively. For males and females, same-sex attraction and both-sex attraction adolescents were more likely to report suicidal ideation and suicide attempts than their heterosexual peers. Across all sexual minority statuses stratified by sex, both-sex attraction males reported the greatest odds for suicide attempts (OR=3.88, 95% CI: 2.87-5.24), and both-sex attraction females reported the greatest odds for suicidal ideation (OR=2.65, 95% CI: 2.45-2.87).
Conclusions: Sexual minority is associated with a higher risk of suicidality among Chinese adolescents; both-sex attraction males and females were associated with an increased risk of suicidality than their same-sex attraction peers. Therefore, our findings emphasize the urgent need to develop targeted interventions to prevent and

effectively address suicide-related problems among Chinese sexual minority adolescents.

Strengths and limitations of this study:

- Our study estimate the prevalence of suicidality and examine the association between sexual minority status and suicidal behavior among Chinese adolescents
- A large-scale, nationally representative sample rendered sufficient statistical power and conduct the between-groups analyses.
- Due to the cross-sectional design, no causal and temporal relationships could be observed between sexual minority status and suicidal behavior.
- Our study sample included only school students and did not include adolescents who dropped out of school or were absent from school on the day the survey was administered.

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Data sharing statement: No additional data are available.

Introduction

Suicidal behavior, which includes suicidal ideation, suicide attempts, and completed suicide, has raised health concerns among sexual minority (i.e., gay, lesbian, and bisexual) adolescents in recent decades. Compared with their heterosexual peers, sexual minority adolescents have been identified in numerous studies as a high-risk group for suicidal behavior.[1-4] A previous finding in the Youth Risk Behavior Surveys (YRBSs) showed that approximately 42.8% and 29.4% of sexual minority adolescents reported having suicidal ideation and suicide attempts, respectively.[5] Studies of secondary school students in Europe reported a lifetime prevalence of 35.4% for

suicidal ideation and 15.4% for suicide attempts among sexual minorities.[6] Other relevant studies, using data from a nationally representative survey, reported that both male and female sexual minority adolescents were more likely to report suicidal ideation and suicide attempts than their heterosexual peers.[1, 3]

To date, most current related studies have been conducted in Western or developed countries. China, being regarded as a country with a high suicide rate, accounts for 21% of the world's population and 30-40% of the world's suicides,[7] and numerous studies have reported the suicide risk in the Chinese general population.[8-10] Since Chinese society was dominated by Confucian ideology, people were expected to derive their identity from family roles and having children.[11] Sexual minority was a large challenge to the Confucian Chinese culture (such as filial piety), and Chinese sexual minorities were under greater stress than their counterparts in Western societies. However, few studies have compared the suicide risk of heterosexual and sexual minorities in a representative sample among Chinese adolescents. Previous studies have mainly focused on Chinese man who have sex with men (MSM)[12, 13] or sexual minority in certain regions of China.[14] Nationally representative data regarding suicide prevalence in Chinese sexual minority adolescents are limited. Whether sexual minority status is independently associated with suicide risk among Chinese adolescents remains unknown. Several studies from Western countries have indicated that individuals with certain sexual minority statuses (such as bisexual identity) have the highest levels of suicide risk across all sexual minority statuses,[15, 16] and whether there is an elevated risk of suicide among Chinese bisexual identity adolescents is

unknown. Therefore, understanding the relationship between sexual minority status and suicide risk may comprehensively reveal the prevalence of suicidal behavior among Chinese sexual minorities, which will contribute to the detection of suicidal behavior and provide effective suicide-related preventive interventions.

We conducted this large-scale study to estimate the prevalence of suicidality among Chinese sexual minority adolescents, to evaluate the associations of sexual minority statuses with suicidal ideation and attempts, and to investigate whether these associations vary in relation to various sexual minority statuses.

Methods

2.1 Study design and participants

We utilized data from the 2015 School-Based Chinese Adolescents Health Survey (SCAHS),[17, 18] an ongoing, large-scale health-related behavior survey among Chinese adolescents (grades 7-12). The SCAHS has been conducted every two years since 2007, and the 2015 survey was the most recent version conducted in seven Chinese provinces.[19]

In the 2015 SCAHS, students were selected by a 4-stage, stratified-cluster, random-sampling method. In stage 1, all 34 province-level regions in China were divided of China into four regional stratifications (East China, West China, South China, and North China), and we then selected two representative provinces from each regional stratification by simple randomization (only one province from East China). In stage 2, cities in each representative province were divided into three

economic stratifications (high-level, middle-level, and low-level) by per capita GDP (Gross Domestic Product). Based on the proportions of these three types of cities, six cities were randomly selected from each representative province. In stage 3, schools were divided into three categories: junior high schools (i.e., grades 7-9), senior high schools (i.e., grades 10-12), and vocational high schools (i.e., grades 7-12). Based on the proportions of these three types of schools, four junior high schools, four senior high schools, and four vocational high schools were randomly selected from each representative city (506 schools agreed to participate in this study). In stage 4, two classes were randomly selected from each grade within the selected schools, and all available students in the selected classes were invited to participate in this study voluntarily. In total, 150,822 students completed the questionnaires (response rate of 95.93%).

It remains unclear whether "unsure" should be classified as sexual minorities, and the "unsure" respondents may be quite different from other types of sexual minority status respondents regarding suicidal behaviors.[20] Thus, for our study, students who belonged to the "unsure" category were not included in the analysis. Therefore, a total of 123,459 students were included in the analysis.

2.2 Data collection

All students from the chosen classes were distributed a standardized self-administered questionnaire on the survey day, and they answered it in the classroom during a normal class period (40 or 45 minutes). To protect the privacy of the students, the questionnaire was completed by each student participant anonymously without the

presence of teachers or other school personnel (to avoid any potential information bias). All data were collected from November 2014 to January 2015.

2.3 Ethics statement

This study was approved by the Sun Yat-Sen University School of Public Health Institutional Review Board. Written informed consent was obtained from each participating student who was at least 18 years old, and written informed consent was obtained from one of the student's parents (or legal guardian) if the student was under 18 years old.

2.4 Measures

2.4.1 Suicidal ideation and suicide attempts

Suicidal ideation was defined as responding "1 or more times" to the following question: "During the past 12 months, how many times did you seriously consider attempting suicide?" Suicide attempts were assessed by asking students to rate on a scale of zero, once, or more: "During the past 12 months, how many times did you actually attempt suicide?"[21-23]

2.4.2 Sexual minority status

Sexual minority was defined as persons who were sexually attracted to people of their own sex; have sexual relations with people of their own sex; or identify as gay, lesbian, bisexual, or queer. Individuals who occupied one or more identities were defined as sexual minority status.[24] Sexual minority status was measured by asking students the following question regarding sexual attraction: "In a romantic relationship, which kind of person are you attracted to?" Response options included

the following: (1) opposite sex, (2) same sex, (3) equally opposite and same sex, and (4) unsure.[25] We used these questions and the sex of respondents to create the following categories: (1) heterosexual, (2) same-sex attraction (SSA), (3) both-sex attraction (BSA), and (4) unsure. Students who belonged to categories (2) and (3) were classified as sexual minority.

2.4.3 Demographic variables

Factors previously reported to be associated with suicidal behavior in sexual minority adolescents were taken into consideration.[1, 3, 26] Demographic variables included sex, age, bullying experience, academic pressure, household socioeconomic status (HSS), current smoking, and current drinking.

After reading a brief definition of bullying from the Olweus Bully/Victim Questionnaire, adolescents were asked: "How often have you been bullied (kicked, excluded intentionally from participating, made fun of with sexual jokes, etc.) at school in the past 30 days?"[27] Answers were given on a 3-point scale as follows: (1) never, (2) sometimes or rarely (one or two times), or (3) often (more than three times). Students reporting a frequency of "often" in the past 30 days were classified as bullied.[28] Academic pressure was assessed based on the student's self-rating concerning their school work; responses were coded as follows: (1) none, (2) less, or (3) medium or great. HSS was measured by asking about the student's perception of his or her household's current socioeconomic status; responses were coded as follows: (1) very good, (2) good, and (3) fair or poor. Current smoking was measured by asking the following question: "During the past 30 days, on how many days did you

smoke cigarettes?" Students who selected answers indicating 1 or more days were classified as current smokers.[29, 30] Current drinking was assessed by the following question: "During the past 30 days, on how many days did you drink alcohol?" Students who selected answers indicating 1 or more days were classified as current drinkers.[31]

2.5 Statistical analysis

Prevalence estimates and logistic regression analyses used appropriate sampling weights (adjusting for student's grade, student's sex, and school location) and estimation procedures that accounted for the complex sampling design. Taylor series estimation methods were utilized to obtain proper standard error estimates. First, descriptive analyses were conducted to describe the demographic characteristics and prevalence of suicidality. Second, Rao-Scott Chi-square tests and one-way ANOVA were used to compare the differences in demographic characteristics and suicide rates between groups. Third, univariate logistic regression models were performed to explore the associations between sexual minority status and suicidal ideation and suicide attempts without the confounding effects of sex. Additional multivariate models sequentially adjusted for age, bullying experience, academic pressure, HSS, current smoking and current drinking. Based on previously reported studies,[9, 10] age, school environment (e.g., bullying experience), socio-family environment (e.g., academic pressure and HSS), and unhealthy behaviors (e.g., smoking and drinking) were associated with suicidal behaviors in China, and all were added as covariates to determine the independent associations of sexual minority status related to suicidality.

OR (Odds ratios) and 95% CI (confidence intervals) were obtained from logistic regression models. *P*-values less than 0.05 were considered statistically significant (tested 2-sided) for regression analysis. The alpha level for paired comparison was set by the Bonferroni correction. All statistical analyses were conducted using SAS 9.4 (SAS Institute, Inc., Cary, NC, USA).

Results

3.1 Demographic characteristics

Basic descriptive statistics are shown in **Table 1**. Of the total sample, 95.01% were heterosexual, and 4.99% were sexual minority. The mean (SE) age of the adolescents was 15.30 (0.49) years. More female students (58.63%) were reported as sexual minority than male students (41.37%), and a higher proportion of sexual minority (16.11%) students reported school bullying experiences during the past 30 days compared with their heterosexual peers (7.97%). Additionally, academic pressure, HSS, smoking and drinking between heterosexual and sexual minority adolescents were significantly different.

3.2 Prevalence of suicidality

As shown in **Table 1**, sexual minority students reported higher rates of both suicidal ideation and suicide attempts than heterosexual students. For male adolescents (**Table 2**), the weighted prevalence of suicidal ideation was more frequently reported in sexual minority (SSA: 21.59%; BSA: 34.69%) students than that in their heterosexual peers (14.50%). After paired comparison, BSA students reported the highest rate of

suicidal ideation among male adolescents. The weighted prevalence of admitting suicide attempts were higher in sexual minority adolescents (SSA: 6.91%; BSA: 12.18%) than that in their heterosexual peers (2.17%); however, no significant differences were found between SSA and BSA students.

For female adolescents (**Table 2**), the weighted prevalence of suicidal ideation was more frequently reported in sexual minority (SSA: 30.40%; BSA: 42.28%) students than that in their heterosexual peers (18.85%). After paired comparison, BSA students reported the highest rate of suicidal ideation among female adolescents. The weighted prevalence of admitting suicide attempts were higher in sexual minority adolescents (SSA: 8.92%; BSA: 10.86%) than that in their heterosexual peers (3.04%); however, no significant differences were found between SSA and BSA students.

Among male and female adolescents, the weighted prevalence of suicidal ideation was more frequently reported in SSA females (30.40%) and BSA females (42.28%) than SSA males (21.59%) and BSA males (34.69%), respectively. However, there were no significant differences in the weighted prevalence of admitting suicide attempts between SSA males and SSA females, and BSA males and BSA females, among male and female adolescents, respectively.

3.3 Associations between sexual minority status and suicidal ideation and suicide attempts

As shown in **Table 3**, for male adolescents, unadjusted analyses (model 1) showed that SSA and BSA were positively associated with suicidal ideation and suicide attempts. Adjusting for bullying experience, academic pressure, HSS, current smoking,

and current drinking attenuated OR estimates, and the differences remained statistically significant (model 2). SSA (OR=1.57, 95% CI: 1.28-1.92) and BSA (OR=2.43, 95% CI: 2.04-2.90) students were more likely to report suicidal ideation than their heterosexual peers. Compared with heterosexual peers, SSA (OR=3.10, 95% CI: 2.28-4.20) and BSA (OR=3.88, 95% CI: 2.87-5.24) males were significantly more likely to report at least one suicide attempts. BSA males reported the greatest odds for suicide attempts across all sexual minority statuses stratified by sex.

For female adolescents, unadjusted analyses (model 1) showed that SSA and BSA were positively associated with suicidal ideation and suicide attempts. Adjusting for bullying experience, academic pressure, HSS, current smoking, and current drinking attenuated OR estimates, and the differences remained statistically significant (model 2). SSA (OR=1.40, 95% CI: 1.28-1.54) and BSA (OR=2.65, 95% CI: 2.45-2.87) females were more likely to report suicidal ideation than their heterosexual peers. Compared with heterosexual students, SSA (OR=1.94, 95% CI: 1.43-2.63) and BSA (OR=2.64, 95% CI: 2.22-3.14) females were significantly more likely to report at least one suicide attempts. BSA females reported the greatest odds for suicidal ideation across all sexual minority statuses stratified by sex.

Discussion

Like many studies in Western countries, we determined that Chinese sexual minority adolescents have a higher risk of suicidal ideation and suicide attempts than their heterosexual peers; both-sex attraction males and females were associated with an

increased risk of suicidality. To our knowledge, this study is the first to utilize nationally representative data to explore the association between sexual minority status and suicidal behavior among Chinese adolescents.

Consistent with previous findings among Western adolescents,[1-3] our results additionally revealed that sexual minority adolescents had a higher prevalence of both suicidal ideation and suicide attempts than their heterosexual peers. Compared with a community-based study conducted in sexual minority youths from three Asian cities (Hanoi, Shanghai, and Taipei),[14] the prevalence of suicidality in our sexual minority samples was similar to that in the Taipei samples; however, the prevalence of suicidality in our sexual minority samples for suicidal ideation and suicide attempts was higher than those in the Shanghai and Hanoi samples. The variation in results may derive from the different sample sources and age structures. Our findings provide population-based evidence of the prevalence of suicidal behavior among Chinese sexual minorities, which is useful for identifying high-risk adolescents who may be at risk of suicide.

Furthermore, we found that, compared with their heterosexual peers, Chinese sexual minority adolescents were associated with an increased risk of suicidality after stratification by sex. To our knowledge, due to insufficient sample sizes, most previous studies combined individuals of different sexual minority statuses into one category without considering sex stratification, which may obscure the estimates of suicide risk among high-risk adolescents.[15, 32] Our study is the first to utilize a large, nationally representative sample to explore the association between sexual minority

status and suicidal behavior among Chinese adolescents grouped according to sexual minority status and stratified by sex. Our results are consistent with a previous Australian national study that reported a higher risk of suicidal ideation and suicide attempts among homosexual males and bisexual females.[15] Although the associations of bisexual males with suicidal ideation and homosexual females with suicide attempts were not statistically significant in their study, our results determined that BSA males were associated with an increased risk of suicidal ideation, and SSA females were associated with an increased risk of suicide attempts. The variation in results may derive from the different population characteristics and measures of sexual minority statuses. One possible mechanism to explain the association between sexual minority status and suicide risk may be related to the experience of minority stress.[33] According to the Minority Stress Model, sexual minority individuals may experience minority stressors (e.g., prejudice events, internalized homophobia, etc.). The experience of these stressors is related to lower well-being and higher levels of suicidal ideation.[34] Previous results from a 2011 National School Climate Survey indicated that over 60-80% of sexual minority students reported being verbally harassed, and 40% of students experienced physical violence at school during the past year.[35] Experiences such as being threatened or injured are directly related to suicidality among sexual minority adolescents.[36] In current Chinese society, stigma against non-heterosexual individuals persists, and a large portion of the general population shows intolerant attitudes toward sexual minorities.[37] In our study, we additionally found that Chinese sexual minorities have a higher prevalence of bullying

experiences (**Table 1**) than their heterosexual peers. Our results suggest that a negative school environment may play a potential role in the association between sexual minority status and suicidal behavior among Chinese adolescents.

In addition, the highest risk of suicidal ideation and suicide attempts was determined for BSA adolescents in our study. One possible explanation is that bisexual identified individuals may experience more psychological distress and mental health problems than homosexuals and heterosexuals due to their belief that they do not belong to a particular group; Furthermore, they may suffer from minority stress by both homosexuals and heterosexuals, which makes them more isolated and vulnerable to chronic stress and could lead to an increased risk of suicide.[38]

Therefore，early detection and intervention programs (such as YRBSs) are urgently needed for Chinese sexual minority adolescents to provide more social support services (e.g., Gay-Straight Alliance groups and Parents and Friends of Lesbians and Gays) as they cope with minority stress.[39] Furthermore, practitioners (e.g., psychologists, psychiatrists, counselors, and social workers) should specifically focus on suicide risk among both-sex sexual minority status adolescents due to their weaker collective identity. By increasing understanding and acceptance of both-sex sexual minority status, we may be able to help those high-risk individuals cope with mental health problems.[40]

There are some noteworthy limitations that should be considered that would provide important directions for future research. First, because of the cross-sectional design, our study is limited to one time point of data collection, and no causal and temporal

relationships could be observed between sexual minority status and relational factors regarding suicidal behavior. Second, our study used a structured, self-rating questionnaire to collect data that could not completely rule out the possibility of recall bias. Third, our study sample included only school students and did not include adolescents who dropped out of school or were absent from school on the day the survey was administered. Despite these limitations, the primary strengths of our study are that it includes a large-scale, nationally representative sample of Chinese adolescents, rendering us sufficient statistical power, and could avoid over-sampling of the sexual minority population. Furthermore, to the best of our knowledge, our study is the first to estimate the association between sexual minority status and suicidal behavior among Chinese adolescents.

Conclusions

Suicide problems among sexual minority adolescents have raised global health concerns. However, few related studies have been conducted among Chinese adolescents. Findings from our study suggest that sexual minority adolescents are associated with a higher risk of suicidal behavior among Chinese adolescents. Compared with their same-sex attraction peers, both-sex attraction males and females were associated with an increased risk of suicidality. Based on the results of our study, conducting early detection and intervention programs is suggested for Chinese sexual minorities (especially both-sex attraction individuals) to more effectively and pertinently prevent suicide-related problems. Future studies that focus on the risk

factors, mechanisms and interventions of suicidal behavior in Chinese sexual minority adolescents are warranted.

Contributors' Statement:
Ciyong Lu conceptualized and designed the study, reviewed and revised the manuscript and approved the final manuscript as submitted. Yeen Huang and Pengsheng Li conceptualized and designed the study, coordinated and supervised data collection, carried out the initial analyses, drafted the initial manuscript, and approved the final manuscript as submitted. They contributed equally to this study. Lan Guo carried out the analyses and interpreted data, reviewed and revised the manuscript and approved the final manuscript as submitted. Xue Gao, Yan Xu, Guoliang Huang, and Xueqing Deng designed the data collection instruments, coordinated and supervised data collection, reviewed and revised the manuscript, and approved the final manuscript as submitted. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Table 1. Demographic characteristics of heterosexual and sexual minority Chinese adolescents (N=123,459).

Variable	Total No. (Weighted %)	Heterosexual No. (Weighted %)	Sexual minority No. (Weighted %)	*P*-value
Total	123,459 (100.00)	116,774 (95.01)	6,685 (4.99)	
Suicidal ideation				<0.001
No	100,772 (82.51)	96,513 (83.44)	4,259 (64.78)	
Yes	22,687 (17.49)	20,261 (16.56)	2,426 (35.22)	
Suicide attempts				<0.001
No	119,515 (97.04)	113,543 (97.42)	5,972 (89.79)	
Yes	3,944 (2.96)	3,231 (2.58)	713 (10.21)	
Sex				<0.001
Male	59,826 (52.20)	57,343 (52.77)	2,483 (41.37)	
Female	63,633 (47.80)	59,431 (47.23)	4,202 (58.63)	
Age (year)[a]	15.30 (0.49)	15.31 (0.49)	15.09 (0.44)	0.0428
Bullying experience				<0.001
No	113,435 (91.62)	107,767 (92.03)	5,668 (83.89)	
Yes	10,024 (8.38)	9,007 (7.97)	1,017 (16.11)	
Academic pressure				<0.001
None	18,111 (14.99)	17,051 (14.93)	1,060 (16.08)	
Less	55,709 (45.75)	53,061 (46.06)	2,648 (39.93)	
Medium or great	49,639 (39.26)	46,662 (39.01)	2,977 (43.98)	
HSS[b]				<0.001
Very good	24,268 (21.91)	22,812 (21.79)	1,456 (24.23)	
Good	75,054 (60.86)	71,306 (61.15)	3,748 (55.36)	
Fair or poor	24,137 (17.23)	22,656 (17.07)	1,481 (20.41)	
Current smoking				<0.001
No	116,144 (93.88)	109,954 (93.94)	6,190 (92.63)	
Yes	7,315 (6.12)	6,820 (6.06)	495 (7.37)	
Current drinking				<0.001
No	101,981 (82.60)	96,909 (82.91)	5,072 (76,63)	
Yes	21,478 (17.40)	19,865 (17.09)	1,613 (23.37)	

[a] Age data are presented as the means (SE).

[b] HSS: Household socioeconomic status.

Table 2. Prevalence of suicidal ideation and suicide attempts among heterosexual and sexual minority adolescents, by sex (N=123,459).

	Males (N=59,826)			Females (N=63,633)		
	Heterosexual=1	SSA=2	BSA=3	Heterosexual=4	SSA=5	BSA=6
	No. (W %)	No. (W %)	No. (W %)	No. (W %)	No. (W %)	No. (W %)
Suicidal ideation						
No	48,572 (85.50)	795 (78.41)	919 (65.31)	47,941 (81.15)	706 (69.60)	1,839 (57.72)
Yes	8,771 (14.50)	243 (21.59)	526 (34.69)	11,490 (18.85)	309 (30.40)	1.348 (42.28)
Suicide attempts						
No	55,991 (97.83)	962 (93.09)	1,267 (87.82)	57,552 (96.96)	923 (91.08)	2,820 (89.14)
Yes	1,352 (2.17)	76 (6.91)	178 (12.18)	1,879 (3.04)	92 (8.92)	367 (10.86)

Note: All analyses are weighted, frequencies are unweighted and prevalence is weighted;
SSA=same-sex attraction; BSA=both-sex attraction; W %=Weighted prevalence;
The alpha level for paired comparison was set at P=0.006 after the Bonferroni correction.

Paired comparison for suicidal ideation:

2>1, P<0.001 4>1, P<0.001 5>4, P<0.001
3>1, P<0.001 5>2, P<0.001 6>4, P<0.001
3>2, P<0.001 6>3, P=0.002 6>5, P<0.001

Paired comparison for suicide attempts:

2>1, P<0.001 4>1, P<0.001 5>4, P<0.001
3>1, P<0.001 5>2, P=0.119 6>4, P<0.001
3>2, P=0.011 6>3, P=0.408 6>5, P=0.0672

Table 3. Associations of sexual minority status with suicidal ideation and suicide attempts among Chinese adolescents, by sex (N=123,459).

	Model 1[a]			Model 2[b]		
	OR	**95% CI**	***P***	**OR**	**95% CI**	***P***
Suicidal ideation						
Males						
Heterosexual	1.0			1.0		
SSA	1.62	1.30-2.03	<0.05	1.57	1.28-1.92	<0.05
BSA	3.14	2.60-3.79	<0.001	2.43	2.04-2.90	<0.001
Females						
Heterosexual	1.0			1.0		
SSA	1.86	1.65-2.10	<0.05	1.40	1.28-1.54	<0.01
BSA	3.16	2.93-3.41	<0.001	2.65	2.45-2.87	<0.001
Suicide attempts						
Males						
Heterosexual	1.0			1.0		
SSA	3.26	2.40-4.44	<0.05	3.10	2.28-4.20	<0.05
BSA	6.25	4.46-8.75	<0.001	3.88	2.87-5.24	<0.001
Females						
Heterosexual	1.0			1.0		
SSA	3.14	2.37-4.15	<0.001	1.94	1.43-2.63	<0.05
BSA	3.90	3.13-4.84	<0.001	2.64	2.22-3.14	<0.001

Note: SSA=same-sex attraction; BSA=both-sex attraction; CI=Confidence interval; OR=Odds ratio.

[a]Unadjusted.

[b]Adjusted for age, bullying experience, academic pressure, household socioeconomic status, current smoking and current drinking.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found Page 1
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Page 2-3
Objectives	3	State specific objectives, including any prespecified hypotheses Page 4
Methods		
Study design	4	Present key elements of study design early in the paper Page 4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Page 5
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up NA. *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls NA. *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants Page 4-5
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Page 6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Page 6-8
Bias	9	Describe any efforts to address potential sources of bias Page 6
Study size	10	Explain how the study size was arrived at Page 4-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why

		Page 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Page 8
		(*b*) Describe any methods used to examine subgroups and interactions NA.
		(*c*) Explain how missing data were addressed NA.
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy Page 8
		(*e*) Describe any sensitivity analyses NA.

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Page 9
		(b) Give reasons for non-participation at each stage NA.
		(c) Consider use of a flow diagram NA.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Page 9-10
		(b) Indicate number of participants with missing data for each variable of interest NA.
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount) NA.
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time NA.
		Case-control study—Report numbers in each exposure category, or summary measures of exposure NA.
		Cross-sectional study—Report numbers of outcome events or summary measures Page 10-11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Page 10-11
		(*b*) Report category boundaries when continuous variables were categorized NA.
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA.
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses NA.
Discussion		
Key results	18	Summarise key results with reference to study objectives Page 11-12
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Page 14-15
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Page 12-14
Generalisability	21	Discuss the generalisability (external validity) of the study results Page 15

Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Page 2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Sexual minority status and suicidal behavior among Chinese adolescents: A large-scale cross-sectional study

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Abstract

Objectives: Suicidality among sexual minority adolescents have raised concern worldwide in recent decades, and previous Western studies have demonstrated that sexual minority status is associated with adolescent suicidality. However, whether this association exists in Chinese adolescents remains largely unknown. This study aimed to estimate the prevalence of suicidality and examine the associations between sexual minority status and suicidal behavior among Chinese adolescents.
Design: Cross-sectional survey.
Setting: A total of 506 high schools in seven provinces of China.
Participants: A total of 150,822 students in grades 7-12 who completed the questionnaires (response rate of 95.93%) were included.
Main outcome measures: Suicidal ideation, suicide attempts and same-sex romantic attraction.
Results: Of the 150,822 adolescents analyzed, 4.1% self-reported as sexual minorities, and 17.3% were unsure. Same-sex romantic attraction (males: 6.9%; females: 8.9%) and both-sex romantic attraction (males: 12.2%; females: 10.9%) adolescents reported a higher prevalence of past-year suicide attempts than heterosexual adolescents (males: 2.2%; females: 3.1%). Compared with their heterosexual peers, sexual minority adolescents were more likely to have past-year suicide attempts, and larger effects of past-year suicide attempts were reported in both-sex romantic attraction adolescents (males: AOR=3.83, 95% CI: 2.85-5.14; females: AOR=2.59, 95% CI: 2.19-3.06).
Conclusions: Our study suggested that Chinese sexual minority adolescents were associated with a higher risk of suicidality, and those with both-sex romantic attraction had an especially high risk in this population. These findings emphasized the urgent need to develop targeted interventions to effectively address suicide-related problems among Chinese sexual minority adolescents.

Strengths and limitations of this study:

- Our study estimated the prevalence of suicidality and examined the association between sexual minority status and suicidal behavior among Chinese adolescents
- A large-scale, nationally representative sample provided sufficient statistical power, and between-groups analyses were conducted.
- Due to the nature of the cross-sectional data, interpretation of the direction of the observed associations is limited.
- Our study sample included only students attending school and did not include adolescents who dropped out of school or were absent from school on the day the survey was administered.

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Conflicting interests: The authors have no conflicts of interest relevant to this article to disclose.

Ethics approval: The study protocol was approved by the Institutional Review Board of Sun Yat-sen University, School of Public Health.

Data sharing statement: No additional data are available.

Introduction

Suicidal behavior, which includes suicidal ideation, suicide attempts, and completed suicide, has raised concerns about the health of sexual minority adolescents (i.e., adolescents who experience same-sex attraction, engage in same-sex sexual behavior, or self-identify as gay, lesbian, bisexual) in recent decades. Minority stress theory[1] suggests that difficulties in dealing with minority stressors (prejudice, discrimination, and stigma) associated with same-sex orientation may lead to substance abuse[2], depression[3], and even suicide[4] among sexual minorities. Compared with their heterosexual peers, sexual minority adolescents have been identified in numerous studies as a high-risk group for suicidal behavior.[5] Regarding the associations of sexual minority status with suicidal behavior, most related studies have been

conducted in Western or developed countries. A previous findings from the Youth Risk Behavior Survey (YRBS) in the United States showed that approximately 42.8% and 29.4% of sexual minority adolescents reported having past-year suicidal ideation and suicide attempts, respectively.[6] Two longitudinal studies from the United States and Norway showed that sexual minority adolescents were twice and four times more likely, respectively, to have attempted suicide in the past year than their heterosexual peers.[5,7] Moreover, a previous systematic review indicated that bisexual individuals from developed countries have the highest levels of suicide risk among sexual minorities.[8] Those findings thus identified sexual minority status as a risk factor for adolescent suicidality in Western or developed countries.

China as the largest developing country with a high suicide rate, accounts for 21% of the world's population and 30-40% of the world's suicides,[9] and although numerous studies focus on suicide risk in Chinese adolescents,[10,11] little attention has been devoted to sexual minorities. Previous studies in China have shown that 4.6%-12.6% of gay adults have reported lifetime suicide attempts[12,13] and sexual minority youth from Taipei were almost twice as likely to have past-year suicidal ideation as their heterosexual peers.[14] It is well known that the cultural background of Western countries is different from that of Asian countries, especially China, where Confucianism has been an influence for thousands of years and families and social climates exert intense pressure on individuals to marry and have children to maintain their family lineages.[15] Thus, sexual minorities are recognized as a major impediment to continuing the family line and maintaining a family's reputation,[16] and

homosexuals in China may experience more minority stressors and higher levels of mental and behavioral problems.[17,18] However, there is a paucity of research exploring the associations between sexual minority status and suicidal behavior among mainland Chinese adolescents, whether this well-known increased suicide risk for sexual minorities can also be found in Chinese adolescents remains largely unknown.

Therefore, we conducted this nationally large-scale study to estimate the prevalence of suicidality among Chinese sexual minority adolescents, to evaluate the associations between sexual minority status and suicidal ideation and attempts, to investigate whether these associations vary in different sexual minority statuses, and to provide suggestions about effective policymaking and develop intervention strategies for governmental public health organizations.

Methods

2.1 Study design and participants

We utilized data from the 2015 School-Based Chinese Adolescents Health Survey (SCAHS),[19,20] an ongoing, large-scale health-related behavior survey among Chinese adolescents (grades 7-12). The SCAHS has been conducted every two years since 2007, and the 2015 survey was the most recent version conducted in seven Chinese provinces.[21]

In the 2015 SCAHS, students were selected via a 4-stage, stratified-cluster, random-sampling method. In stage 1, all 34 province-level regions in China were divided into four regional strata (East China, West China, South China, and North

China), and then two representative provinces from each regional strata were selected by simple randomization (only one province from East China). In stage 2, cities in each representative province were divided into three economic strata (high-level, middle-level, and low-level) by per capita GDP (gross domestic product). Based on the proportions of these three types of cities, six cities were randomly selected from each representative province. In stage 3, schools were divided into three categories: junior high schools (i.e., grades 7-9), senior high schools (i.e., grades 10-12), and vocational high schools (i.e., grades 7-12). Based on the proportions of these three types of schools, four junior high schools, four senior high schools, and four vocational high schools were randomly selected from each representative city (506 schools agreed to participate in this study). In stage 4, two classes were randomly selected from each grade within the selected schools, and all available students in the selected classes were invited to participate in this study voluntarily. In total, 150,822 students completed the questionnaires (response rate of 95.93%).

2.2 Data collection

All students from the chosen classes were given a standardized self-administered questionnaire on the day of the survey, to be completed in the classroom during a normal class period (40 or 45 minutes). To protect student privacy, the questionnaire was completed by each student participant anonymously without the presence of teachers or other school personnel (to avoid any potential information bias). All data were collected from November 2014 to January 2015.

2.3 Ethics statement

This study was approved by the Sun Yat-Sen University School of Public Health Institutional Review Board. Written informed consent was obtained from each participating student who was at least 18 years old, or from one of the student's parents (or legal guardian) if the student was under 18 years old.

2.4 Measures

2.4.1 Suicidal ideation and suicide attempts

Suicidal ideation was defined as responding "1 or more times" to the following question: "During the past 12 months, how many times did you seriously consider attempting suicide?" Suicide attempts were assessed by asking students to respond to the following question with zero, once, or more: "During the past 12 months, how many times did you actually attempt suicide?"[22,23]

2.4.2 Sexual minority status

The number of transsexuals among sexual minority adolescents is still very low[24] and hard to investigate in our school-based survey, so this minority group was not included in this study. Sexual minority status was measured by asking students the following question regarding sexual attraction: "In a romantic relationship, what kind of person are you attracted to?" Response options included the following: (1) opposite sex, (2) same sex, (3) equally opposite sex and same sex, and (4) unsure.[25,26] Respondents were classified as the following categories: (1) heterosexual, (2) same-sex romantic attraction (SSA), (3) both-sex romantic attraction (BSA), and (4) unsure. Students who belonged to categories (2) and (3) were classified as sexual

minorities.

2.4.3 Demographic variables

Factors previously reported to be associated with suicidal behavior in sexual minority adolescents were taken into consideration.[4,5,27] Demographic variables included sex, age, academic pressure, household socioeconomic status (HSS), current smoking, current drinking, and bullying experience.

After reading a brief definition of bullying from the Olweus Bully/Victim Questionnaire, adolescents were asked the following question: "How often have you been bullied (kicked, intentionally excluded from participating, made fun of with sexual jokes, etc.) at school in the past 30 days?"[28] Answers were given on a 3-point scale as follows: (1) never, (2) sometimes or rarely (one or two times), or (3) often (more than three times). Students reporting a frequency of "often" in the past 30 days were classified as being bullied.[29] Academic pressure was assessed based on students' self-rating about their school work; responses were coded as follows: (1) none, (2) less, or (3) medium or great. HSS was measured by asking about the student's perception of his or her household's current socioeconomic status; responses were coded as follows: (1) very good, (2) good, and (3) fair or poor. Current smoking was measured by asking the following question: "During the past 30 days, on how many days did you smoke cigarettes?" Students who selected answers indicating 1 or more days were classified as current smokers.[30,31] Current drinking was assessed with the following question: "During the past 30 days, on how many days did you drink alcohol?" Students who selected answers indicating 1 or more days were classified as

current drinkers.[32]

2.5 Statistical analysis

Prevalence estimates and logistic regression analyses used appropriate sampling weights (adjusting for students' grade, sex, and school location) and estimation procedures that accounted for the complex sampling design. Taylor series estimation methods were utilized to obtain proper standard error estimates. First, descriptive analyses were conducted to describe the demographic characteristics and prevalence of suicidality. Second, Rao-Scott chi-square tests and one-way ANOVA were used to compare the differences in demographic characteristics and suicide rates between groups. Third, univariate logistic regression models were performed to explore the associations between sexual minority status and suicidal ideation and suicide attempts without the confounding effects of sex. Additional multivariate models were sequentially adjusted for age, academic pressure, HSS, current smoking current drinking, and bullying experience. Based on previously reported studies,[33,34] age, socio-family environment (e.g., academic pressure and HSS), unhealthy behaviors (e.g., smoking and drinking), and school environment (e.g., bullying experience) were associated with suicidal behaviors in China, and all were added as covariates to determine the independent associations between sexual minority status and suicidality. Missing data accounted for less than 3.1% for all relevant variables and were eliminated in the analyses. OR (odds ratios) and 95% CI (confidence intervals) were obtained from logistic regression models. *P*-values less than 0.05 were considered statistically significant (tested 2-sided) for regression analysis. The alpha level for

paired comparison was set by Bonferroni correction. All statistical analyses were conducted using SAS 9.4 (SAS Institute, Inc., Cary, NC, USA).

Results

3.1 Demographic characteristics

The characteristics of the students are shown in **Table 1**. Of the total sample, the mean (SE) age of the adolescents was 15.1 (0.4) years old; 51.8% were males, and 48.2% were females. Among these adolescents, 4.1% self-reported as sexual minorities, 17.3% as unsure, and 78.6% as heterosexual. Compared with their unsure and heterosexual peers, sexual minority adolescents were more likely to be females ($P<0.001$), to come from a family with poor socioeconomic status ($P<0.001$), and to report medium or great academic pressure ($P<0.001$). Additionally, sexual minority adolescents were also more likely to report smoking, alcohol use, and school bullying experiences during the past 30 days than their unsure and heterosexual peers.

3.2 Prevalence of suicidality by sexual minority status

As shown in **Table 2**, for male adolescents, the weighted prevalence of past-year suicidal ideation was more frequently reported in sexual minority (SSA: 21.6%; BSA: 34.7%) adolescents than in their heterosexual (14.50%) and unsure (11.7%) peers, and BSA students reported the highest rate of past-year suicidal ideation. The weighted prevalence of past-year suicide attempts was higher in sexual minority (SSA: 6.9%; BSA: 12.2%) and unsure (3.1%) adolescents than in their heterosexual peers (2.2%), and BSA students reported the highest rate of past-year suicide attempts.

As for female adolescents, the weighted prevalence of past-year suicidal ideation was higher in sexual minority (SSA: 30.4%; BSA: 42.3%) adolescents than in their heterosexual (18.8%) and unsure (14.9%) peers, with BSA students having the highest prevalence. The weighted prevalence of past-year suicide attempts was higher in sexual minority adolescents (SSA: 8.9%; BSA: 10.9%) than in their heterosexual (3.1%) and unsure (3.2%) peers, and BSA adolescents reported the highest rate of past-year suicide attempts.

3.3 Associations between sexual minority status and suicidal ideation and suicide attempts

As shown in **Table 3**, for male adolescents, unadjusted analyses (model 1) showed that SSA and BSA adolescents were associated with higher suicidal ideation and suicide attempts than their heterosexual peers. After adjustment for academic pressure, HSS, current smoking, current drinking, and bullying experience (model 2), SSA (AOR=1.56, 95% CI: 1.26-1.94) and BSA (AOR=2.42, 95% CI: 2.03-2.88) adolescents were more likely to report suicidal ideation than their heterosexual and unsure peers. Compared with heterosexual peers, SSA (AOR=3.13, 95% CI: 2.28-4.28), BSA (AOR=3.83, 95% CI: 2.85-5.14), and unsure (AOR=1.55, 95% CI: 1.24-1.94) male adolescents were more likely to have suicide attempts.

As for female adolescents, unadjusted analyses (model 1) showed that SSA and BSA adolescents were associated with higher suicidal ideation and suicide attempts than their heterosexual and unsure peers. After adjustment for academic pressure, HSS, current smoking, current drinking, and bullying experience (model 2). SSA

(OR=1.42, 95% CI: 1.30-1.56) and BSA (OR=2.61, 95% CI: 2.41-2.82) adolescents were more likely to report suicidal ideation than their heterosexual and unsure peers. Compared with heterosexual peers, SSA (OR=1.97, 95% CI: 1.43-2.70) and BSA (OR=2.59, 95% CI: 2.19-3.06) female students were more likely to have suicide attempts.

Moreover, in both male and female adolescents, differences in sexual minority status were larger for suicide attempts than for suicidal ideation, and BSA adolescents reported the highest risk of suicide attempts.

Discussion

As in many studies in Western or developed countries, we determined that Chinese sexual minority adolescents had a higher risk of suicidal ideation and suicide attempts than their heterosexual peers; being a BSA male or female was associated with an increased risk of suicidality. To our knowledge, this study is the first to utilize nationally representative data to explore the associations between sexual minority status and suicidal behavior among Chinese adolescents.

Consistent with previous studies,[4-6] our results additionally revealed that sexual minority adolescents had a higher prevalence of both suicidal ideation and suicide attempts than their heterosexual peers. Compared with a cross-sectional survey conducted with sexual minority youths from three Asian cities (Hanoi, Shanghai, and Taipei),[14] the prevalence of past-year suicidal ideation and suicide attempts in our sexual minority samples was similar to that in Taipei samples, but higher than that in

Shanghai and Hanoi samples. This variation in results may derive from the different sample sources and age structures. Our findings provide population-based evidence of the prevalence of suicidal behavior among Chinese sexual minorities, which is useful for identifying adolescents who may be at high risk of suicide.

Furthermore, we found that, compared with their heterosexual peers, Chinese sexual minority adolescents were associated with an increased risk of suicidality after stratification by sex. To our knowledge, because of their insufficient sample sizes, most previous studies combined individuals with different sexual minority statuses into one category without considering sex stratification, which may obscure the estimates of suicide risk among high-risk adolescents.[35,36] This study is the first to utilize a nationally large-scale sample to explore the associations between sexual minority status and suicidal behavior among Chinese adolescents grouped according to sexual minority status and stratified by sex. Our results are consistent with a previous systematic review that reported elevated risks of past-year suicide attempts in homosexual and bisexual adolescents, especially males.[37] One possible mechanism to explain these associations is the experience of minority stress.[1] According to the minority stress model, sexual minority individuals may experience minority stressors (e.g., prejudice events, internalized homophobia), which are related to lower well-being and higher levels of suicidal ideation.[38] Previous results from a 2011 National School Climate Survey indicated that more than 60-80% of sexual minority students reported being verbally harassed and that 40% of students experienced physical violence at school during the past year.[39] Experiences such as being

threatened or injured are directly related to suicidality among sexual minority adolescents.[40] In current Chinese society, stigma against nonheterosexual individuals persists, and a large portion of the general population shows intolerant attitudes toward sexual minorities.[41] In our study, we also found that Chinese sexual minorities have a higher prevalence of bullying experiences than their heterosexual peers. Therefore, a negative school environment may plays a potential role in the associations between sexual minority status and suicidal behavior among Chinese adolescents.

In line with previous studies,[37,42] our study found that sexual orientation differences were more apparent for suicide attempts than for suicidal ideation, and a higher effects of suicide attempts were more common for BSA adolescents than their SSA and heterosexual peers. Several reasons may explain the more severe forms of suicidality among the bisexual group. First, bisexual individuals may experience additional forms of minority stress from both homosexuals and heterosexuals, and the various forms of biphobia and monosexism can create emotional and cognitive dysfunction that may lead to depression, anxiety, or even suicide attempts.[1,43] Second, bisexual individuals are pervasively invisible in society. Heterosexual and homosexual people have mutual interests in maintaining the primacy of monosexual assumptions and binary sexual orientation, which may contribute to an internalized sense of belief that bisexuals do not belong to any particular sexual minority group. The lack of a sense of belonging may be one of the factors contributing to suicide attempts among bisexual people.[8,43] Third, lack of social and healthcare support was

more commonly reported among bisexual individuals than among their homosexual and heterosexual peers, and this lack of support made bisexuals feel more socially isolated and vulnerable to chronic stress and led to an increased risk of suicide. [44] Moreover, our results reported that 17.3% of adolescents reported being unsure about sexual romantic attraction, which is consistent with previous research.[45] In accordance with a previous systematic review,[37] the risks of past-year suicide attempts was smaller for unsure adolescents than for sexual minorities in our study. However, previous studies reported that unsure adolescents may show same-sex attraction or behaviors[46] and thus may experience minority stress (e.g., bullying victimization),[47] leading to health disparities such as depression, anxiety,[48] and suicidal ideation.[49] Therefore, further research to explore the prevalence and mechanisms of suicidality among unsure adolescents is needed.

Chinese sexual minorities suffer from minority stressors due to discrimination, homophobia and other conditions in the social environment impacted by traditional Chinese culture (which is rooted in Confucian philosophies).[50] Confucianism emphasizes the continuation of the family line and filial piety to protect the family's reputation and lineage (e.g., prior to 2016, the One-Child Policy; from 2016 to the present, the Two-Child Policy).[16] Although attitudes toward Chinese sexual minorities have become more positive in particular populations (e.g., younger or highly educated people),[51] a large proportion of the Chinese population still holds negative attitudes toward sexual minorities. Same-sex orientation is still considered to conflict with traditional values and associated with prejudice and stigma in the current Chinese

social context.[52] These negative attitudes toward sexual minorities and minority stressors that they experience have been linked to high levels of mental and behavioral problems, such as depression and suicide attempts.[17,18] In this study, our findings suggested that sexual minority status was associated with suicidal behavior among Chinese adolescents, and that BSA individuals were the highest-risk group in this population. Therefore，the following appropriate interventions for suicidality among Chinese sexual minority adolescents are recommended: First, schools and related public health organizations should formulate policies to prevent students from experiencing minority stressors (e.g., being bullied at school) to reduce discrimination and create a generally positive school climate. Second, online resources (e.g., online sex education websites) should be integrated to provide more relevant information and education, which may help to foster a more tolerant and open atmosphere toward sexual minorities. Third, families and communities should provide social support (e.g., Gay-Straight Alliance groups, and Parents and Friends of Lesbians and Gays) to promote acceptance for sexual minority orientation[53] and reduce pressure from traditional values and norms embedded in Confucianism (e.g., filial piety and family responsibilities).[51] Fourth, practitioners (e.g., psychologists, psychiatrists, counselors, and social workers) should specifically focus on the group that is at particularly high suicide risk (e.g., BSA adolescents) with a weaker collective identity. Developing early and effective suicide-related preventive interventions (e.g., treatment of depression, anxiety, and their comorbidities)[13] can help improve mental well-being in high-risk sexual minority adolescents.

Some noteworthy limitations should be considered when interpreting the results of this study. First, due to the cross-sectional design, it is difficult to make causal inferences. Second, our study used a structured self-rating questionnaire to collect data. Although self-reporting is a common and accepted method in sexuality research on adolescents, we could not completely rule out the possibility of recall bias and misclassification bias. Third, our study sample included only students attending school and did not include adolescents who dropped out of school or were absent from school on the day the survey was administered; suicidality may be more common among sexual minority students who were absent, possibly leading to underestimation of the sexual orientation disparities in our study. Fourth, we used the item on same-sex romantic attraction to measure sexual minority status, and the results might not be comparable to those in other studies using sexual orientation as a measurement. However, our measure is particularly appropriate for surveying the health of sexual minority adolescents[45] and is more likely to capture a broad range of adolescents who have "come out" or acknowledged romantic attraction but may not have adopted a homosexual identity,[5] which may help to identify that high-risk population. Despite these limitations, the primary strengths of our study are that it includes a nationally large-scale sample of Chinese adolescents, which provides sufficient statistical power and may avoid over-sampling of the sexual minority population. Furthermore, to the best of our knowledge, our study is the first study investigating the risk for suicidal behavior among Chinese sexual minority adolescents in a representative sample.

Conclusions

Increases in suicide risk among sexual minority adolescents have raised global health concerns. However, few related studies have been conducted among Chinese adolescents. The findings from our study suggested that Chinese sexual minority adolescents were associated with a higher risk of suicidal behavior and that BSA adolescents have the highest risk of suicidality regardless of their sex. Based on our study results, conducting early detection and intervention programs for Chinese sexual minorities (especially BSA individuals) is suggested to more effectively and appropriately prevent suicide-related problems. Future studies that focus on the risk factors, mechanisms and interventions of suicidal behavior in Chinese sexual minority adolescents are warranted.

Contributors' Statement:
Ciyong Lu conceptualized and designed the study, reviewed and revised the manuscript and approved the final manuscript as submitted. Yeen Huang and Pengsheng Li conceptualized and designed the study, coordinated and supervised the data collection, carried out the initial analyses, drafted the initial manuscript, and approved the final manuscript as submitted. They contributed equally to this study. Lan Guo carried out the analyses and interpreted the data, reviewed and revised the manuscript and approved the final manuscript as submitted. Xue Gao, Yan Xu, Guoliang Huang, and Xueqing Deng designed the data collection instruments, coordinated and supervised the data collection, reviewed and revised the manuscript, and approved the final manuscript as submitted. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Table 1. Demographic characteristics of participants by sexual minority status among Chinese adolescents (N=150,822).

Variable	Total	Heterosexual	Sexual minorities[a]	Unsure	χ^2/F	*P*-value
	No. (%)	No. (%)	No. (%)	No. (%)		
Total	150,822 (100.00)	116,774 (78.6)	6,685 (4.1)	27,363 (17.3)		
Sex					182.90	<0.001
Male	72,409 (51.8)	57,343 (52.8)	2,483 (41.4)	12,583 (49.7)		
Female	78,413 (48.2)	59,431 (47.2)	4,202 (58.6)	14,780 (50.3)		
Age (year)[b]	15.1 (0.4)	15.3 (0.5)	15.1 (0.4)	14.1 (0.3)	754.33	<0.001
Academic pressure					567.69	<0.001
None	23,387 (15.8)	17,051 (14.9)	1,060 (16.1)	5,276 (19.8)		
Less	69,359 (46.5)	53,061 (46.1)	2,648 (39.9)	13,650 (49.8)		
Medium or great	58,076 (37.7)	46,662 (39.0)	2,977 (44.0)	8,437 (30.4)		
HSS[c]					204.56	<0.001
Very good	30,766 (22.7)	22,812 (21.8)	1,456 (24.2)	6,498 (26.6)		
Good	90,894 (60.3)	71,306 (61.1)	3,748 (55.4)	15,840 (57.4)		
Fair or poor	29,162 (17.0)	22,656 (17.1)	1,481 (20.4)	5,025 (16.0)		
Current smoking					288.12	<0.001
No	143,032 (94.6)	110,194 (94.1)	6,212 (93.0)	26,626 (97.3)		
Yes	7,790 (5.4)	6,580 (5.9)	473 (7.0)	737 (2.7)		
Current drinking					818.05	<0.001
No	126,765 (84.0)	96,909 (82.9)	5,072 (76.6)	24,784 (90.5)		
Yes	24,057 (16.0)	19,865 (17.1)	1,613 (23.4)	2,579 (9.5)		
Bullying experience					57.58	<0.001
No	138,523 (91.6)	107,767 (92.0)	5,668 (83.9)	25,088 (91.3)		
Yes	12,299 (8.4)	9,007 (8.0)	1,017 (16.1)	2,275 (8.7)		

[a]Sexual minorities included adolescents who reported same-sex or both-sex romantic attraction.

[b] Age data are presented as means (SE).

[c] HSS, Household socioeconomic status.

All numbers were unweighted, whereas all percentages were adjusted for sampling weights.

Table 2. Prevalence of past-year suicidal ideation and suicide attempts by sexual minority status among Chinese adolescents (N=150,822).

	Males (N=72,409)				Females (N=78,413)			
	Heterosexual=1	SSA=2	BSA=3	Unsure=4	Heterosexual=5	SSA=6	BSA=7	Unsure=8
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Suicidal ideation								
No	48,572 (85.5)	795 (78.4)	919 (65.3)	11,067 (88.3)	47,941 (81.2)	706 (69.6)	1,839 (57.7)	12,527 (85.1)
Yes	8,771 (14.5)	243 (21.6)	526 (34.7)	1,516 (11.7)	11,490 (18.8)	309 (30.4)	1,348 (42.3)	2,253 (14.9)
Suicide attempts								
No	55,991 (97.8)	962 (93.1)	1,267 (87.8)	12,184 (96.9)	57,552 (96.9)	923 (91.1)	2,820 (89.1)	14,318 (96.8)
Yes	1,352 (2.2)	76 (6.9)	178 (12.2)	399 (3.1)	1,879 (3.1)	92 (8.9)	367 (10.9)	462 (3.2)

SSA, same-sex romantic attraction; BSA, both-sex romantic attraction;

All numbers were unweighted, whereas all percentages were adjusted for sampling weights.

The alpha level for paired comparison was set at P=0.0083 after Bonferroni correction.

Paired comparison for suicidal ideation:

2>1, χ^2=51.42, P<0.001; 6>5, χ^2=78.41, P<0.001;
3>1, χ^2=471.59, P<0.001; 7>5, χ^2=978.63, P<0.001;
3>2, χ^2=47.69, P<0.001; 7>6, χ^2=45.29, P<0.001;
4<1, χ^2=86.74, P<0.001; 8<5, χ^2=131.20, P<0.001;
4<2, χ^2=110.08, P<0.001; 8<6, χ^2=161.47, P<0.001;
4<3, χ^2=618.07, P<0.001; 8<7, χ^2=1197.33, P<0.001;

Paired comparison for suicide attempts:

2>1, χ^2=105.29, P<0.001; 6>5, χ^2=110.22, P<0.001;
3>1, χ^2=551.67, P<0.001; 7>5, χ^2=610.42, P<0.001;
3>2, χ^2=16.42, P<0.001; 7>6, χ^2=4.76, P=0.029;
4>1, χ^2=27.95, P<0.001; 8>5, χ^2=0.05, P=0.824;
4<2, χ^2=49.09, P<0.001; 8<6, χ^2=98.96, P<0.001;
4<3, χ^2=274.99, P<0.001; 8<7, χ^2=419.29, P<0.001;

Table 3. Associations of sexual minority status with past-year suicidal ideation and suicide attempts among Chinese adolescents (N=150,822).

	Model 1[a]			Model 2[b]		
	OR	**95% CI**	***P***	**AOR**	**95% CI**	***P***
Suicidal ideation						
Males						
Heterosexual	1.0			1.0		
SSA	1.62	1.30-2.03	<0.001	1.56	1.26-1.94	<0.001
BSA	3.13	2.59-3.79	<0.001	2.42	2.03-2.88	<0.001
Unsure	0.78	0.67-0.91	<0.001	0.78	0.69-0.87	<0.001
Females						
Heterosexual	1.0			1.0		
SSA	1.88	1.67-2.11	<0.001	1.42	1.30-1.56	<0.001
BSA	3.15	2.93-3.39	<0.001	2.61	2.41-2.82	<0.001
Unsure	0.75	0.60-0.94	<0.001	0.71	0.61-0.83	<0.001
Suicide attempts						
Males						
Heterosexual	1.0			1.0		
SSA	3.29	2.43-4.47	<0.001	3.13	2.28-4.28	<0.001
BSA	6.25	4.46-8.76	<0.001	3.83	2.85-5.14	<0.001
Unsure	1.42	1.07-1.90	<0.001	1.55	1.24-1.94	<0.001
Females						
Heterosexual	1.0			1.0		
SSA	3.13	2.36-4.15	<0.001	1.97	1.43-2.70	<0.001
BSA	3.89	3.13-4.83	<0.001	2.59	2.19-3.06	<0.001
Unsure	1.04	0.75-1.44	0.824	1.03	0.80-1.34	0.531

SSA, same-sex romantic attraction; BSA, both-sex romantic attraction; CI, confidence interval; OR, odds ratio; AOR, adjusted odds ratio.

[a]Unadjusted.

[b]Adjusted for age, academic pressure, household socioeconomic status, current smoking, current drinking, and bullying experience.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found Page 1
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Page 2-3
Objectives	3	State specific objectives, including any prespecified hypotheses Page 4
Methods		
Study design	4	Present key elements of study design early in the paper Page 4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Page 5
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up NA. *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls NA. *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants Page 4-5
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Page 6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Page 6-8
Bias	9	Describe any efforts to address potential sources of bias Page 5
Study size	10	Explain how the study size was arrived at Page 4-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why

		Page 8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Page 8
		(*b*) Describe any methods used to examine subgroups and interactions NA.
		(*c*) Explain how missing data were addressed NA.
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy Page 8
		(*e*) Describe any sensitivity analyses NA.

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Page 9
		(b) Give reasons for non-participation at each stage NA.
		(c) Consider use of a flow diagram NA.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Page 9
		(b) Indicate number of participants with missing data for each variable of interest NA.
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount) NA.
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time NA.
		Case-control study—Report numbers in each exposure category, or summary measures of exposure NA.
		Cross-sectional study—Report numbers of outcome events or summary measures Page 9-11
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Page 10-11
		(*b*) Report category boundaries when continuous variables were categorized NA.
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA.
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses NA.
Discussion		
Key results	18	Summarise key results with reference to study objectives Page 11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Page 16
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Page 11-15
Generalisability	21	Discuss the generalisability (external validity) of the study results Page 14-15

Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Page 2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Sexual minority status and suicidal behavior among Chinese adolescents: A nationally representative cross-sectional study

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Abstract

Objectives: Suicidality among sexual minority adolescents have generated worldwide concern in recent decades, and previous Western studies have demonstrated that sexual minority status is associated with adolescent suicidality. However, whether this association exists in Chinese adolescents remains largely unknown. This study aimed to estimate the associations between sexual minority status and suicidal behavior among Chinese adolescents.

Design: Cross-sectional survey.

Setting: A total of 506 high schools in seven provinces of China.

Participants: A total of 150,822 students in grades 7-12 who completed the questionnaires (response rate of 95.9%) were included.

Main outcome measures: Suicidal ideation and suicide attempts were used to measure suicidal behavior, and sexual attraction (opposite-sex, same-sex, or both-sex) was used as a measure for sexual minority status.

Results: Of the 150,822 adolescents analyzed, 4.1% self-reported as sexual minorities, and 17.3% were unsure. Compared to heterosexual and unsure adolescents, same-sex romantic attraction (SSA) and both-sex romantic attraction (BSA) adolescents reported a higher prevalence of past-year suicidal ideation (SSA: 21.6% for males and 30.4% for females; BSA: 34.7% for males and 42.3% for females) and suicide attempts (SSA: 6.9% for males and 8.9% for females; BSA: 12.2% for males and 10.9% for females). After adjustment for covariates, SSA and BSA adolescents were more likely to have past-year suicidal ideation and suicide attempts than their heterosexual and unsure peers. BSA adolescents reported the highest risk of suicidal ideation (males: AOR=2.42, 95% CI=2.03-2.88; females: AOR=2.61, 95% CI=2.41-2.82) and suicide attempts (males: AOR=3.83, 95% CI: 2.85-5.14; females: AOR=2.59, 95% CI: 2.19-3.06).

Conclusions: Our study suggested that Chinese sexual minority adolescents were at

increased risk of suicidality, and those with both-sex romantic attraction had an especially high risk in this population. These findings emphasized the urgent need to develop targeted interventions to effectively address suicide-related problems among Chinese sexual minority adolescents.

Strengths and limitations of this study:

- Our study estimated the prevalence of suicidality and examined the association between sexual minority status and suicidal behavior among Chinese adolescents.
- A large-scale, nationally representative sample provided sufficient statistical power, and between-groups analyses were conducted.
- Due to the nature of the cross-sectional data, interpretation of the direction of the observed associations is limited.
- Our study sample included only students attending school and did not include adolescents who dropped out of school or were absent from school on the day the survey was administered.

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Introduction

Suicidal behavior, which includes suicidal ideation, suicide attempts, and completed suicide, has raised concerns about the health of sexual minority adolescents (i.e., adolescents who experience same-sex attraction, engage in same-sex sexual behavior, or self-identify as gay, lesbian, bisexual) in recent decades. Minority stress theory[1] suggests that difficulties in dealing with minority stressors (prejudice, discrimination, and stigma) associated with same-sex orientation may lead to substance abuse[2], depression[3], and even suicide[4] among sexual minorities. Compared with their

heterosexual peers, sexual minority adolescents have been identified in numerous studies as a high-risk group for suicidal behavior.[5] Regarding the associations of sexual minority status with suicidal behavior, most related studies have been conducted in Western or developed countries. Previous findings from the Youth Risk Behavior Survey (YRBS) in the United States showed that approximately 42.8% and 29.4% of sexual minority adolescents reported having past-year suicidal ideation and suicide attempts, respectively.[6] Two longitudinal studies from the United States and Norway showed that sexual minority adolescents were twice and four times more likely, respectively, to have attempted suicide in the past year than their heterosexual peers.[5,7] Moreover, a previous systematic review indicated that bisexual individuals from developed countries have the highest levels of suicide risk among sexual minorities.[8] Those findings thus identified sexual minority status as a risk factor for adolescent suicidality in Western or developed countries.

As the largest developing country with a high suicide rate, China accounts for 21% of the world's population and 30-40% of the world's suicides.[9] Although numerous studies have focused on suicide risk in Chinese adolescents,[10,11] little attention has been devoted to sexual minorities. Previous studies in China have shown that 4.6%-12.6% of gay adults have reported lifetime suicide attempts,[12,13] and sexual minority youth from Taipei were almost twice as likely to have past-year suicidal ideation as their heterosexual peers.[14] It is well known that the cultural background of Western countries is different from that of Asian countries, especially China, where Confucianism has been an influence for thousands of years and families and social

climates exert intense pressure on individuals to marry and have children to maintain their family lineages.[15] Thus, sexual minorities are recognized as a major impediment to continuing the family line and maintaining a family's reputation,[16] and sexual minorities in China may experience more minority stressors and higher levels of mental and behavioral problems.[17,18] However, there is a paucity of research exploring the associations between sexual minority status and suicidal behavior among mainland Chinese adolescents; whether this well-known increased suicide risk for sexual minorities can also be found in Chinese adolescents remains largely unknown.

Therefore, we conducted this nationally representative large-scale study to estimate the prevalence of suicidality among Chinese sexual minority adolescents, to evaluate the associations between sexual minority status and suicidal ideation and attempts, to investigate whether these associations vary in different sexual minority statuses, and to provide suggestions for effective policymaking and developing intervention strategies for governmental public health organizations.

Methods

2.1 Study design and participants

We utilized data from the 2015 School-Based Chinese Adolescents Health Survey (SCAHS),[19,20] an ongoing, large-scale health-related behavior survey among Chinese adolescents (grades 7-12). The SCAHS has been conducted every two years since 2007, and the 2015 survey was the most recent version conducted in seven Chinese provinces.[21]

In the 2015 SCAHS, students were selected via a 4-stage, stratified-cluster, random-sampling method. In stage 1, all 34 province-level regions in China were divided into four regional strata (East China, West China, South China, and North China), and then two representative provinces from each regional stratum were selected by simple randomization (only one province from East China). In stage 2, cities in each representative province were divided into three economic strata (high-level, middle-level, and low-level) by per capita GDP (gross domestic product). Based on the proportions of these three types of cities, six cities were randomly selected from each representative province. In stage 3, schools were divided into three categories: junior high schools (i.e., grades 7-9), senior high schools (i.e., grades 10-12), and vocational high schools (i.e., grades 7-12). Based on the proportions of these three types of schools, four junior high schools, four senior high schools, and four vocational high schools were randomly selected from each representative city (506 schools agreed to participate in this study). In stage 4, two classes were randomly selected from each grade within the selected schools, and all available students in the selected classes were invited to participate in this study voluntarily. In total, 150,822 students completed the questionnaires (response rate of 95.9%).

2.2 Participants involvement and data collection

All students from the chosen classes were given a standardized self-administered questionnaire which was developed by research team on the day of the survey, to be completed in the classroom during a normal class period (40 or 45 minutes). To

protect student privacy, the questionnaire was completed by each student participant anonymously without the presence of teachers or other school personnel (to avoid any potential information bias). After collecting the questionnaires from students, investigators would check the questionnaires carefully and contact with the student timely when they found important missing data. The investigators were all trained and quality control was carried out during data collection. All data were collected from November 2014 to January 2015.

2.3 Ethics statement

This study was approved by the Sun Yat-Sen University School of Public Health Institutional Review Board. Written informed consent was obtained from each participating student who was at least 18 years old or from one of the student's parents (or legal guardian) if the student was under 18 years old.

2.4 Measures

2.4.1 Suicidal ideation and suicide attempts

Suicidal ideation was defined as responding "1 or more times" to the following question: "During the past 12 months, how many times did you seriously consider attempting suicide?" Suicide attempts were assessed by asking students to respond to the following question with zero, once, or more: "During the past 12 months, how many times did you actually attempt suicide?"[22,23]

2.4.2 Sexual minority status

The number of transsexuals among sexual minority adolescents is still very low[24] and was difficult to investigate in our school-based survey, and this minority group was

therefore not included in this study. Sexual minority status was measured by asking students the following question regarding sexual attraction: "In a romantic relationship, what kind of person are you attracted to?" Response options included the following: (1) opposite sex, (2) same sex, (3) equally opposite sex and same sex, and (4) unsure.[25,26] Respondents were classified as the following categories: (1) heterosexual, (2) same-sex romantic attraction (SSA), (3) both-sex romantic attraction (BSA), and (4) unsure. Students who belonged to categories (2) and (3) were classified as sexual minorities.

2.4.3 Demographic variables

Factors previously reported to be associated with suicidal behavior in sexual minority adolescents were taken into consideration.[4,5,27] Demographic variables included sex, age, academic pressure, household socioeconomic status (HSS), current smoking, current drinking, and bullying experience.

After reading a brief definition of bullying from the Olweus Bully/Victim Questionnaire, adolescents were asked the following question: "How often have you been bullied (kicked, intentionally excluded from participating, made fun of with sexual jokes, etc.) at school in the past 30 days?"[28] Answers were given on a 3-point scale as follows: (1) never, (2) sometimes or rarely (one or two times), or (3) often (more than three times). Students reporting a frequency of "often" in the past 30 days were classified as being bullied.[29] Academic pressure was assessed based on students' self-rating about their school work; responses were coded as follows: (1) none, (2) less, or (3) medium or great. HSS was measured by asking about the student's

perception of his or her household's current socioeconomic status; responses were coded as follows: (1) very good, (2) good, and (3) fair or poor. Current smoking was measured by asking the following question: "During the past 30 days, on how many days did you smoke cigarettes?" Students who selected answers indicating 1 or more days were classified as current smokers.[30,31] Current drinking was assessed with the following question: "During the past 30 days, on how many days did you drink alcohol?" Students who selected answers indicating 1 or more days were classified as current drinkers.[32]

2.5 Statistical analysis

Prevalence estimates and logistic regression analyses used appropriate sampling weights (adjusting for students' grade, sex, and school location) and estimation procedures that accounted for the complex sampling design. Taylor series estimation methods were utilized to obtain proper standard error estimates. First, descriptive analyses were conducted to describe the demographic characteristics and prevalence of suicidality. Second, Rao-Scott chi-square tests and one-way ANOVA were used to compare the differences in demographic characteristics and suicide rates between groups. Third, univariate logistic regression models were performed to explore the associations between sexual minority status and suicidal ideation and suicide attempts without the confounding effects of sex. Additional multivariate models were sequentially adjusted for age, academic pressure, HSS, current smoking, current drinking, and bullying experience. Based on previously reported studies,[33,34] age, socio-family environment (e.g., academic pressure and HSS), unhealthy behaviors

(e.g., smoking and drinking), and school environment (e.g., bullying experience) were associated with suicidal behaviors in China, and all were added as covariates to determine the independent associations between sexual minority status and suicidality. Missing data accounted for less than 3.1% for all relevant variables and were eliminated from the statistical analysis. OR (odds ratios) and 95% CI (confidence intervals) were obtained from logistic regression models. *P*-values less than 0.05 were considered statistically significant (tested 2-sided) for regression analysis. The alpha level for paired comparison was set by Bonferroni correction. All statistical analyses were conducted using SAS 9.4 (SAS Institute, Inc., Cary, NC, USA).

Results

3.1 Demographic characteristics

The characteristics of the students are shown in **Table 1**. Of the total sample, the mean (SE) age of the adolescents was 15.1 (0.4) years old; 51.8% were males, and 48.2% were females. Among these adolescents, 4.1% self-reported as sexual minorities, 17.3% as unsure, and 78.6% as heterosexual. Compared with their unsure and heterosexual peers, sexual minority adolescents were more likely to be females ($P<0.001$), to come from a family with poor socioeconomic status ($P<0.001$), and to report medium or great academic pressure ($P<0.001$). Additionally, sexual minority adolescents were also more likely to report smoking, alcohol use, and school bullying experiences during the past 30 days than their unsure and heterosexual peers.

3.2 Prevalence of suicidality by sexual minority status

As shown in **Table 2**, for male adolescents, the weighted prevalence of past-year suicidal ideation was more frequently reported in sexual minority (SSA: 21.6%; BSA: 34.7%) adolescents than in their heterosexual (14.50%) and unsure (11.7%) peers, and BSA students reported the highest rate of past-year suicidal ideation. The weighted prevalence of past-year suicide attempts was higher in sexual minority (SSA: 6.9%; BSA: 12.2%) and unsure (3.1%) adolescents than in their heterosexual peers (2.2%), and BSA students reported the highest rate of past-year suicide attempts.

As for female adolescents, the weighted prevalence of past-year suicidal ideation was higher in sexual minority (SSA: 30.4%; BSA: 42.3%) adolescents than in their heterosexual (18.8%) and unsure (14.9%) peers, with BSA students having the highest prevalence. The weighted prevalence of past-year suicide attempts was higher in sexual minority adolescents (SSA: 8.9%; BSA: 10.9%) than in their heterosexual (3.1%) and unsure (3.2%) peers, and BSA adolescents reported the highest rate of past-year suicide attempts.

3.3 Associations between sexual minority status and suicidal ideation and suicide attempts

As shown in **Table 3**, for male adolescents, unadjusted analyses (model 1) showed that SSA and BSA adolescents had a higher risk of suicidal ideation and suicide attempts than their heterosexual peers. After adjustment for academic pressure, HSS, current smoking, current drinking, and bullying experience (model 2), SSA (AOR=1.56, 95% CI: 1.26-1.94) and BSA (AOR=2.42, 95% CI: 2.03-2.88) adolescents were more likely to report suicidal ideation than their heterosexual and

unsure peers. Compared with heterosexual peers, SSA (AOR=3.13, 95% CI: 2.28-4.28), BSA (AOR=3.83, 95% CI: 2.85-5.14), and unsure (AOR=1.55, 95% CI: 1.24-1.94) male adolescents were more likely to have suicide attempts.

As for female adolescents, unadjusted analyses (model 1) showed that SSA and BSA adolescents had a higher risk of suicidal ideation and suicide attempts than their heterosexual and unsure peers. After adjustment for academic pressure, HSS, current smoking, current drinking, and bullying experience (model 2). SSA (AOR=1.42, 95% CI: 1.30-1.56) and BSA (AOR=2.61, 95% CI: 2.41-2.82) adolescents were more likely to report suicidal ideation than their heterosexual and unsure peers. Compared with heterosexual and unsure peers, SSA (AOR=1.97, 95% CI: 1.43-2.70) and BSA (AOR=2.59, 95% CI: 2.19-3.06) female students were more likely to have suicide attempts.

Moreover, in both male and female adolescent sexual minorities, differences in the risk of suicide attempts were more pronounced than differences in the risk of suicidal ideation compared with those in heterosexual and unsure peers, and BSA adolescents reported the highest risk of suicide attempts.

Discussion

As in many studies in Western or developed countries, we determined that Chinese sexual minority adolescents had a higher risk of suicidal ideation and suicide attempts than their heterosexual and unsure peers; being a BSA male or female was associated with an increased risk of suicidality. To our knowledge, this study is the first to utilize

nationally representative data to explore the associations between sexual minority status and suicidal behavior among Chinese adolescents.

Consistent with previous studies,[4-6] our results additionally revealed that sexual minority adolescents had a higher prevalence of both suicidal ideation and suicide attempts than their heterosexual peers. Compared with a cross-sectional survey conducted with sexual minority youths from three Asian cities (Hanoi, Shanghai, and Taipei),[14] the prevalence of past-year suicidal ideation and suicide attempts in our sexual minority samples was similar to that in Taipei samples but higher than that in Shanghai and Hanoi samples. This variation in results may derive from the different sample sources and age structures. Our findings provide population-based evidence of the prevalence of suicidal behavior among Chinese sexual minorities, which is useful for identifying adolescents who may be at high risk of suicide.

Furthermore, we found that, compared with their heterosexual peers, Chinese sexual minority adolescents had increased risk of suicidality after stratification by sex. To our knowledge, because of their insufficient sample sizes, most previous studies combined individuals with different sexual minority statuses into one category without considering sex stratification, which may obscure the estimates of suicide risk among high-risk adolescents.[35,36] This study is the first to utilize a nationally representative and large-scale sample to explore the associations between sexual minority status and suicidal behavior among Chinese adolescents grouped according to sexual minority status and stratified by sex. Our results are consistent with a previous systematic review that reported elevated risks of past-year suicide attempts

in homosexual and bisexual adolescents, especially males.[37] One possible mechanism to explain these associations is the experience of minority stress.[1] According to the minority stress model, sexual minority individuals may experience minority stressors (e.g., prejudice events, internalized homophobia), which are related to lower well-being and higher levels of suicidal ideation.[38] Previous results from a 2011 National School Climate Survey indicated that more than 60-80% of sexual minority students reported being verbally harassed and that 40% of students experienced physical violence at school during the past year.[39] Experiences such as being threatened or injured are directly related to suicidality among sexual minority adolescents.[40] In current Chinese society, stigma against nonheterosexual individuals persists, and a large portion of the general population shows intolerant attitudes toward sexual minorities.[41] In our study, we also found that Chinese sexual minorities have a higher prevalence of bullying experiences than their heterosexual peers. Therefore, a negative school environment may play a potential role in the associations between sexual minority status and suicidal behavior among Chinese adolescents.

In line with previous studies,[37,42] our study found that sexual orientation-associated differences were more pronounced for suicide attempts than for suicidal ideation, and BSA adolescents showed a higher risk of suicide attempts than their SSA, unsure, and heterosexual peers. Several reasons may explain the more severe forms of suicidality among the bisexual group. First, bisexual individuals may experience additional forms of minority stress from both gays/lesbians and heterosexuals, and the various forms of biphobia and monosexism can create emotional and cognitive dysfunction that may

lead to depression, anxiety, or even suicide attempts.[1,43] Second, bisexual individuals are pervasively invisible in society. Heterosexual and homosexual people have mutual interests in maintaining the primacy of monosexual assumptions and binary sexual orientation, which may contribute to an internalized sense of belief that bisexuals do not belong to any particular sexual minority group. The lack of a sense of belonging may be one of the factors contributing to suicide attempts among bisexual people.[8,43] Third, lack of social and healthcare support was more commonly reported among bisexual individuals than among their homosexual and heterosexual peers, and this lack of support made bisexuals feel more socially isolated and vulnerable to chronic stress and led to an increased risk of suicide.[44] Moreover, our results reported that 17.3% of adolescents reported being unsure about sexual romantic attraction, which is higher than that reported in previous Western research.[45] One potential explanation is that the unsure category may include many adolescents who did not understand the question about sexual minority status or were unwilling to disclose their sexual orientation. In accordance with a previous systematic review,[37] the risk of past-year suicide attempts was smaller for unsure adolescents than for sexual minorities in our study. However, previous studies reported that unsure adolescents may show same-sex attraction or behaviors[46] and thus may experience minority stress (e.g., bullying victimization),[47] leading to health disparities such as depression, anxiety,[48] and suicidal ideation.[49] In contrast to previous studies, our findings showed that unsure adolescents had no increased risk of suicidal ideation compared to heterosexual peers. One possible reason explaining the discrepant findings could be

the much larger proportion of unsure adolescents in our Chinese sample. Therefore, further research to explore the prevalence and mechanisms of suicidality among unsure adolescents is needed.

Chinese sexual minorities suffer from minority stressors due to discrimination, homophobia and other conditions in the social environment impacted by traditional Chinese culture (which is rooted in Confucian philosophies).[50] Confucianism emphasizes the continuation of the family line and filial piety to protect the family's reputation and lineage (e.g., prior to 2016, the One-Child Policy; from 2016 to the present, the Two-Child Policy).[16] Although attitudes toward Chinese sexual minorities have become more positive in particular populations (e.g., younger or highly educated people),[51] a large proportion of the Chinese population still holds negative attitudes toward sexual minorities. Same-sex orientation is still considered to conflict with traditional values and associated with prejudice and stigma in the current Chinese social context.[52] These negative attitudes toward sexual minorities and minority stressors that they experience have been linked to high levels of mental and behavioral problems, such as depression and suicide attempts.[17,18] In this study, our findings suggested that sexual minority status was associated with suicidal behavior among Chinese adolescents and that BSA individuals were the highest-risk group in this population. Therefore, the following appropriate interventions for suicidality among Chinese sexual minority adolescents are recommended. First, government and policy makers should establish a set of nationwide policies and programs to provide a significant source of support for sexual minorities and to reduce the homophobia

arising from societal/structural homophobia and rigid gender roles. Second, schools and related public health organizations should formulate policies to prevent students from experiencing minority stressors (e.g., being bullied at school) to reduce discrimination and create a generally positive school climate. Third, online resources (e.g., online sex education websites) should be integrated to provide more relevant information and education, which may help to foster a more tolerant and open atmosphere toward sexual minorities. Fourth, families and communities should provide social support (e.g., Gay-Straight Alliance groups, and Parents and Friends of Lesbians and Gays) to promote acceptance of sexual minority orientation[53] and reduce pressure from traditional values and norms embedded in Confucianism (e.g., filial piety and family responsibilities).[51] Fifth, practitioners (e.g., psychologists, psychiatrists, counselors, and social workers) should specifically focus on the group that is at particularly high risk of suicidality (i.e., BSA adolescents) with a weaker collective identity. Developing early and effective suicide-related preventive interventions (e.g., treatment of depression, anxiety, and their comorbidities)[13] can help improve mental well-being in high-risk sexual minority adolescents.

Some noteworthy limitations should be considered when interpreting the results of this study. First, due to the cross-sectional design, it is difficult to make causal inferences. Second, our study used a structured self-rating questionnaire to collect data. Although self-reporting is a common and accepted method in sexuality research on adolescents, we could not completely rule out the possibility of recall bias and misclassification bias. Third, our study sample included only students attending

school and did not include adolescents who dropped out of school or were absent from school on the day the survey was administered; suicidality may be more common among sexual minority students who were absent, possibly leading to underestimation of the sexual orientation disparities in our study. Fourth, we used the item on same-sex romantic attraction to measure sexual minority status, and the results might not be comparable to those in other studies using sexual orientation as a measurement. However, our measure is particularly appropriate for surveying the health of sexual minority adolescents[45] and is more likely to capture a broad range of adolescents who have "come out" or acknowledged romantic attraction but may not have adopted a homosexual identity,[5] which may help to identify that high-risk population. Fifth, gender dysphoria/transgender status was not measured in our study because sexual minority status was assumed using a binary definition of sex; although this way of definition is common in current scientific practice, we were unable to evaluate the experiences of suicidality in this minority group. Despite these limitations, the primary strengths of our study includes its nationally representative and large-scale sample of Chinese adolescents, providing sufficient statistical power and potentially avoiding over-sampling of the sexual minority population. Furthermore, to the best of our knowledge, our study is the first study investigating the risk for suicidal behavior among Chinese sexual minority adolescents in a representative sample.

Conclusions

Increased suicide risk among sexual minority adolescents has become a major global health concern. However, few related studies have been conducted among Chinese adolescents. The findings from our study suggested that Chinese sexual minority adolescents had a higher risk of suicidal behavior and that BSA adolescents have the highest risk of suicidality regardless of sex. Based on our study results, conducting early detection and intervention programs for Chinese sexual minorities (especially BSA individuals) is suggested to more effectively and appropriately prevent suicide-related problems. Future studies that focus on the risk factors, mechanisms and interventions of suicidal behavior in Chinese sexual minority adolescents are warranted.

Contributors' Statement:
Ciyong Lu conceptualized and designed the study, reviewed and revised the manuscript and approved the final manuscript as submitted. Yeen Huang and Pengsheng Li conceptualized and designed the study, coordinated and supervised the data collection, carried out the initial analyses, drafted the initial manuscript, and approved the final manuscript as submitted. They contributed equally to this study. Lan Guo carried out the analyses and interpreted the data, reviewed and revised the manuscript and approved the final manuscript as submitted. Xue Gao, Yan Xu, Guoliang Huang, and Xueqing Deng designed the data collection instruments, coordinated and supervised the data collection, reviewed and revised the manuscript, and approved the final manuscript as submitted. All authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Table 1. Demographic characteristics of participants by sexual minority status among Chinese adolescents (N=150,822).

Variable	Total	Heterosexual	Sexual minorities[a]	Unsure	χ^2/F	*P*-value
	No. (%)	No. (%)	No. (%)	No. (%)		
Total	150,822 (100.00)	116,774 (78.6)	6,685 (4.1)	27,363 (17.3)		
Sex					182.90	<0.001
Male	72,409 (51.8)	57,343 (52.8)	2,483 (41.4)	12,583 (49.7)		
Female	78,413 (48.2)	59,431 (47.2)	4,202 (58.6)	14,780 (50.3)		
Age (year)[b]	15.1 (0.4)	15.3 (0.5)	15.1 (0.4)	14.1 (0.3)	754.33	<0.001
Academic pressure					567.69	<0.001
None	23,387 (15.8)	17,051 (14.9)	1,060 (16.1)	5,276 (19.8)		
Less	69,359 (46.5)	53,061 (46.1)	2,648 (39.9)	13,650 (49.8)		
Medium or great	58,076 (37.7)	46,662 (39.0)	2,977 (44.0)	8,437 (30.4)		
HSS[c]					204.56	<0.001
Very good	30,766 (22.7)	22,812 (21.8)	1,456 (24.2)	6,498 (26.6)		
Good	90,894 (60.3)	71,306 (61.1)	3,748 (55.4)	15,840 (57.4)		
Fair or poor	29,162 (17.0)	22,656 (17.1)	1,481 (20.4)	5,025 (16.0)		
Current smoking					288.12	<0.001
No	143,032 (94.6)	110,194 (94.1)	6,212 (93.0)	26,626 (97.3)		
Yes	7,790 (5.4)	6,580 (5.9)	473 (7.0)	737 (2.7)		
Current drinking					818.05	<0.001
No	126,765 (84.0)	96,909 (82.9)	5,072 (76.6)	24,784 (90.5)		
Yes	24,057 (16.0)	19,865 (17.1)	1,613 (23.4)	2,579 (9.5)		
Bullying experience					57.58	<0.001
No	138,523 (91.6)	107,767 (92.0)	5,668 (83.9)	25,088 (91.3)		
Yes	12,299 (8.4)	9,007 (8.0)	1,017 (16.1)	2,275 (8.7)		

[a]Sexual minorities included adolescents who reported same-sex or both-sex romantic attraction.

[b] Age data are presented as the means (SE).

[c] HSS, Household socioeconomic status.

All numbers were unweighted, whereas all percentages were adjusted for sampling weights.

Table 2. Prevalence of past-year suicidal ideation and suicide attempts by sexual minority status among Chinese adolescents (N=150,822).

	Males (N=72,409)				Females (N=78,413)			
	Heterosexual=1	SSA=2	BSA=3	Unsure=4	Heterosexual=5	SSA=6	BSA=7	Unsure=8
	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Suicidal ideation								
No	48,572 (85.5)	795 (78.4)	919 (65.3)	11,067 (88.3)	47,941 (81.2)	706 (69.6)	1,839 (57.7)	12,527 (85.1)
Yes	8,771 (14.5)	243 (21.6)	526 (34.7)	1,516 (11.7)	11,490 (18.8)	309 (30.4)	1,348 (42.3)	2,253 (14.9)
Suicide attempts								
No	55,991 (97.8)	962 (93.1)	1,267 (87.8)	12,184 (96.9)	57,552 (96.9)	923 (91.1)	2,820 (89.1)	14,318 (96.8)
Yes	1,352 (2.2)	76 (6.9)	178 (12.2)	399 (3.1)	1,879 (3.1)	92 (8.9)	367 (10.9)	462 (3.2)

SSA, same-sex romantic attraction; BSA, both-sex romantic attraction;

All numbers were unweighted, whereas all percentages were adjusted for sampling weights.

The alpha level for paired comparison was set at P=0.0083 after Bonferroni correction.

Paired comparison for suicidal ideation:

2>1, χ^2=51.42, P<0.001; 6>5, χ^2=78.41, P<0.001;
3>1, χ^2=471.59, P<0.001; 7>5, χ^2=978.63, P<0.001;
3>2, χ^2=47.69, P<0.001; 7>6, χ^2=45.29, P<0.001;
4<1, χ^2=86.74, P<0.001; 8<5, χ^2=131.20, P<0.001;
4<2, χ^2=110.08, P<0.001; 8<6, χ^2=161.47, P<0.001;
4<3, χ^2=618.07, P<0.001; 8<7, χ^2=1197.33, P<0.001;

Paired comparison for suicide attempts:

2>1, χ^2=105.29, P<0.001; 6>5, χ^2=110.22, P<0.001;
3>1, χ^2=551.67, P<0.001; 7>5, χ^2=610.42, P<0.001;
3>2, χ^2=16.42, P<0.001; 7>6, χ^2=4.76, P=0.029;
4>1, χ^2=27.95, P<0.001; 8>5, χ^2=0.05, P=0.824;
4<2, χ^2=49.09, P<0.001; 8<6, χ^2=98.96, P<0.001;
4<3, χ^2=274.99, P<0.001; 8<7, χ^2=419.29, P<0.001;

Table 3. Associations of sexual minority status with past-year suicidal ideation and suicide attempts among Chinese adolescents (N=150,822).

	Model 1[a]			Model 2[b]		
	OR	**95% CI**	***P***	**AOR**	**95% CI**	***P***
Suicidal ideation						
Males						
Heterosexual	1.0			1.0		
SSA	1.62	1.30-2.03	<0.001	1.56	1.26-1.94	<0.001
BSA	3.13	2.59-3.79	<0.001	2.42	2.03-2.88	<0.001
Unsure	0.78	0.67-0.91	<0.001	0.78	0.69-0.87	<0.001
Females						
Heterosexual	1.0			1.0		
SSA	1.88	1.67-2.11	<0.001	1.42	1.30-1.56	<0.001
BSA	3.15	2.93-3.39	<0.001	2.61	2.41-2.82	<0.001
Unsure	0.75	0.60-0.94	<0.001	0.71	0.61-0.83	<0.001
Suicide attempts						
Males						
Heterosexual	1.0			1.0		
SSA	3.29	2.43-4.47	<0.001	3.13	2.28-4.28	<0.001
BSA	6.25	4.46-8.76	<0.001	3.83	2.85-5.14	<0.001
Unsure	1.42	1.07-1.90	<0.001	1.55	1.24-1.94	<0.001
Females						
Heterosexual	1.0			1.0		
SSA	3.13	2.36-4.15	<0.001	1.97	1.43-2.70	<0.001
BSA	3.89	3.13-4.83	<0.001	2.59	2.19-3.06	<0.001
Unsure	1.04	0.75-1.44	0.824	1.03	0.80-1.34	0.531

SSA, same-sex romantic attraction; BSA, both-sex romantic attraction; CI, confidence intervals; OR, odds ratios; AOR, adjusted odds ratios.

[a]Unadjusted.

[b]Adjusted for age, academic pressure, household socioeconomic status, current smoking, current drinking, and bullying experience.

STROBE Statement—checklist of items that should be included in reports of observational studies

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract Page 1
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found Page 1
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported Page 2-4
Objectives	3	State specific objectives, including any prespecified hypotheses Page 4
Methods		
Study design	4	Present key elements of study design early in the paper Page 4-5
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection Page 4-6
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up NA. *Case-control study*—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls NA. *Cross-sectional study*—Give the eligibility criteria, and the sources and methods of selection of participants Page 4-5
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed *Case-control study*—For matched studies, give matching criteria and the number of controls per case
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable Page 6-8
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group Page 6-8
Bias	9	Describe any efforts to address potential sources of bias Page 5-6
Study size	10	Explain how the study size was arrived at Page 4-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why

		Page 7-8
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding Page 8-9
		(*b*) Describe any methods used to examine subgroups and interactions NA.
		(*c*) Explain how missing data were addressed Page 8-9
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed *Case-control study*—If applicable, explain how matching of cases and controls was addressed *Cross-sectional study*—If applicable, describe analytical methods taking account of sampling strategy Page 8
		(*e*) Describe any sensitivity analyses NA.

Continued on next page

Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed Page 9
		(b) Give reasons for non-participation at each stage NA.
		(c) Consider use of a flow diagram NA.
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders Page 9-10
		(b) Indicate number of participants with missing data for each variable of interest NA.
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount) NA.
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time NA.
		Case-control study—Report numbers in each exposure category, or summary measures of exposure NA.
		Cross-sectional study—Report numbers of outcome events or summary measures Page 9-10
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included Page 10-11
		(*b*) Report category boundaries when continuous variables were categorized NA.
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period NA.
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses NA.
Discussion		
Key results	18	Summarise key results with reference to study objectives Page 11
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias Page 16-17
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence Page 11-15
Generalisability	21	Discuss the generalisability (external validity) of the study results Page 14-16

Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based Page 2

*Give information separately for cases and controls in case-control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.